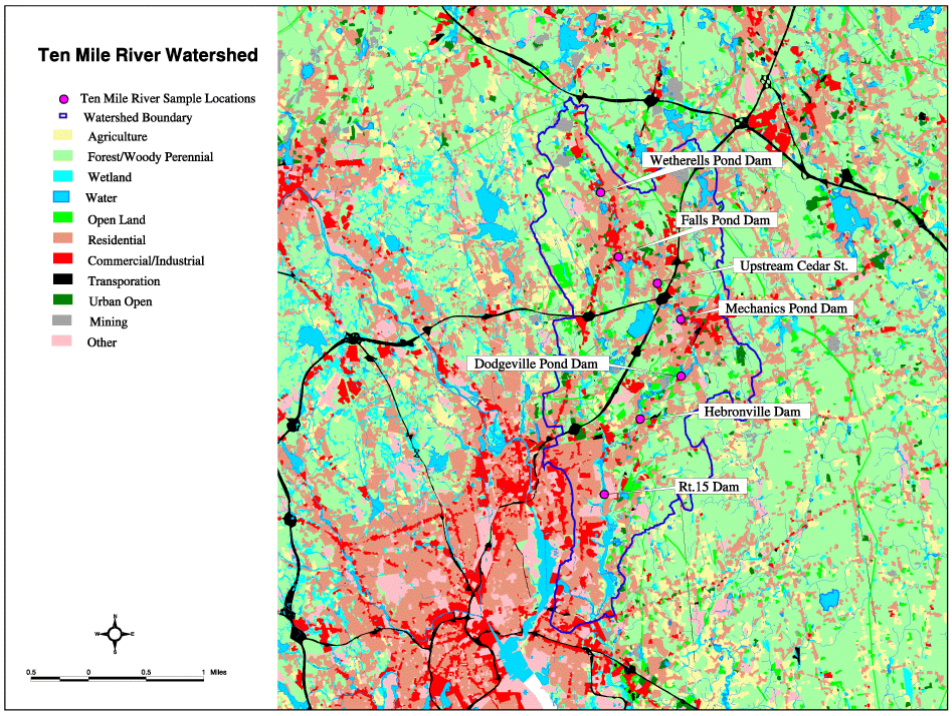
Ten Mile River Watershed-Massachusetts

An Assessment of Sediment Chemistry and Ecotoxicity



Prepared for Massachusetts Department of Environmental Protection
by
Greg Hellyer, Ecosystems Assessment Unit
USEPA - New England Regional Laboratory
Office of Environmental Measurement and Evaluation
11 Technology Drive, North Chelmsford, MA 01863
617-918-8677
hellyer.greg@epa.gov

October 5, 2000

E:\USER\GHELLYER\SEDTOX\10MILE\10 Mile Watershed Ecotoxicity Report.WPD

TABLE of CONTENTS

Executive Summary 1

Introduction, Purpose and Scope 2
Field Reconnaissance and Sampling 3
GPS (Global Positioning System) Locations and Ambient Water Quality Parameters . . . 3

Laboratory Analyses - Chemistry and Biology 5
Acid Volatile Sulfides and Simultaneously Extractable Metals 5
Total Mercury 7
Total Organic Carbon 8
Sediment Grain Size Analysis 9
Statistical Analysis of Sediment Toxicity Data 11

Contaminant Levels of Potential Ecotoxicological Concern 12
Inorganic Chemicals (Metals) 14
Chlorinated Pesticides and Polychlorinated Biphenyls (PCBs) 30
Volatile and Semi-Volatile Organic Compounds 40

Multivariate Exploratory Data Analysis 56

Discussion and Recommendations 60

References 64
Report References 64
Analytical Chemistry References 64
Statistical References 65

APPENDICES 66
Appendix A: Chemistry Analytical Results 66
Inorganic Chemicals (Metals) 66
Total Organic Carbon 75
Acid Volatile Sulfides/Simultaneously Extractable Metals (AVS/SEM) 77
Volatile and Semi-Volatile Organic Compounds 81
Chlorinated Pesticides and PCBs 130
Appendix B: Multivariate Graphical and Numerical Chemistry Data Analysis 143
Graphical Analysis Results 143
Inorganic Chemicals (Metals) Data 143
Volatile and Semi-Volatile Organic Compounds Data 149
Chlorinated Pesticides and PCBs Data 156
Total Chemistry Data 162

Numerical Ordination Results 168
Inorganic Chemicals (Metals) Data 168
Volatile and Semi-Volatile Organic Compounds Data 171
Chlorinated Pesticides and PCBs Data 176
Total Chemistry Data 179
Appendix C: Biology Analytical Results 184
Chironomid *(C. tentans)* Toxicity Data 184
Amphipod *(H. azteca)* Toxicity Data 187
Chironomid *(C. tentans)* Growth and Survival Data Statistical Analysis . . . 190
Appendix D. Sediment Ecotoxicological Screening Benchmark Tables 195
Inorganic Chemicals (Metals) Benchmark Tables 195
Chlorinated Pesticide and Polychlorinated Biphenyl (PCB)
Benchmark Tables 202
Volatile and Semi-Volatile Organic Compound Benchmark Tables 210
Appendix E: Derivation, Strengths and Limitations of Sediment Ecotoxicological
Screening Benchmarks (ESBs) 220
Appendix F: Project Work/QA Plan Ten Mile River Sediment/
Water Quality Assessment 241

Maps

Map 1. Map of the Ten Mile River Watershed showing land use/land cover and sediment sampling stations. 4

Tables

Table 1. Ten Mile Watershed Sample Site GPS (Global Positioning System) Locations and Ambient Water Quality Parameters 5

Table 2. Acid Volatile Sulfides/Simultaneously Extractable Metals (AVS/SEM) 6

Table 3. Mercury Analysis in Ten Mile Sediment Samples 7

Table 4. Sediment Grain Size Analysis for Ten Mile Sediment Samples 9

Table 5. Ecotoxicological Screening Thresholds 13

Ecotoxicity Inorganic Chemicals - Metals

Table 6. Wetherell Dam Pond (WETH01) - Inorganic Chemicals (Metals) exceeding Ecotoxicological Thresholds 14

Table 7. Wetherell Pond #2 (WETH02) - Inorganic Chemicals (Metals) exceeding Ecotoxicological Thresholds 16

Table 8. Fall Pond Dam (TENM01) - Inorganic Chemicals (Metals) exceeding Ecotoxicological Thresholds 18

Table 9. Upstream Cedar St. (NATP01) - Inorganic Chemicals (Metals) exceeding Ecotoxicological Thresholds 20

Table 10. Mechanic Pond Dam (MECH01) - Inorganic Chemicals (Metals) exceeding Ecotoxicological Thresholds 22

Table 11. Dodgeville Pond Dam (DODG01) - Inorganic Chemicals (Metals) exceeding Ecotoxicological Thresholds 24

Table 12. Hebronville Pond Dam (HEBR01) - Inorganic Chemicals (Metals) exceeding Ecotoxicological Thresholds 26

Table 13. Rt. 15 Pond Dam (RESE01) - Inorganic Chemicals (Metals) exceeding Ecotoxicological Thresholds 28

Ecotoxicity Chlorinated Pesticides and PCBs

Table 14. Wetherell Dam Pond (WETH01) - Chlorinated Pesticides and PCBs exceeding Ecotoxicological Thresholds 30

Table 15. Wetherell Pond #2 (WETH02) - Chlorinated Pesticides and PCBs exceeding Ecotoxicological Thresholds 31

Table 16. Fall Pond Dam (TENM01) - Chlorinated Pesticides and PCBs exceeding Ecotoxicological Thresholds 32

Table 17. Upstream Cedar St. (NATP01) - Chlorinated Pesticides and PCBs exceeding Ecotoxicological Thresholds 33

Table 18. Mechanic Pond Dam (MECH01) - Chlorinated Pesticides and PCBs exceeding Ecotoxicological Thresholds 34

Table 19. Dodgeville Pond Dam (DODG01) - Chlorinated Pesticides and PCBs exceeding Ecotoxicological Thresholds 36

Table 20. Hebronville Pond Dam (HEBR01) - Chlorinated Pesticides and PCBs exceeding Ecotoxicological Thresholds 38

Table 21. Rt. 15 Pond Dam (RESE01) - Chlorinated Pesticides and PCBs exceeding Ecotoxicological Thresholds 39

Ecotoxicity Volatile and Semi-Volatile Organic Compounds

Table 22. Wetherell Dam Pond (WETH01) - Volatile and Semi-volatile Organic Compounds exceeding Ecotoxicological Thresholds 40

Table 23. Wetherell Pond #2 (WETH02) - Volatile and Semi-volatile Organic Compounds exceeding Ecotoxicological Thresholds 42

Table 24. Fall Pond Dam (TENM01) - Volatile and Semi-volatile Organic Compounds exceeding Ecotoxicological Thresholds 44

Table 25. Upstream Cedar St. (NATP01) - Volatile and Semi-volatile Organic Compounds exceeding Ecotoxicological Thresholds 46

Table 26. Mechanic Pond Dam (MECH01) - Volatile and Semi-volatile Organic Compounds exceeding Ecotoxicological Thresholds 48

Table 27. Dodgeville Pond Dam (DODG01) - Volatile and Semi-volatile Organic Compounds exceeding Ecotoxicological Thresholds 50

Table 28. Hebronville Pond Dam (HEBR01) - Volatile and Semi-volatile Organic Compounds exceeding Ecotoxicological Thresholds 52

Table 29. Rt. 15 Pond Dam (RESE01) - Volatile and Semi-volatile Organic Compounds exceeding Ecotoxicological Thresholds 54

Discussion and Recommendations

Table 30. The Number of Ecotoxicological Thresholds Exceeded by Site for Inorganic Chemicals (Metals). 0

Table 31. The Number of Ecotoxicological Thresholds Exceeded by Site for Chlorinated Pesticides and Polychlorinated Biphenyls 0

Table 32. The Number of Ecotoxicological Thresholds Exceeded by Site for Volatile and Semi-Volatile Organic Compounds 0

Figures

Figure 1. Acid Volatile Sulfides and Simultaneously Extractable Metals (SEM/AVS) 6

Figure 2. Total Mercury Concentration in Ten Mile Watershed Sediment Samples 7

Figure 3. Total Organic Carbon content (unadjusted) of Ten Mile Watershed Sediment Samples 8

Figure 4. Sediment Grain Size Analysis for the Ten Mile River Watershed 10

Figure 5. Sites with significant and non-significant effects on chironomid survival. 11

Figure 6. Sites with significant and non-significant effects on chironomid growth. 12

Ecotoxicity Inorganic Chemicals - Metals

Figure 7. Sediment Ecotoxicity - Wetherell Dam Pond (WETH01) (Inorganic Chemicals - Metals) 14

Figure 8. Sediment Ecotoxicity - Wetherell Pond #2 (WETH02) (Inorganic Chemicals - Metals) 16

Figure 9. Sediment Ecotoxicity - Fall Pond Dam (TENM01) (Inorganic Chemicals - Metals) 18

Figure 10. Sediment Ecotoxicity - Upstream Cedar St. (NATP01) (Inorganic Chemicals - Metals) 20

Figure 11. Sediment Ecotoxicity - Mechanic Pond Dam (MECH01) (Inorganic Chemicals - Metals) 22

Figure 12. Sediment Ecotoxicity - Dodgeville Pond Dam (DODG01) (Inorganic Chemicals - Metals) 24

Figure 13. Sediment Ecotoxicity - Hebronville Pond Dam (HEBR01) (Inorganic Chemicals - Metals) 26

Figure 14. Sediment Ecotoxicity - Rt. 15 Pond Dam (RESE01) (Inorganic Chemicals - Metals) 28

Ecotoxicity Chlorinated Pesticides and PCBs

Figure 15. Sediment Ecotoxicity - Wetherell Dam Pond (WETH01)
(Chlorinated Pesticides and PCBs) 30

Figure 16.Sediment Ecotoxicity - Wetherell Pond #2 (WETH02)
(Chlorinated Pesticides and PCBs) 31

Figure 17. Sediment Ecotoxicity - Fall Pond Dam (TENM01)
(Chlorinated Pesticides and PCBs) 32

Figure 18. Sediment Ecotoxicity - Upstream Cedar St. (NATP01)
(Chlorinated Pesticides and PCBs) 33

Figure 19. Sediment Ecotoxicity - Mechanic Pond Dam (MECH01)
(Chlorinated Pesticides and PCBs) 34

Figure 20. Sediment Ecotoxicity - Dodgeville Pond Dam (DODG01)
(Chlorinated Pesticides and PCBs) 36

Figure 21. Sediment Ecotoxicity - Hebronville Pond Dam (HEBR01)
(Chlorinated Pesticides and PCBs) 38

Figure 22. Sediment Ecotoxicity - Rt. 15 Pond Dam (RESE01)
(Chlorinated Pesticides and PCBs) 39

Ecotoxicity Volatile and Semi-Volatile Organic Compounds

Figure 23. Sediment Ecotoxicity - Wetherell Dam Pond (WETH01)
(Volatile and Semi-Volatile Organic Compounds) 40

Figure 24.Sediment Ecotoxicity - Wetherell Pond #2 (WETH02)
(Volatile and Semi-Volatile Organic Compounds) 42

Figure 25. Sediment Ecotoxicity - Fall Pond Dam (TENM01)
(Volatile and Semi-Volatile Organic Compounds) 44

Figure 26. Sediment Ecotoxicity - Upstream Cedar St. (NATP01)
(Volatile and Semi-Volatile Organic Compounds) 46

Figure 27. Sediment Ecotoxicity - Mechanic Pond Dam (MECH01)
(Volatile and Semi-Volatile Organic Compounds) 48

Figure 28. Sediment Ecotoxicity - Dodgeville Pond Dam (DODG01)
(Volatile and Semi-Volatile Organic Compounds) 50

Figure 29. Sediment Ecotoxicity - Hebronville Pond Dam (HEBR01)
(Volatile and Semi-Volatile Organic Compounds) 52

Figure 30. Sediment Ecotoxicity -Rt. 15 Pond Dam (RESE01)
(Volatile and Semi-Volatile Organic Compounds) 54

Executive Summary

A reconnaissance was undertaken by EPA-New England (EPA-NE) and Massachusetts Department of Environmental Protection (MADEP) of the Ten Mile River watershed which runs through the City of Attleboro in southeastern Massachusetts. Seven discrete sediment sampling locations were identified as being representative of the past and current pollutant history of the river. Sampling was undertaken by OEME staff on March 25, 1998 following a previously approved QAPP which is appended to this document (Appendix F). All sample collection, handling and analysis was consistent with the requirements in the QAPP.

Eight sediment samples (Wetherell Pond was sampled twice at the same location) were analysed at the OEME laboratory for a full suite of analytical parameters including inorganics (metals), volatile and semi-volatile organic compounds, chlorinated pesticides, polychlorinated biphenyls (PCBs), total organic carbon (TOC), grain size, acid volatile sulfides (AVS) and simultaneously extractable metals (SEM). Chemistry analytical results are given in Appendix A. These sediments are highly contaminated with complex mixtures of inorganic chemicals (metals), volatile and semi-volatile organic compounds, chlorinated pesticides and PCBs. Given the history of this river during and subsequent to the Industrial Revolution in New England, including jewelry, tannery, and electroplating works, such remnant contamination is not unexpected. Should any remediation of this river, such as dredging be proposed, further study would be warranted.

These results were then screened using a new tool recently developed at OEME, the Sediment Ecotoxicological Screening Benchmark (SESB) tables (Appendices D and E). These SESB tables screen inorganics (primarily metals), chlorinated pesticides and polychlorinated biphenyls and volatile and semi-volatile organic hydrocarbons (SVOCs) relative to ecotoxicological screening benchmark values derived from the published scientific and technical literature. These results are depicted in Figures 7-30 and Tables 6-29 and summarized in Appendix D and Tables 30-32. Contamination of potential ecotoxicological concern was observed at all sample locations.

An exploratory multivariate data analysis including clustering and ordination techniques was undertaken of the chemistry data sets. Graphical and numerical results are shown in Appendix B. These depict similarity and dissimilarity between sample sites based on observed contaminants.

Biological tests of these sediment samples were undertaken in which two freshwater invertebrate species (chironomids and amphipods) were exposed under controlled laboratory conditions. The amphipod test failed to meet test acceptability criteria with excessive mortality in the control animals. Thus these results could not be statistically analyzed and interpreted further. However, the chironomid test observed significant impairment of survival in three test site replicates: Dodgeville Pond Dam (DODG01), Rt. 15 Pond Dam (RESE01) and Wetherell Pond Dam (WETH01/02). No significant impairment in the growth endpoint was observed. However, one site, Hebronville Pond Dam (HEBR01), displayed significantly enhanced growth relative to the control. The implications of this are unclear. Moreover, the potential for adverse effects from

these sediments could be underestimated since, for example, tests did not measure subchronic effects, such as reproduction and emergence.

The chemical and physical characterization of river bed sediments is of interest as sediment quality is often a good indicator of aquatic system "health". Persistent contaminants associated with past and present cultural and natural influences enter aquatic systems and may be adsorbed onto or absorbed into sediments. These contaminated sediments may pose an ecotoxicological and human health risk if their contaminants are able to enter the aquatic food chain, or if people or organisms are otherwise exposed to them.

Introduction, Purpose and Scope

The Massachusetts Department of Environmental Protection Office of Watershed Management (OWM) requested EPA-New England's Office of Environmental Measurement and Evaluation (OEME) assistance in evaluating the sediment quality in the Ten Mile River. The Ten Mile River has a history of physical alteration and chemical contamination, particularly from jewelry, tannery, and electro-plating industries. The purpose of this investigation is to determine chemical concentrations of inorganic chemicals (primarily metals), chlorinated pesticides and polychlorinated biphenyls (PCBs), and volatile and semi-volatile organic chemicals (SVOCs), in the river sediment upstream of several impoundments and a Waste Water Treatment Plant (WWTP), to evaluate the potential ecotoxicity of these sediments to benthic invertebrates and other organisms, and to determine ambient surface water quality conditions associated with the sampling locations.

Field Reconnaissance and Sampling

Table 1 and Map 1 identify the seven sample locations. Wetherell Pond Dam was sampled twice, with two co-located sediment samples. All samples were taken, tagged, and transported as per the QAPP (Appendix F).

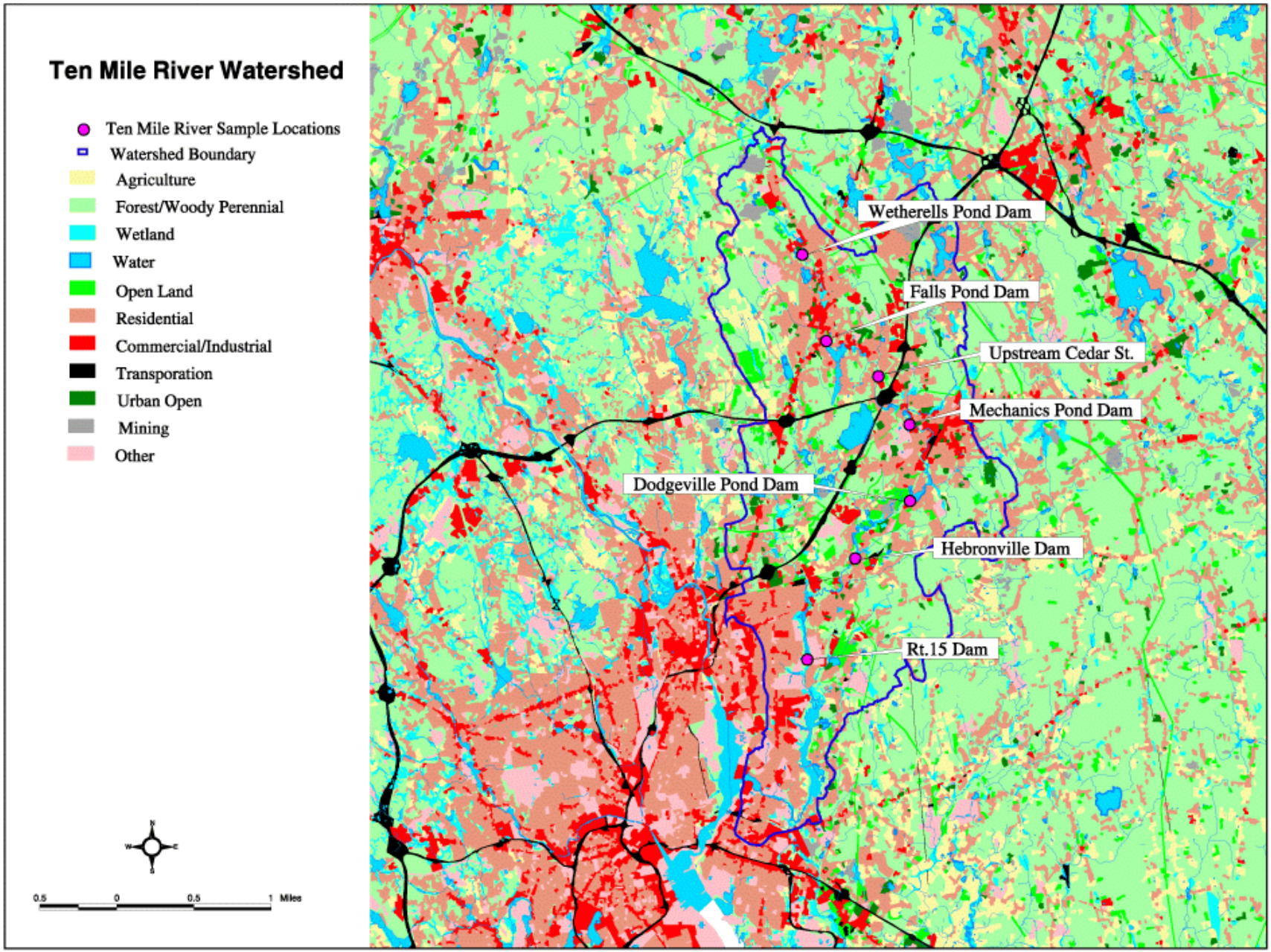
GPS (Global Positioning System) Locations and Ambient Water Quality Parameters

Table 1 documents the GPS locations and ambient water quality parameters taken at each sample location pH, dissolved oxygen, conductivity, and temperature.

Table 1. Ten Mile Watershed Sample Site GPS (Global Positioning System) Locations and Ambient Water Quality Parameters

Site	Wetherells Pond Dam	Falls Pond Dam	Upstream Cedar St	Mechanics Pond Dam	Dodgeville Pond Dam	Hebronville Dam	Rt.15 Pond Dam
Site #	WETH01 WETH02	TENM01	NATP01	MECH01	DODG01	HEBR01	RESE01
Chemical Analytical Sample #	07697 07704	07698	07699	07700	07701	7702	7703
pH (s.u.)	6.9	7.3	7.1	6.6	6.9	6.9	7
Temperature(C)	5.1	7.4	7.2	4.8	6.2	7.2	8.3
Conductivity (us/cm)	--	152.1	130	163.9	161.5	163.7	209.5
Dissolved Oxygen (mg/l)	11.3	11.3	10.45	11.6	12.1	11.8	12.4
Latitude	42 00'00.18"	41 58' 23.47"	41 57'42.35"	41 56'47.02"	41 55'22.03"	41 54'20.67"	41 52'30.35"
Longitude	71 20'12.09"	71 19' 41.15"	71 18'25.71"	71 17'41.83"	71 17'45.35"	71 19'10.04"	71 20'27.00"
Date	03/24/98	03/24/98	03/24/98	03/25/98	03/25/98	03/25/98	03/25/98
Time	09:30 AM	02:00 PM	03:20 PM	09:30 AM	10:45 AM	12:15 PM	02:30 PM

Ambient water quality parameters at all sample sites indicated very similar circumneutral, well oxygenated water of similar conductivity.



Map 1. Map of the Ten Mile River Watershed showing land use/land cover and sediment sampling stations.

Laboratory Analyses - Chemistry and Biology

An evaluation of the quality of the Ten Mile River sediment was attempted using a multidimensional approach. This approach includes the use of bulk sediment chemistry data, bulk sediment toxicity testing, comparison to sediment quality guidelines and an attempt to explain any correlation of chemical and toxicological findings, or lack of, through the use of bioavailability information i.e. site specific SEM/AVS and TOC normalization.

Simultaneously Extractable Metals and Acid Volatile Sulfides

Table 2. Acid Volatile Sulfides/Simultaneously Extractable Metals (AVS/SEM)[1] (*u*mole/gm, dry weight)

SITE	Wetherell Pond Dam #1 (WETH01)	Wetherell Pond Dam #2 (WETH02)	Fall Pond Dam (TENM01)	Upstream Cedar St. (NATP01)	Mechanic Pond Dam (MECH01)	Dodgeville Pond Dam (DODG01)	Hebronville Pond Dam (HEBR01)	Rt. 15 Pond Dam (RESE01)
SEM	108.1	133.5	13.9	11.6	21.6	111.3	105.6	80.9
AVS	3.7	6.9	57.9	0.0	91.3	46.6	43.6	22.8
SEM/AVS Ratio	**29.2**	**19.3**	**0.24**	**0.0**	**0.24**	**2.4**	**2.4**	**3.5**

[1]AVS - "An extractable reactive pool of solid-phase sulfide that is associated with and available from the mineral surfaces of sediment to bind metals and may render that portion unavailable and non-toxic to biota. Metals associated with the sulfide fraction of suspended matter and sediments in anaerobic environments include zinc, lead, copper, cobalt, nickel, cadmium, arsenic, antimony, mercury, manganese, and molybdenum" (Rand 1995:939).

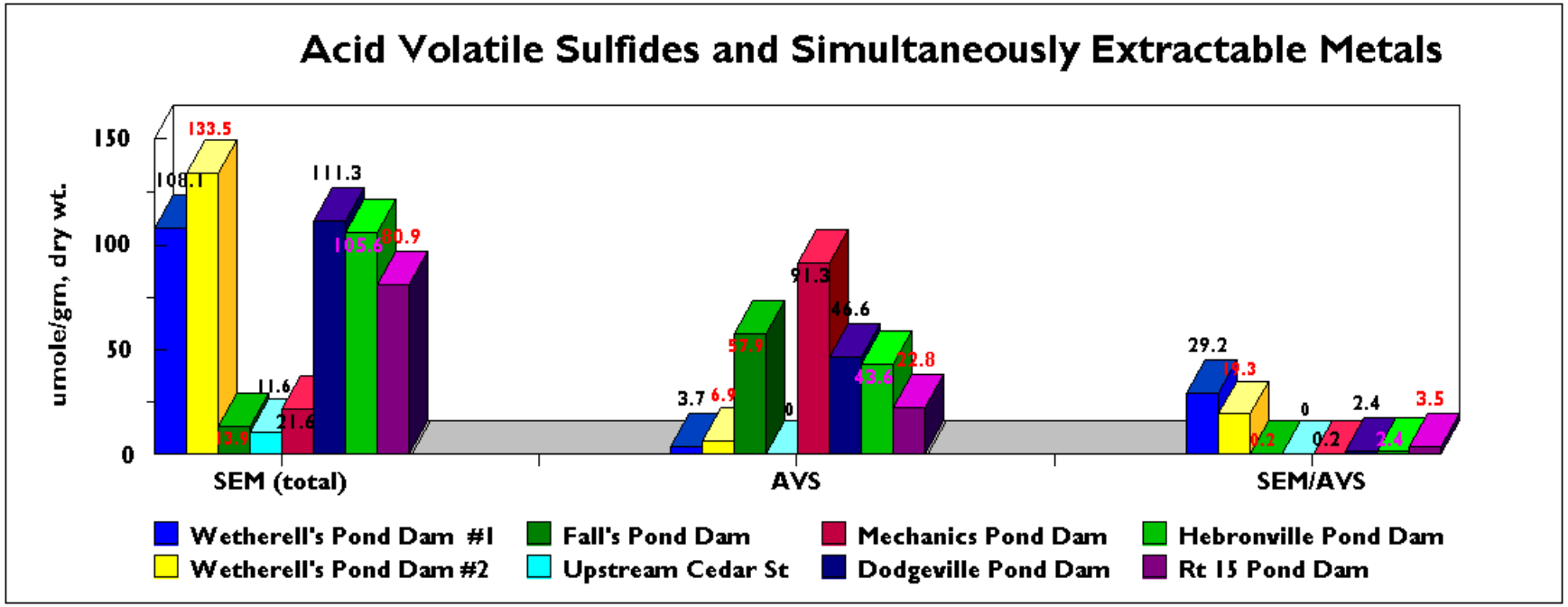


Figure 1. Acid Volatile Sulfides and Simultaneously Extractable Metals of Ten Mile River Watershed Sediment Samples

When AVS exceeds SEM, with a ratio of 1 or less, such as at Fall Pond Dam (TENM01) and Mechanic Pond Dam (MECH01), it is assumed that metals will be less available to biota and therefore less toxic. When AVS is not detected above reporting limits, as in the case of the Upstream Cedar St. site (NATP01), metals are assumed to be more bioavailable. The Ten Mile river sites vary widely in SEM/AVS levels, however, all sites except those mentioned above exhibit ratios greater than 1 suggesting that metals are more bioavailable than if higher levels of AVS were observed in these sediments.

Total Mercury

Table 3. Mercury Analysis in Ten Mile Sediment Samples

SITE	Wetherell Pond Dam #1 (WETH01)	Wetherell Pond Dam #2 (WETH02)	Fall Pond Dam (TENM01)	Upstream Cedar St. (NATP01)	Mechanic Pond Dam (MECH01)	Dodgeville Pond Dam (DODG01)	Hebronville Pond Dam (HEBR01)	Rt. 15 Pond Dam (RESE01)
Hg	166	112	3.9	6.3	20.4	38.9	24.7	13.2

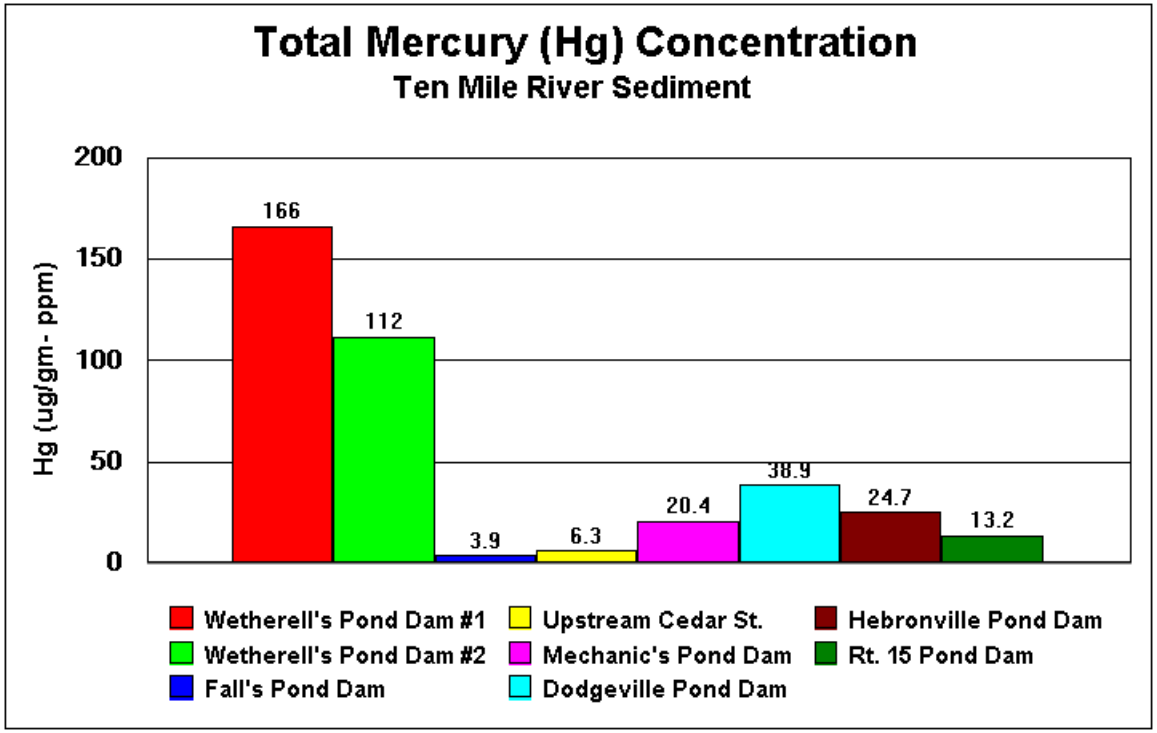


Figure 2. Total Mercury Concentration in Ten Mile Watershed Sediment Samples

Notes: Dry sample results in *u*g/gm (ppm)
* Results on a dry weight basis

A metal whose bioavailability is affected by the SEM/AVS ratio and which is of the highest ecotoxicological and human health concern is Hg. High levels were observed, especially at Wetherell Pond Dam (WETH01/02). We have no analytical knowledge of whether the mercury is in inorganic or methylated (bioavailable) states. Given the extremely high observed mercury values at all sampled sites in this watershed, this contaminant is of both potential ecotoxicological and human health concern. Furthermore, the toxicity test endpoints of growth and survival do not account for possible bioaccumulation. Methly mercury may bioaccumulate in aquatic organisms from 10,000 to 100,000 times the ambient water concentration (Rand 1995). It should be noted that the values in Figure 2 are for sediment and *not* water concentrations.

Total Organic Carbon

Samples were analyzed for Total Organic Carbon (TOC)[2] according to the methods identified in the QAPP. The SESBs in Appendix D adjust ecotox thresholds of SEL, SQAL and SQC for the percent of TOC. The ecotox values were developed for a normalized TOC concentration of 1%. Adjustment is applied to TOC values between .2%(.2) and 10%(10). Samples with TOC >10% default to 10% and <.2% to .2%. As Rand (1995:498) notes, "[O]rganic carbon-based partitioning provides a good estimate of the amount of organic chemical sorbed to natural particles, even though the actual sorption mechanism may involve a variety of adsorption (surface binding) and partitioning processes."

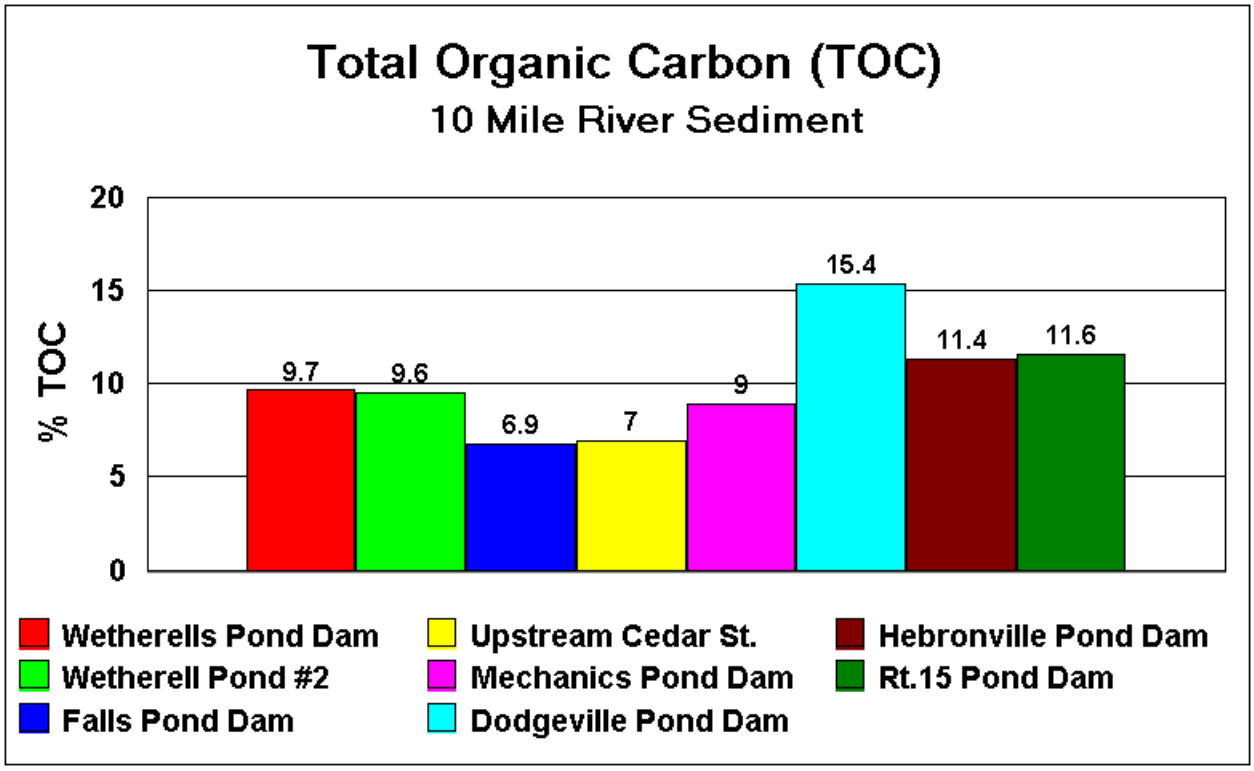


Figure 3. Total Organic Carbon content (unadjusted) of 10 Mile River Watershed Sediment Samples

[2] "Total Organic Carbon (TOC) is the total amount in the water column and represents the sum of contributions from truly dissolved, colloidal, and suspended particulate organic carbon (POC)" (Rand 1995:496).

Sediment Grain Size Analysis

Figure 4 and Table 4 indicates a large percentage of the grain size of the Ten Mile River sediment samples is in silts and clays, from 31-64%. Mechanic Pond (MECH01), Dodgeville Pond (DODG01), Hebronville Pond (HEBR01) and Rt. 15 Pond (RESE01) Dams all have similar grain size distributions. Upstream Cedar St. (NATP01) has a larger percentage of material in the finer and finest sand categories. Finer sediments, such as silts and clays, tend to bind contaminants more than sand.

Table 4. Sediment Grain Size Analysis for Ten Mile Sediment Samples

	Wetherell Pond Dam #1 and #2 (WETH01/02)	**Fall Pond Dam (TENM01)**	**Upstream Cedar St. (NATP01)**	**Mechanic Pond Dam (MECH01)**	**Dodgeville Pond Dam (DODG01)**	**Hebronville Pond Dam (HEBR01)**	**Rt. 15 Pond Dam (RESE01)**
Coarse Sand (>2mm)	1.5	2.1	0.4	1.5	0.1	1.9	0.8
Medium-Coarse Sand (>850um)	7.9	1	6.6	16.7	13.9	18.5	8.8
Medium-Fine Sand (>0.425um)	26	30.7	12.9	19.3	11.8	18	12.9
Fine Sand (>250um)	12.8	7.7	24.1	6.2	5.7	8.5	7.2
Finer Sand (>106um)	15.7	21	30.7	10.3	4.5	9.8	19.9
Finest Sand (>75um)	3.8	6.1	6	3.4	0.2	2.5	13.6
Silt and Clay (<75um)	32.3	31.4	19.3	42	63.8	40.8	36.8

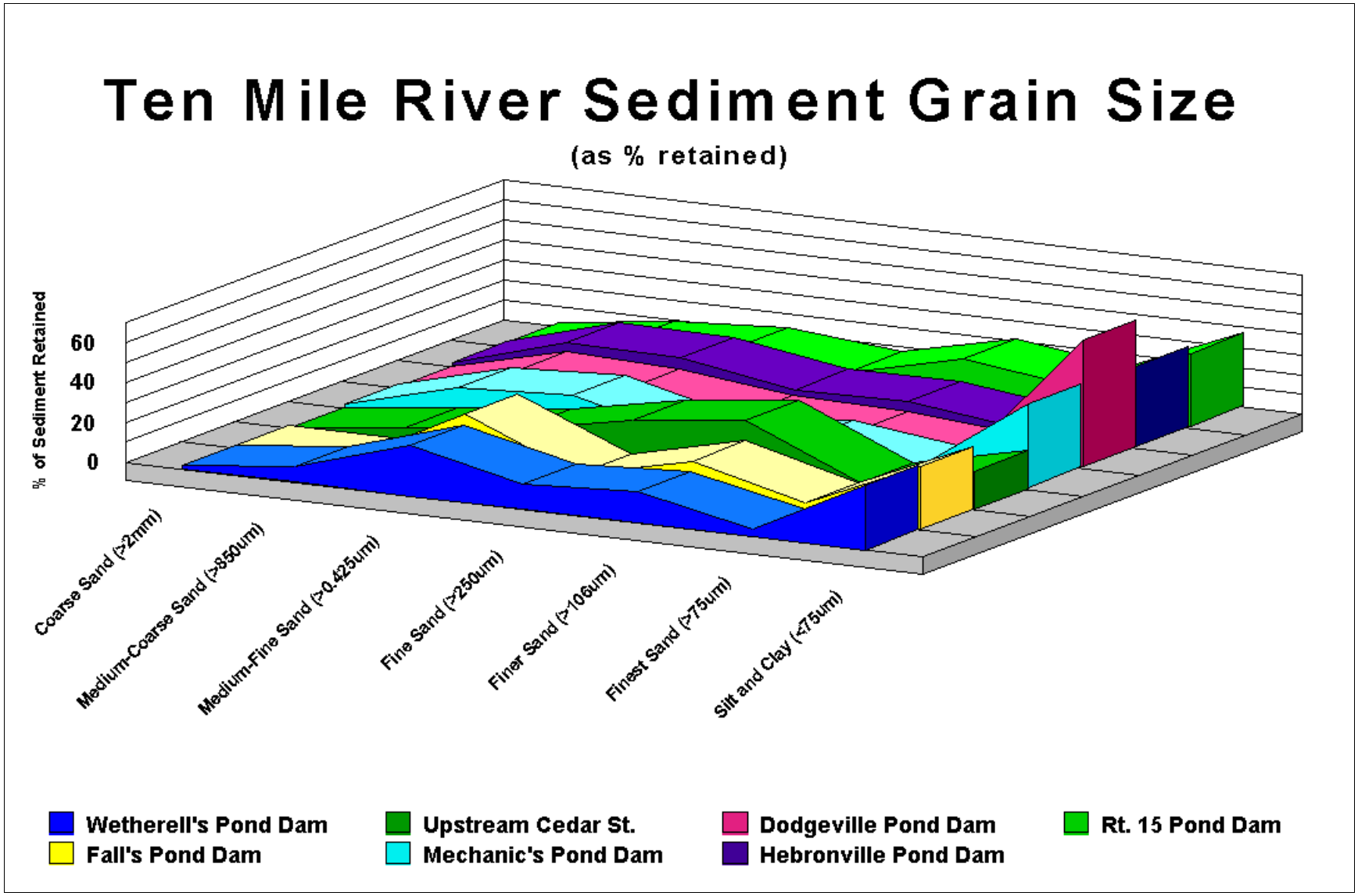


Figure 4. Sediment Grain Size Analysis for the Ten Mile River Watershed

Statistical Analysis of Sediment Toxicity Data

Bulk sediment toxicity testing was successful for chironomids (*Chironomus tentans*) exceeding test acceptability criteria of 70% survival in the laboratory control. However the ARTSED laboratory control for amphipods (*Hyallela azteca*) only achieved a survival of 61%, considerably below the 80% required for test acceptability for this species. Given that we have no way of knowing the cause for impairment of the controls we must exclude this test from statistical analysis and further discussion. For example, the control results might indicate impaired health of the amphipod test organisms.

The acute endpoints selected for statistical analyses for chironomids were survival and growth. Statistical analyses performed using the TOXSTAT Version 3.0 DOS software package are shown in Appendix C (Gulley and others, N.D.). Test replicates were first compared at all locations relative to the laboratory control (Artificial Sediment) for survival. The survival data set was tested for normality using the Chi-Square test and for homogeneity of variance using Hartley's and Bartlett's tests. It passed all three tests allowing analysis of the data using Dunnett's Test, given the equal number of replicates. Dunnett's test identified statistically significant impairment in survival (p=0.05,one-tailed; df=40,7; T Stat=2.42) at Dodgeville Pond Dam (DODG01), Rt. 15 Pond Dam (RESE01) and Wetherell Pond Dam (WETH01/02).

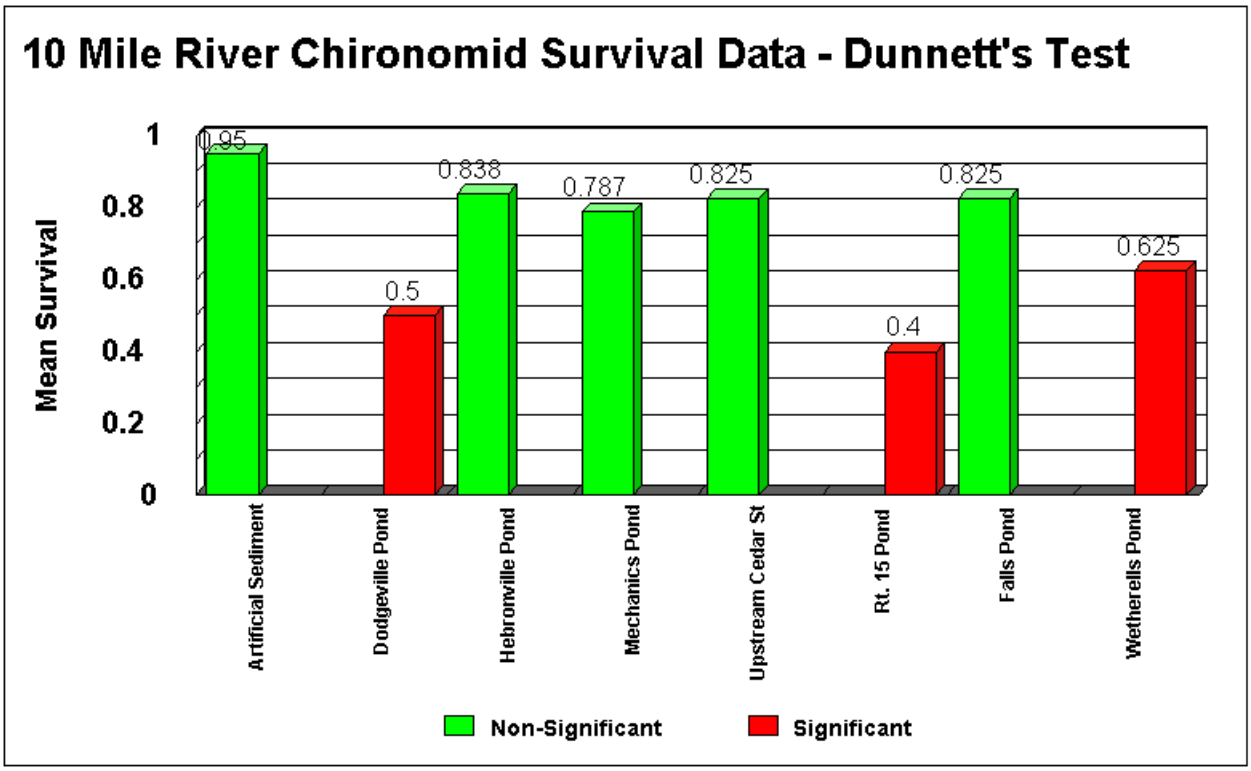


Figure 5. Sites with significant and non-significant effects on chironomid survival.

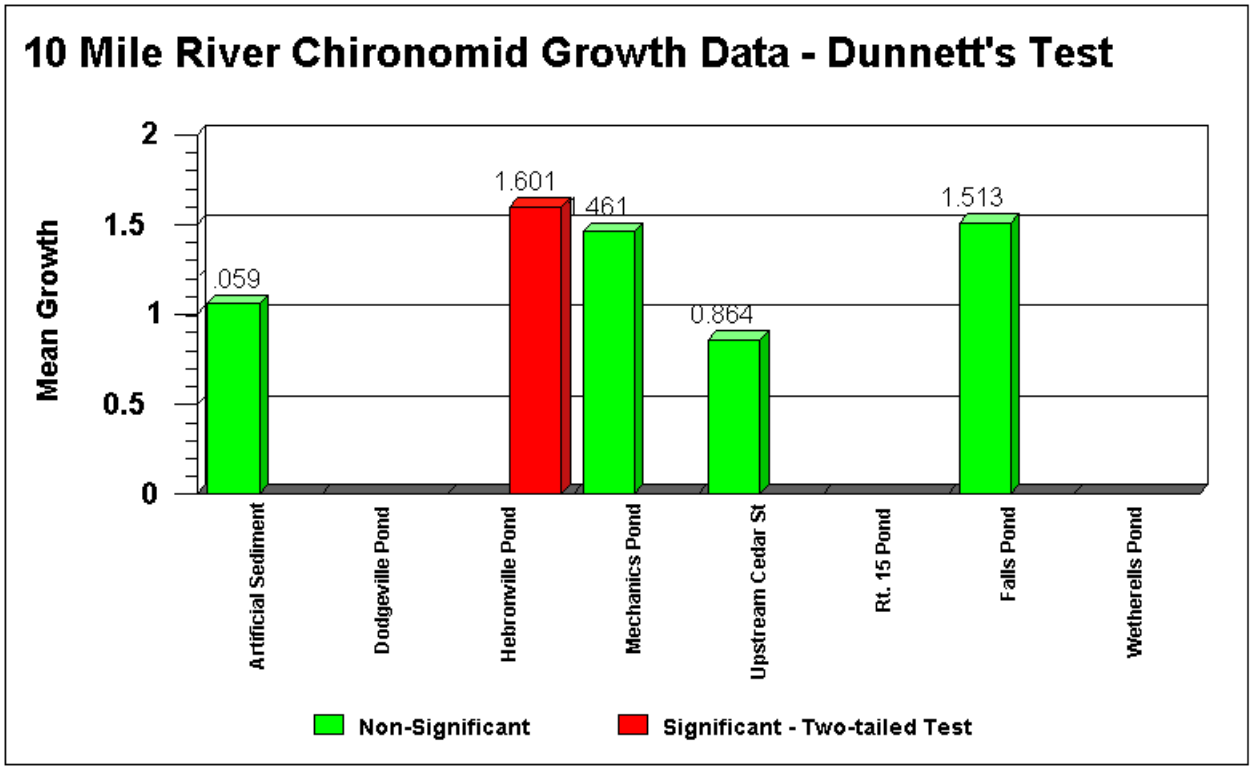


Figure 6. Sites with significant and non-significant effects on chironomid growth.

These sites were then removed from further statistical analysis for growth impairment, as impaired survival precludes this analysis. The growth data set was also tested for normality using the Chi-Square test and for homogeneity of variance using Hartley's and Bartlett's tests. It passed all three tests allowing analysis of the growth data using Dunnett's Test, given the equal number of replicates. Dunnett's test identified no statistically significant impairment in growth (p=0.05,one-tailed; df=30,4; T Stat=2.25). When the two-tailed Dunnett's test value is used in the analysis then statistically enhanced growth (p=0.05;two-tailed;df=30,4;T Stat=2.58) is observed at Hebronville Pond Dam (HEBR01) (Zar, 1974).

Contaminant Levels of Potential Ecotoxicological Concern

Tables 6-29 and Figures 7-30 document the presence and absence of potential ecotoxicological effects from observed contaminants at each site. Potential effects are highlighted in red. Specific thresholds exceeded are shown in the Sediment Ecotoxicological Screening Benchmark (SESB) tables (Table 5). Appendix E provides a thorough discussion of the derivation, strengths and limitations of the SESB tables.

Table 5. Ecotoxicological Screening Thresholds

Ecotoxicological Thresholds	Source
ORNL-AWQC	Oak Ridge National Laboratory - NAWC chronic [9, 16, 31]
ORNL-SCV	Oak Ridge National Laboratory - Secondary Chronic Value [9, 16, 31]
OSWER Type	Office of Solid Waste and Emergency Response Ecotox Thesholds [26]
Region IV	U.S. EPA Region IV Ecological Screening Values [15]
AET-L	Apparent Effects Threshold-Low, for selected organics and metals [3, 30]
AET-H	Apparent Effects Threshold-High [3, 30]
LEL	Lowest Effects Level [8, 14]
SEL	Severe Effects Level [8, 14]
MEL	Minimum Effect level [8, 17, 19]
TOEL	Toxic Effect Level [8, 17, 19]
ERL	Effects Range-Low (lower 10th percentile of the marine/estuarine effects data distribution) [11, 12]
ERM	Effects Range-Median [11, 12]
WA State	Washington State Sediment Quality Standards for ionizable organic compounds [4, 6]
SQAL/SQC	Sediment Quality Advisory Levels/Sediment Quality Criteria (values are lower limit of 95% confidence limit) [22, 24, 25]
TEC-ARCS	Threshold Effect Concentration-Assessment and Remediation of Contaminated Sediments (ARCS) Program [20, 21, 27]
PEC-ARCS	Probable Effect Concentration-Assessment and Remediation of Contaminated Sediments (ARCS) Program [20, 21, 27]
NEC-ARCS	No Effect Concentration- ARCS Program [20, 21, 27]
TEL-C	Threshold Effects Levels - Canada; for selected nonionic organics and metals (Freshwater) [17, 18]
TEL-F	Threshold Effects Levels - Florida (Marine) [5, 13]
TEL-HA	Threshold Effects Level for *Hyalella azteca*; 28 day test [7]
PEL-C	Probable Effects Levels - Canada (Freshwater) [17, 18]
PEL-F	Probable Effects Levels -Florida (Marine) [5, 13]
PEL-HA	Probable Effects Levels - *Hyalella azteca*; 28 day test [7]

Inorganic Chemicals (Metals)

Table 6. Wetherell Dam Pond (WETH01) Inorganic Chemicals (Metals) exceeding

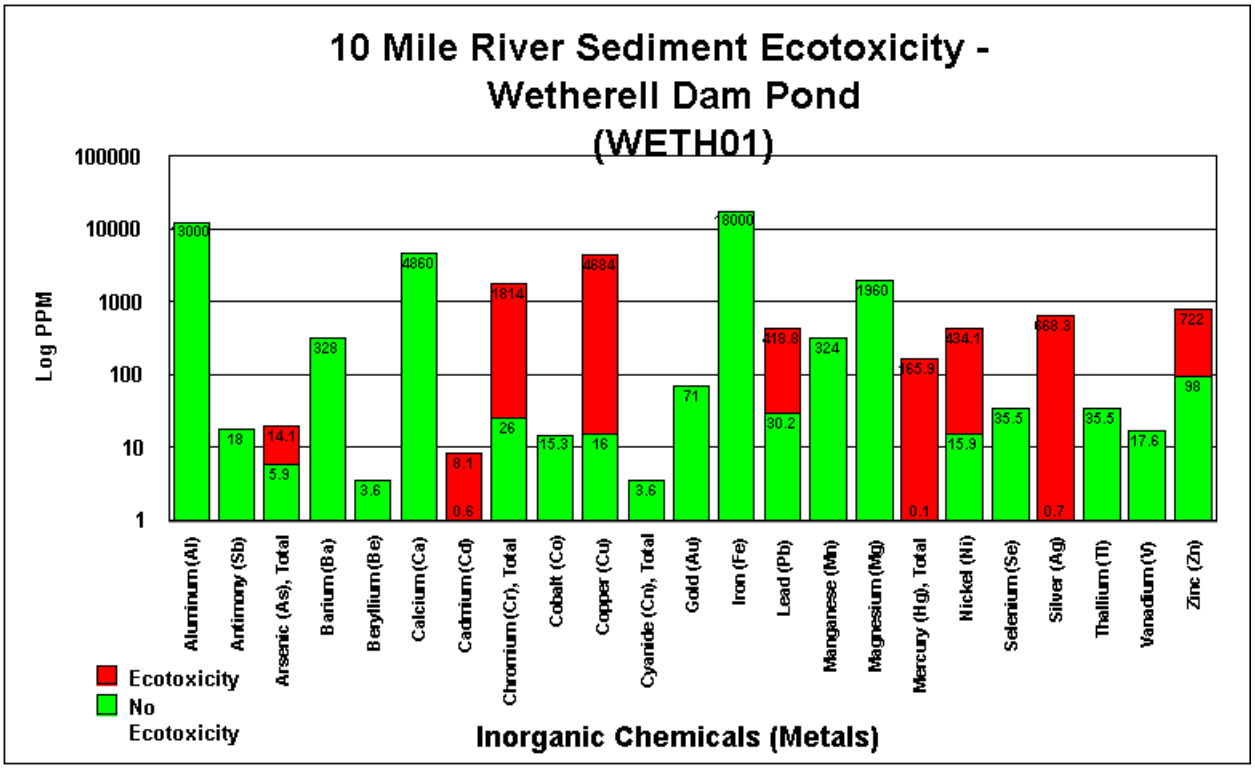


Figure 7. Sediment Ecotoxicity - Wetherell Dam Pond (WETH01) (Inorganic Chemicals - Metals)

Ecotoxicological Thresholds (SEM/AVS = 29.2)

Contaminant	Ecotox Thresholds Exceeded
Arsenic	OSWER, Region IV, LEL, MEL, TOEL, ERL, TEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C
Cadmium	OSWER, Region IV, AET-L, LEL, MEL, TOEL, ERL, TEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Chromium, total	OWSER, Region IV, AEL-L, AET-H, LEL, SEL, MEL, TOEL, ERL, ERM, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Copper	OSWER, Region IV, AET-L, AET-H, LEL, SEL, MEL, TOEL, ERL, ERM, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Lead	OSWER, Region IV, LEL, SEL, MEL, TOEL, ERL, ERM, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA

Mercury, total	OSWER, Region IV, AET-L, AET-H, LEL, SEL, MEL, TOEL, ERL, ERM, TEL-C, TEL-F, PEL-C, PEL-F
Nickel	OSWER, Region IV, LEL, SEL, MEL, TOEL, ERL, ERM, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Silver	Region IV, AET-L. AET-H, ERL, ERM, TEL-F, PEL-F
Zinc	OSWER, Region IV, AET-L, LEL, SEL, MEL, TOEL, ERL, ERM, TEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA

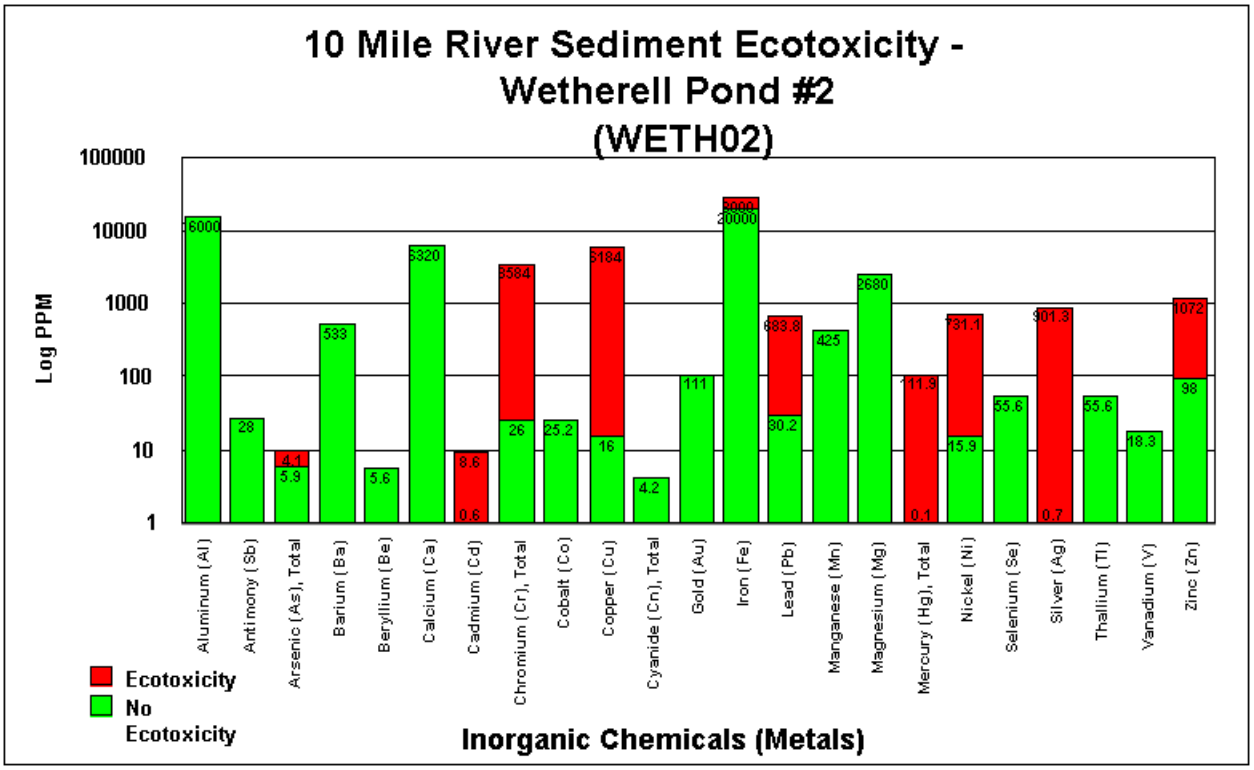


Figure 8. Sediment Ecotoxicity - Wetherell Pond #2 (WETH02) (Inorganic Chemicals - Metals)

Table 7. Wetherell Pond #2 (WETH02) Inorganic Chemicals (Metals) exceeding Ecotoxicological Threshold (SEM/AVS = 19.3)

Contaminant	Ecotox Thresholds Exceeded
Arsenic	OSWER, Region IV, LEL, MEL, ERL, TEL-C, TEL-F
Cadmium	OSWER, Region IV, AET-L, LEL, MEL, TOEL, ERL, TEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Chromium, total	OWSER, Region IV, AEL-L, AET-H, LEL, SEL, MEL, TOEL, ERL, ERM, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Copper	OSWER, Region IV, AET-L, AET-H, LEL, SEL, MEL, TOEL, ERL, ERM, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Iron	LEL
Lead	OSWER, Region IV, AET-L, AET-H, LEL, SEL, MEL, TOEL, ERL, ERM, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA

Mercury, total	OSWER, Region IV, AET-L, AET-H, LEL, SEL, MEL, TOEL, ERL, ERM, TEL-C, TEL-F, PEL-C, PEL-F
Nickel	OSWER, Region IV, LEL, SEL, MEL, TOEL, ERL, ERM, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Silver	Region IV, AET-L. AET-H, ERL, ERM, TEL-F, PEL-F
Zinc	OSWER, Region IV, AET-L, LEL, SEL, MEL, TOEL, ERL, ERM, TEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA

The Wetherell Dam Pond (WETH01) and Wetherell Pond #2 (WETH02) sites are most notable because of the high levels of mercury detected there (166 and 112 ppm., respectively). Other inorganic chemicals which exceeded ecotoxicological thresholds at these sites included cadmium, chromium[3], copper, lead, nickel, silver and zinc. Silver, nickel, copper, and chromium were present at high levels compared to the other Ten Mile sites. Further, the high SEM/AVS ratios observed in both samples (29.2 and 19.3), by far the highest in the watershed, indicates the potential for bioavailability of zinc, lead, copper, nickel, cadmium, arsenic, and mercury.

[3] We have no analytical knowledge of the speciation of chromium at any of the Ten Mile sites. Clearly the much more toxic Cr^{+6} form, if present, would be of greater ecotoxicological concern than the less toxic Cr^{+3} form.

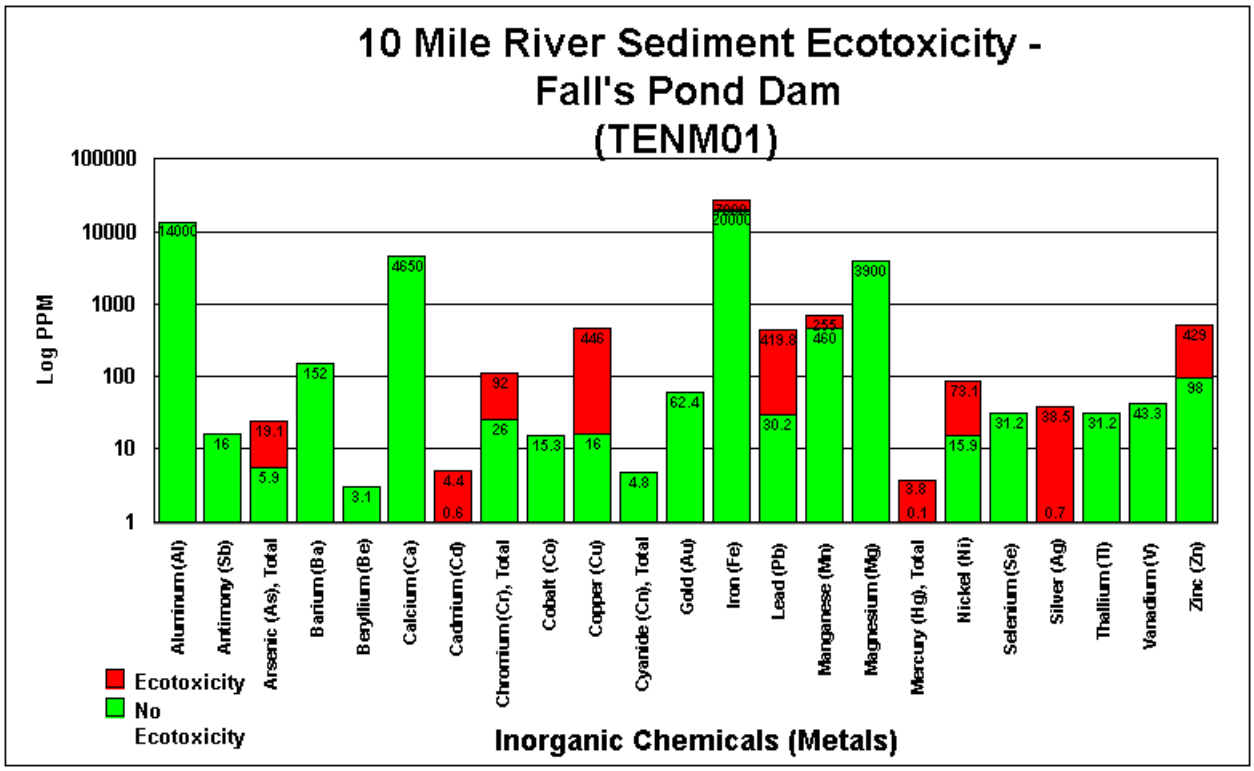


Figure 9. Sediment Ecotoxicity - Fall Pond Dam (TENM01) (Inorganic Chemicals - Metals)

Table 8. Fall Pond Dam (TENM01) Inorganic Chemicals (Metals) exceeding Ecotoxicological Thresholds (SEM/AVS = 0.24)

Contaminant	Ecotox Thresholds Exceeded
Arsenic	OSWER, Region IV, LEL, MEL, TOEL, ERL, TEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C
Cadmium	OSWER, Region IV, LEL, MEL, TOEL, ERL, TEC-ARC,. TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Chromium, total	OSWER, Region IV, LEL, SEL, MEL, TOEL, ERL, TEL-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C
Copper	OSWER, Region IV, AET-L, LEL, SEL, MEL, TOEL, ERL, ERM, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Iron	LEL
Lead	OSWER, Region IV, AET-L, LEL, SEL, MEL, TOEL, ERL, ERM, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA

Manganese	LEL
Mercury, total	OSWER, Region IV, AET-L, AET-H, LEL, SEL, MEL, TOEL, ERL, ERM, TEL-C, TEL-F, PEL-C, PEL-F
Nickel	OSWER, Region IV, LEL, SEL, MEL, TOEL, ERL, ERM, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Silver	Region IV, AET-L, AET-H, ERL, ERM, TEL-F, PEL-F
Zinc	OSWER, Region IV, AET-L, LEL, MEL, ERL, ERM, TEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA

The low SEM/AVS ratio of 0.24 indicates greater binding and less bioavailability of zinc, lead, copper, nickel, cadmium, arsenic, mercury, and manganese at the Fall Pond Dam site.

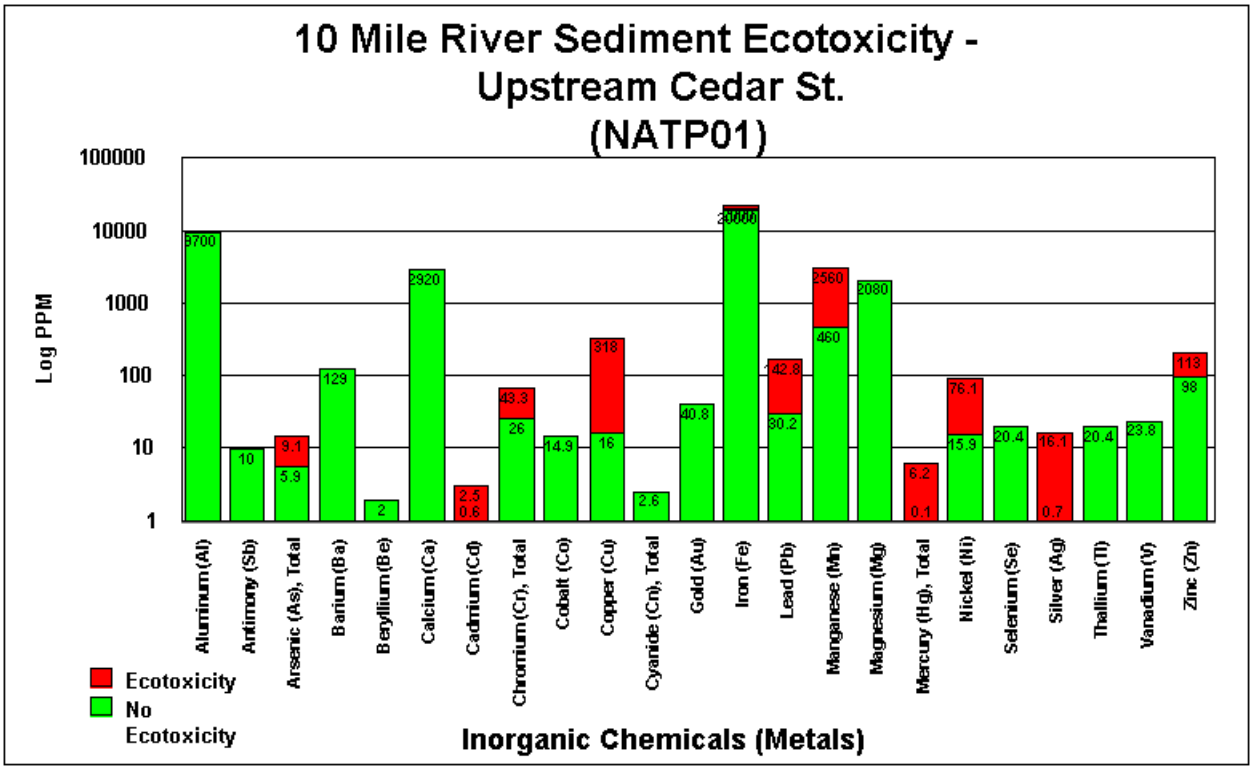


Figure 10. Sediment Ecotoxicity - Upstream Cedar St.(NATP01) (Inorganic Chemicals - Metals)

Table 9. Upstream Cedar St. (NATP01) Inorganic Chemicals (Metals) exceeding Ecotoxicological Thresholds (SEM/AVS = 0.00)

Contaminant	Ecotox Thresholds Exceeded
Arsenic	OSWER, Region IV, LEL, MEL, ERL, TEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Cadmium	OSWER, Region IV, LEL, MEL, TOEL, ERL, TEC-ARCS, TEL-C, TEL-F, TEL-HA
Chromium, total	Region IV, LEL, MEL, TEC-ARCS, TEL-C, TEL-F, TEL-HA
Copper	OSWER, Region IV, LEL, SEL, MEL, TOEL, ERL, ERM, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Iron	LEL
Lead	OSWER, Region IV, LEL, MEL, ERL, TEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Manganese	LEL, SEL, TEC-ARCS, PEC-ARCS, NEC-ARCS

Mercury, total	OSWER, Region IV, AET-L, AET-H, LEL, SEL, MEL, TOEL, ERL, ERM, TEL-C, TEL-F, PEL-C, PEL-F
Nickel	OSWER, Region IV, LEL, SEL, MEL, TOEL, ERL, ERM, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Silver	Region IV, AET-L, AET-H, ERL, ERM, TEL-F, PEL-F
Zinc	OSWER, Region IV, LEL, MEL, ERL, TEC-ARCS, TEL-C, TEL-F, TEL-HA

The low SEM/AVS ratio of 0.00 suggests the greater binding in the sediment and lesser bioavailability of zinc, lead, copper, cobalt, nickel, cadmium, arsenic, mercury and manganese at the Upstream Cedar St. site (NATP01). The strongly associated Fall Pond Dam (TENM01) and Upstream Cedar St. sites were distinguished by relatively low levels, although still of potential ecotoxicological effect, of cadmium, chromium, copper, mercury, nickel, and silver. Other inorganics observed at values more similar to the other Ten Mile sites and exceeding ecotoxicological thresholds included iron, lead, manganese and zinc

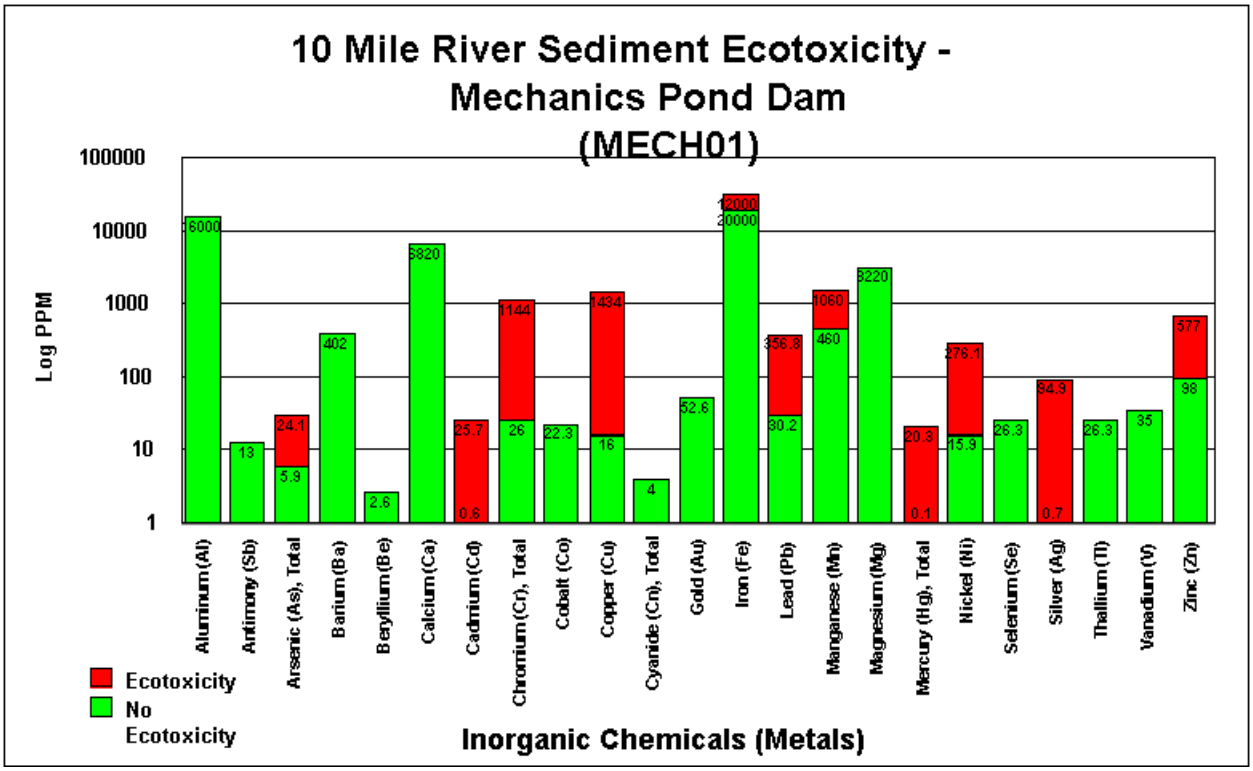


Figure 11. Sediment Ecotoxicity - Mechanic Pond Dam (MECH01) (Inorganic Chemicals - Metals)

Table 10. Mechanic Pond Dam (MECH01) Inorganic Chemicals (Metals) exceeding Ecotoxicological Thresholds (SEM/AVS = 0.24)

Contaminant	Ecotox Thresholds Exceeded
Arsenic	OSWER, Region IV, LEL, MEL, TOEL, ERL, TEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C
Cadmium	OSWER, Region IV, AET-L, AET-H, LEL, SEL, MEL, TOEL, ERL, ERM, TEC-ARCS, PEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Chromium, total	OSWER, Region IV, AET-L, AET-H, LEL, SEL, MEL, TOEL, ERL, ERM, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Copper	OSWER, Region IV, AET-L, AET-H, LEL, SEL, MEL, TOEL, ERL, ERM, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Iron	LEL

Lead	OSWER, Region IV, LEL, SEL, MEL, TOEL, ERL, ERM, TEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Manganese	LEL, SEL, PEC-ARCS, NEC-ARCS
Mercury, total	OSWER, Region IV, AET-L, AET-H, LEL, SEL, MEL, TOEL, ERL, ERM, TEL-C, TEL-F, PEL-C, PEL-F
Nickel	OSWER, Region IV, LEL, SEL, MEL, TOEL, ERL, ERM, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Silver	Region IV, AET-L, AET-H, ERL, ERM, TEL-F, PEL-F
Zinc	OSWER, Region IV, AET-L, LEL, MEL, TOEL, ERL, ERM, TEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA

The low SEM/AVS ratio of 0.24 at Mechanic Pond suggests greater binding to sediment and less bioavailability of zinc, lead, copper, nickel, cadmium, arsenic, mercury and manganese.

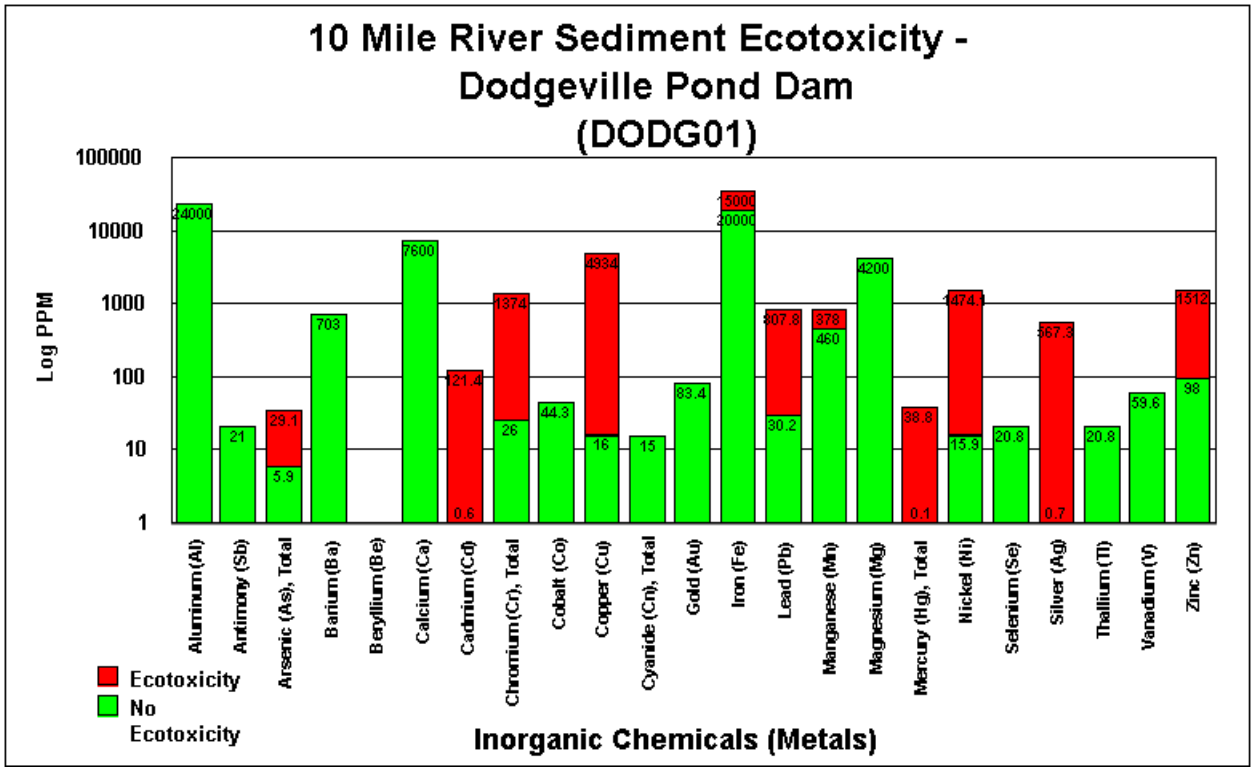


Figure 12. Sediment Ecotoxicity - Dodgeville Pond Dam (DODG01) (Inorganic Chemicals - Metals)

Table 11. Dodgeville Pond Dam (DODG01) Inorganic Chemicals (Metals) exceeding Ecotoxicological Thresholds (SEM/AVS = 2.4)

Contaminant	Ecotox Thresholds Exceeded
Arsenic	OSWER, Region IV, LEL, SEL, MEL, TOEL, ERL, TEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C
Cadmium	OSWER, Region IV, AET-L, AET-H, LEL, SEL, MEL, TOEL, ERL, ERM, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Chromium, total	OSWER, Region IV, AET-L, AET-H, LEL, SEL, MEL, TOEL, ERL, ERM, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Copper	OSWER, Region IV, AET-L, AET-H, LEL, SEL, MEL, TOEL, ERL, ERM, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Iron	LEL

Lead	OSWER, Region IV, AET-L, AET-H, LEL, SEL, MEL, TOEL, ERL, ERM, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Manganese	LEL, NEC-ARCS
Mercury, total	OSWER, Region IV, AET-L, AET-H, LEL, SEL, MEL, TOEL, ERL, ERM, TEL-C, TEL-F, PEL-C, PEL-F
Nickel	OSWER, Region IV, LEL, SEL, MEL, TOEL, ERL, ERM, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Silver	Region IV, AET-L, AET-H, ERL, ERM, TEL-F, PEL-F
Zinc	OSWER, Region IV, AET-L, AET-H, LEL, SEL, MEL, TOEL, ERL, ERM, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PERL-HA

The high SEM/AVS ratio of 2.4 at Dodgeville Pond suggests less binding in sediment and greater bioavailability of zinc, lead, copper, nickel, cadmium, arsenic,mercury and manganese.

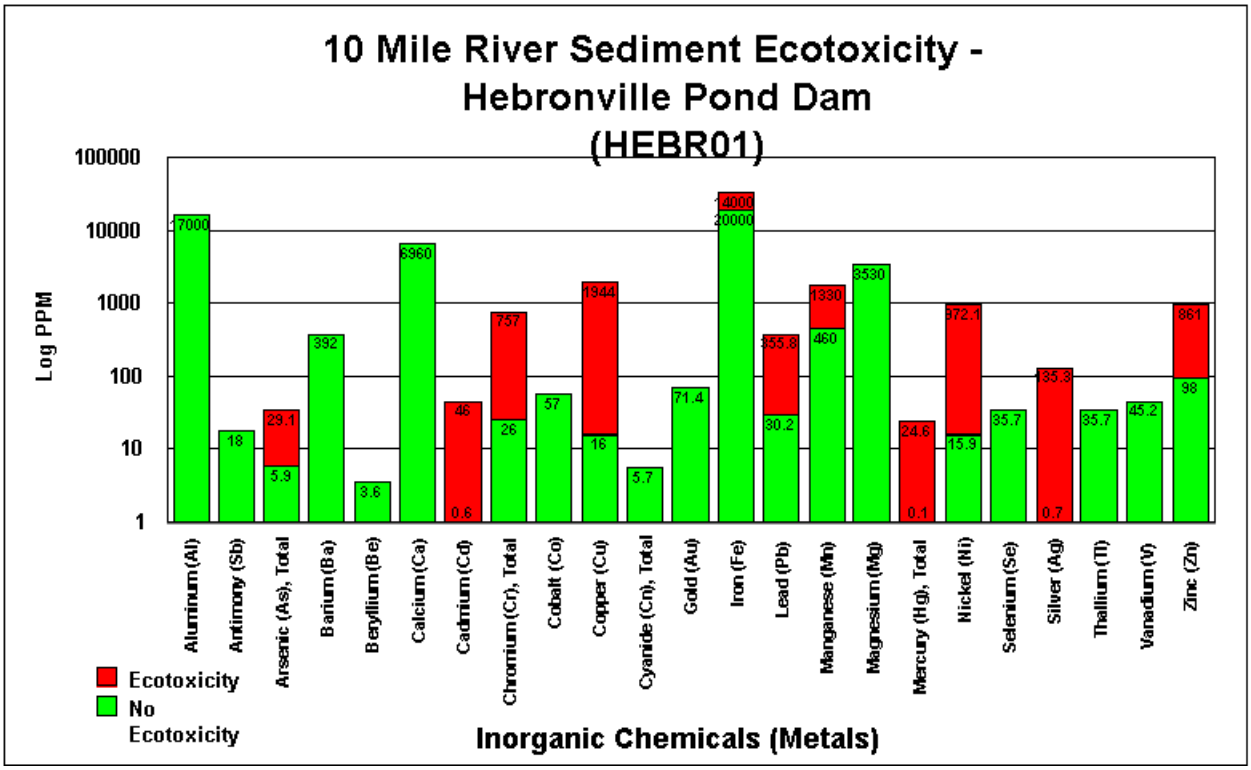


Figure 13. Sediment Ecotoxicity - Hebronville Pond Dam (HEBR01) (Inorganic Chemicals - Metals)

Table 12. Rt. 15 Hebronville Pond Dam (HEBR01) Inorganic Chemicals (Metals) exceeding Ecotoxicological Thresholds (SEM/AVS = 2.4)

Contaminant	Ecotox Thresholds Exceeded
Arsenic	OSWER, Region IV, LEL, SEL, MEL, TOEL, ERL, TEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C
Cadmium	OSWER, Region IV, AET-L, AET-H, LEL, SEL, MEL, TOEL, ERL, ERM, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Chromium, total	OSWER, Region IV, AET-L, AET-H, LEL, SEL, MEL, TOEL, ERL, ERM, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Copper	OSWER, Region IV, AET-L, AET-H, LEL, SEL, MEL, TOEL, ERL, ERM, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Iron	LEL

Lead	OSWER, Region IV, LEL, SEL, MEL, TOEL, ERL, ERM, TEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Manganese	LEL, SEL, TEC-ARCS, PEC-ARCS, NEC-ARCS
Mercury, total	OSWER, Region IV, AET-L, AET-H, LEL, SEL, MEL, TOEL, ERL, ERM, TEL-C, TEL-F, PEL-C, PEL-F
Nickel	OSWER, Region IV, LEL, SEL, MEL, TOEL, ERL, ERM, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Silver	Region IV, AET-L, AET-H, ERL, ERM, TEL-F, PEL-F
Zinc	OSWER, Region IV, AET-L, LEL, SEL, MEL, TOEL, ERL, ERM, TEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA

The high SEM/AVS ratio of 2.4 suggests less sediment binding and greater bioavailability of zinc, lead, copper, nickel, cadmium, arsenic, mercury and manganese at the Hebronville Pond Dam site. The aggregation of Dodgeville Pond Dam (DODG01), Hebronville Pond Dam (HEBR01), and Mechanics Pond Dam (MECH01) were distinguished by the high levels of cadmium, chromium, nickel, and relatively high level of mercury. Other ecotoxicological exceedances at these sites included copper, iron, lead, manganese, silver and zinc. However, the much lower SEM/AVS of Mechanic Pond Dam site suggests a considerable difference between these sites in biovailability of zinc, lead, copper, nickel, cadmium, arsenic, mercury and manganese.

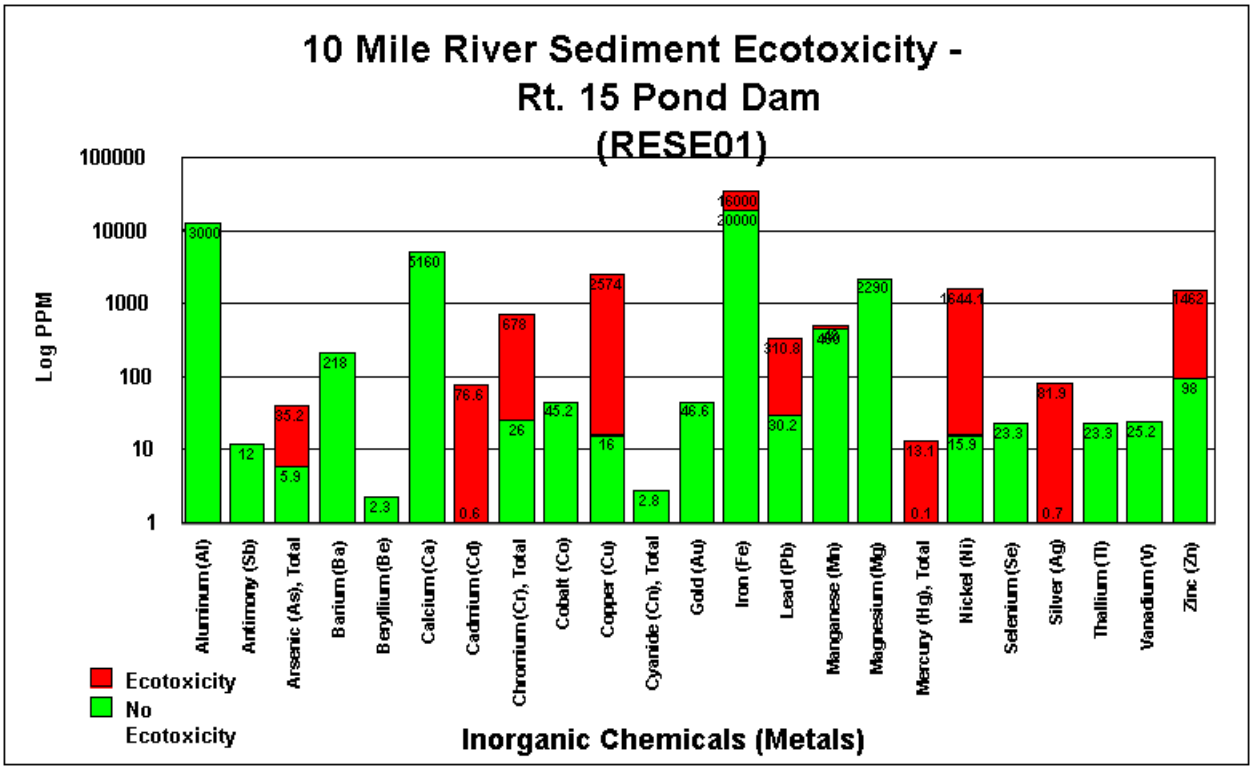


Figure 14. Sediment Ecotoxicity - Rt. 15 Pond Dam (RESE01) (Inorganic Chemicals - Metals)

Table 13. Rt. 15 Pond Dam (RESE01) Inorganic Chemicals (Metals) exceeding Ecotoxicological Thresholds (SEM/AVS = 3.5)

Contaminant	Ecotox Thresholds Exceeded
Arsenic	OSWER, Region IV, LEL, SEL, MEL, TOEL, ERL, TEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Cadmium	OSWER, Region IV, AET-L, AET-H, LEL, SEL, MEL, TOEL, ERL, ERM, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Chromium, total	OSWER, Region IV, AET-L, AET-H, LEL, SEL, MEL, TOEL, ERL, ERM, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Copper	OSWER, Region IV, AET-L, AET-H, LEL, SEL, MEL, TOEL, ERL, ERM, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Iron	LEL
Lead	OSWER, Region IV, LEL, SEL, MEL, TOEL, ERL, ERM, TEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA

Manganese	LEL, SEL, TEC-ARCS, PEC-ARCS, NEC-ARCS
Mercury, total	OSWER, Region IV, AET-L, AET-H, LEL, SEL, MEL, TOEL, ERL, ERM, TEL-C, TEL-F, PEL-C, PEL-F
Nickel	OSWER, Region IV, LEL, SEL, MEL, TOEL, ERL, ERM, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Silver	Region IV, AET-L, AET-H, ERL, ERM, TEL-F, PEL-F
Zinc	OSWER, Region IV, AET-L, LEL, SEL, MEL, TOEL, ERL, ERM, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA

The high SEM/AVS ratio of 3.5 at the Rt. 15 Pond Dam (RESE01) site suggests less sediment binding and greater bioavailability of zinc, lead, copper, nickel, cadmium, arsenic, mercury and manganese.

Chlorinated Pesticides and Polychlorinated Biphenyls (PCBs)

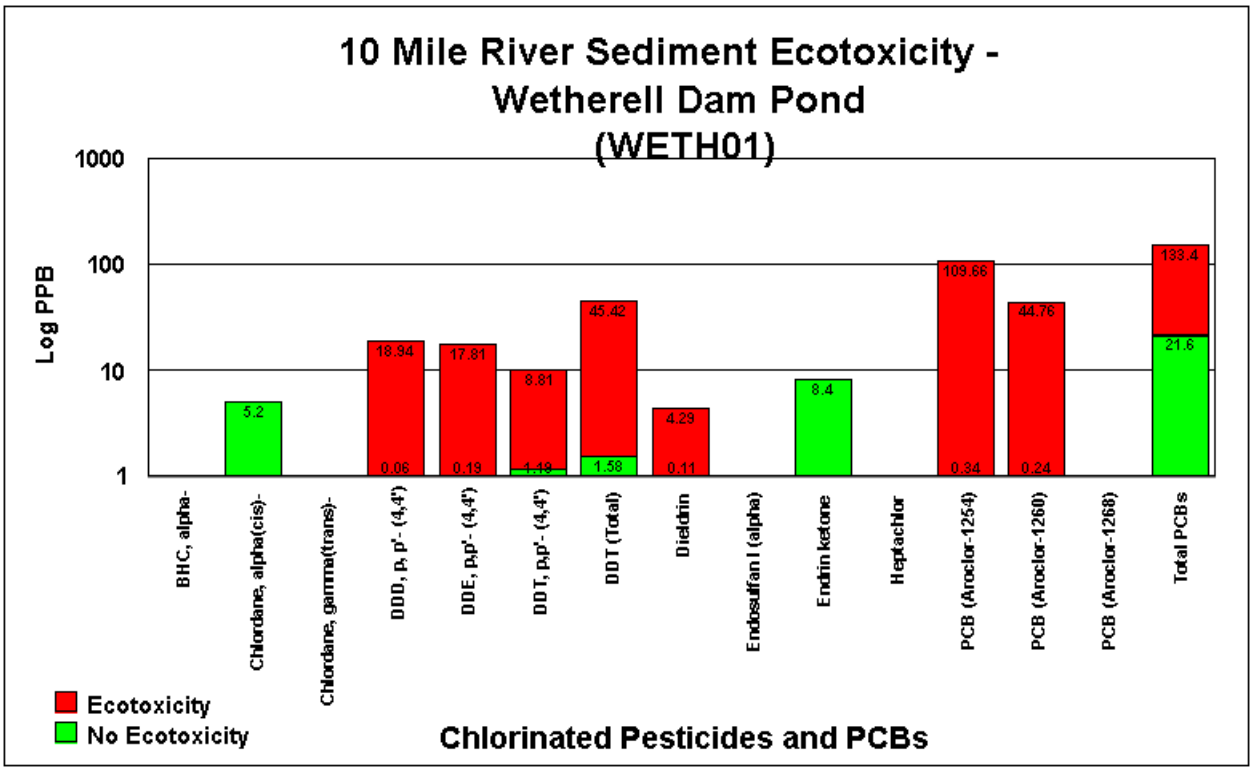


Figure 15. Sediment Ecotoxicity - Wetherell Dam Pond (WETH01) (Chlorinated Pesticides and PCBs)

Table 14. Wetherell Dam Pond (WETH01) Chlorinated Pesticides/PCBs exceeding Ecotoxicological Thresholds

Contaminant	Ecotox Thresholds Exceeded
DDD, p, p' (4,4')	Region IV, AET-L, LEL, MEL, TEL-C, TEL-F, PEL-C, PEL-F
DDE, p,p' (4,4')	AET-L, AET-H, LEL, MEL, ERL, TEL-C, TEL-F, PEL-C, PEL-F
DDT, p,p' (4,4')	Region IV, TEL-C, PEL-F
DDT, total	OSWER, Region IV, AET-L, AET-H, LEL, MEL, ERL, ERM, TEL-C, TEL-F
Dieldrin	Region IV, LEL, MEL, TEL-C, TEL-F, PEL-F
PCB (Aroclor-1254)	LEL
PCB (Aroclor-1260)	LEL
PCB, total	OSWER, Region IV, LEL, ERL, TEC-ARCS, TEL-C, TEL-F, TEL-HA

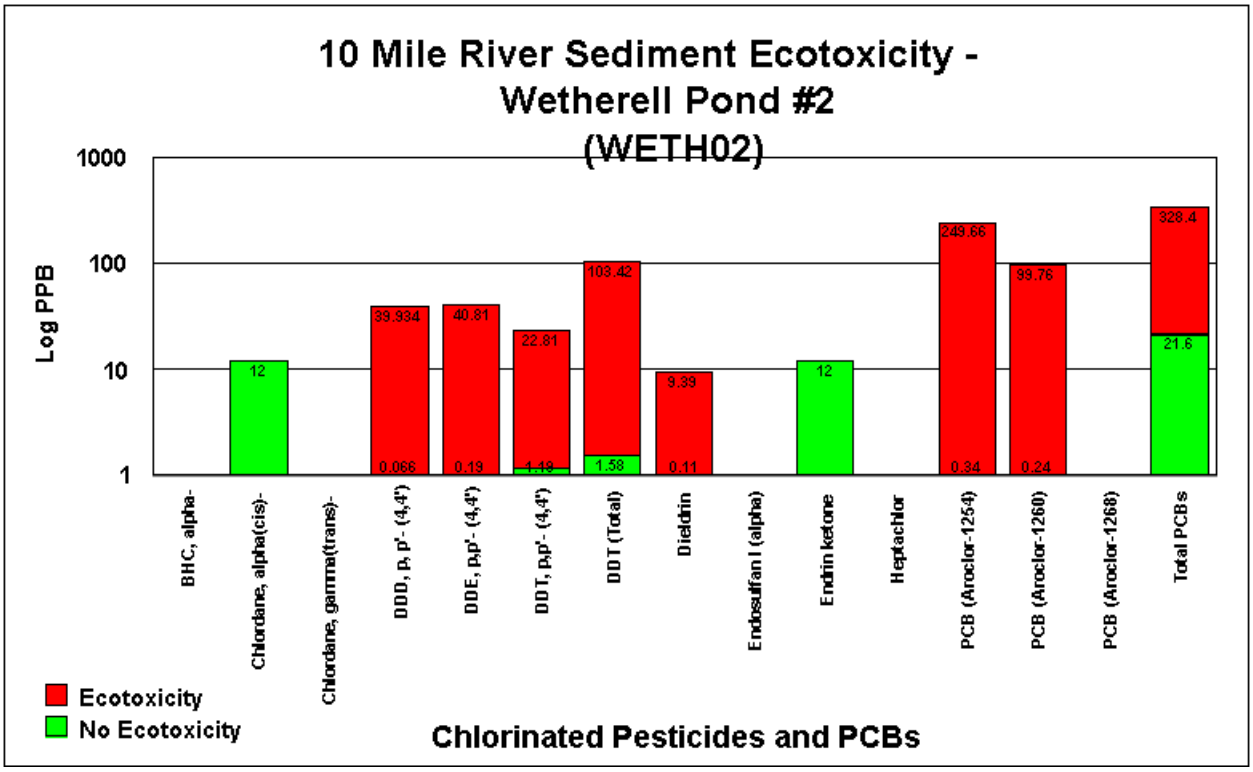


Figure 16. Sediment Ecotoxicity - Wetherell Pond #2 (WETH02) (Chlorinated Pesticides and PCBs)

Table 15. Wetherell Pond #2 (WETH02) Chlorinated Pesticides/PCBs exceeding Ecotoxicological Thresholds

Contaminant	Ecotox Thresholds Exceeded
BHC, alpha	LEL
DDD, p, p' (4,4')	Region IV, AET-L, AET-H, LEL, SEL, MEL, TOEL, TEL-C, TEL-F, PEL-C, PEL-F
DDE, p,p' (4,4')	AET-L, AET-H, LEL, MEL, TOEL, ERL, ERM, TEL-C, TEL-F, PEL-C, PEL-F
DDT, p,p' (4,4')	Region IV, AET-L, AET-H, LEL, MEL, TOEL, ERL, ERM, TEL-F, PEL-F
DDT, total	OSWER, Region IV, AET-L, AET-H, LEL, SEL, MEL, TOEL, ERL, ERM, TEL-C, TEL-F, PEL-F
PCB (Aroclor-1254)	LEL
PCB (Aroclor-1260)	LEL

PCB, total	OSWER, Region IV, LEL, MEL, ERL, ERM, TEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA

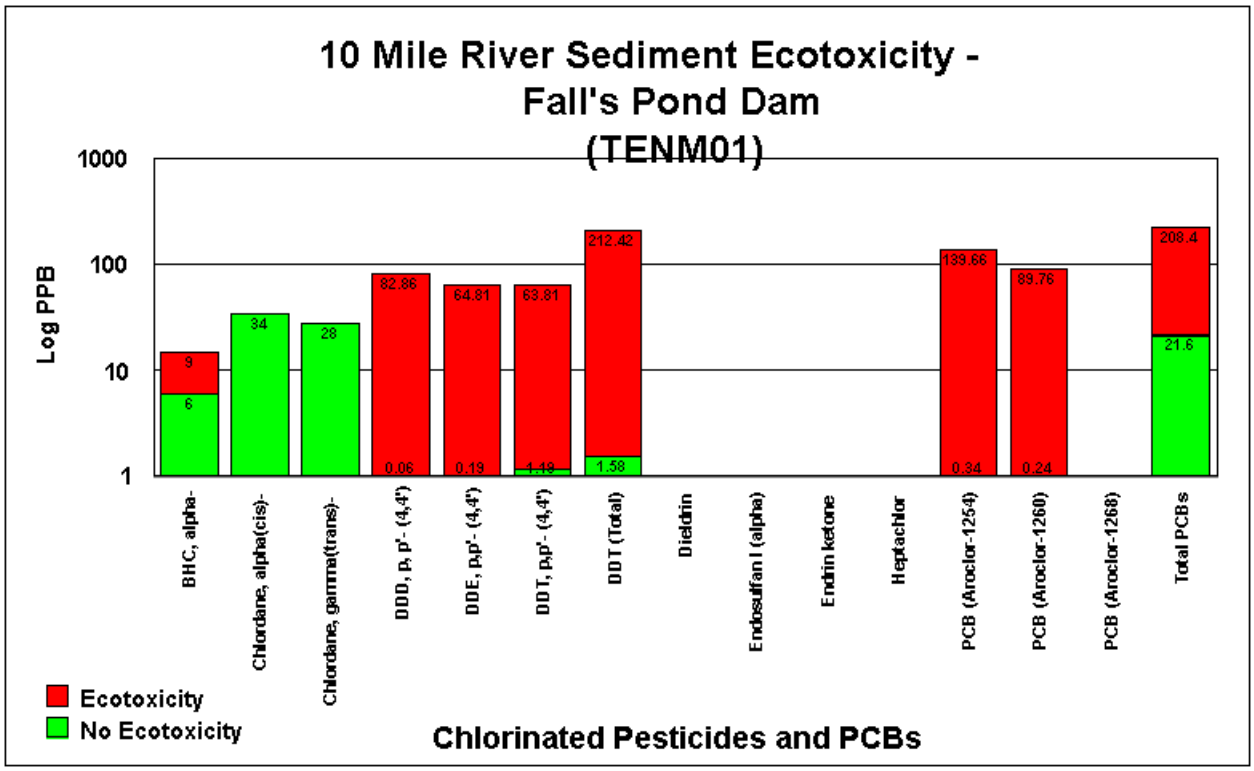


Figure 17. Sediment Ecotoxicity - Fall Pond Dam (TENM01)(Chlorinated Pesticides and PCBs)

Table 16. Fall Pond Dam (TENM01) Chlorinated Pesticides/PCBs exceeding Ecotoxicological Thresholds

Contaminant	Ecotox Thresholds Exceeded
BHC, alpha	LEL
DDD, p, p' (4,4')	Region IV, AET-L, AET-H, LEL, SEL, MEL, TOEL, TEL-C, TEL-F, PEL-C, PEL-F
DDE, p,p' (4,4')	AET-L, AET-H, LEL, MEL, TOEL, ERL, ERM, TEL-C, TEL-F, PEL-C, PEL-F
DDT, p,p' (4,4')	Region IV, AET-L, AET-H, TEL-F, PEL-F
DDT, total	OSWER, Region IV, AET-L, AET-H, LEL, SEL, MEL, TOEL, ERL, ERM, TEL-C, TEL-F, PEL-F
PCB (Aroclor-1254)	LEL
PCB (Aroclor-1260)	LEL
PCB, total	OSWER, Region IV, LEL, MEL, TEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-F,

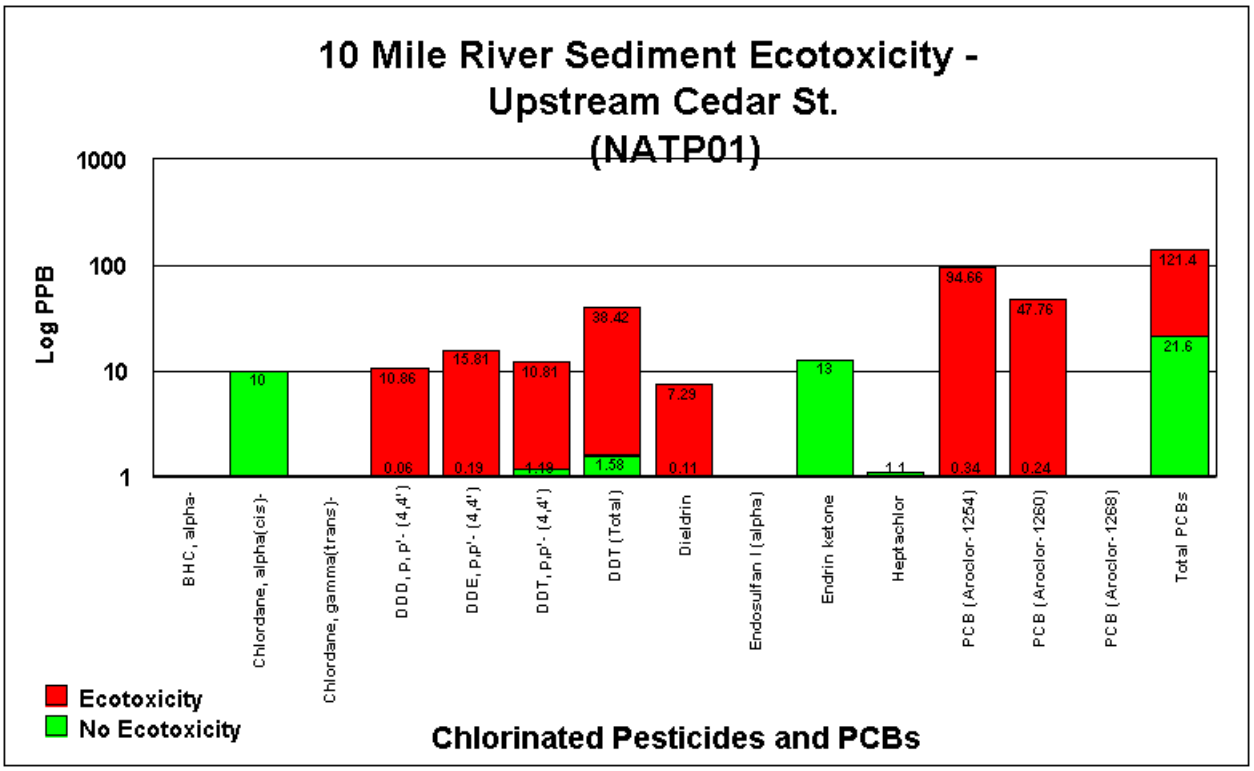


Figure 18. Sediment Ecotoxicity - Upstream Cedar St. (NATP01) (Chlorinated Pesticides and PCBs)

Table 17. Upstream Cedar St. (NATP01) Chlorinated Pesticides/PCBs exceeding Ecotoxicological Thresholds

Contaminant	Ecotox Thresholds Exceeded
DDD, p, p' (4,4')	Region IV, MEL, TEL-C, TEL-F, PEL-C, PEL-F
DDE, p,p' (4,4')	AET-L, AET-H, LEL, MEL, ERL, TEL-C, TEL-F, PEL-C
DDT, p,p' (4,4')	Region IV, TEL-F, PEL-F
DDT, total	OSWER, Region IV, AET-L, AET-H, LEL, MEL, ERL, TEL-C, TEL-F
Dieldrin	Region IV, LEL, MEL, TEL-C, TEL-F, PEL-C, PEL-F
PCB (Aroclor-1254)	LEL
PCB (Aroclor-1260)	LEL
PCB, total	OSWER, Region IV, LEL, ERL, TEC-ARCS, TEL-C, TEL-F, TEL-HA

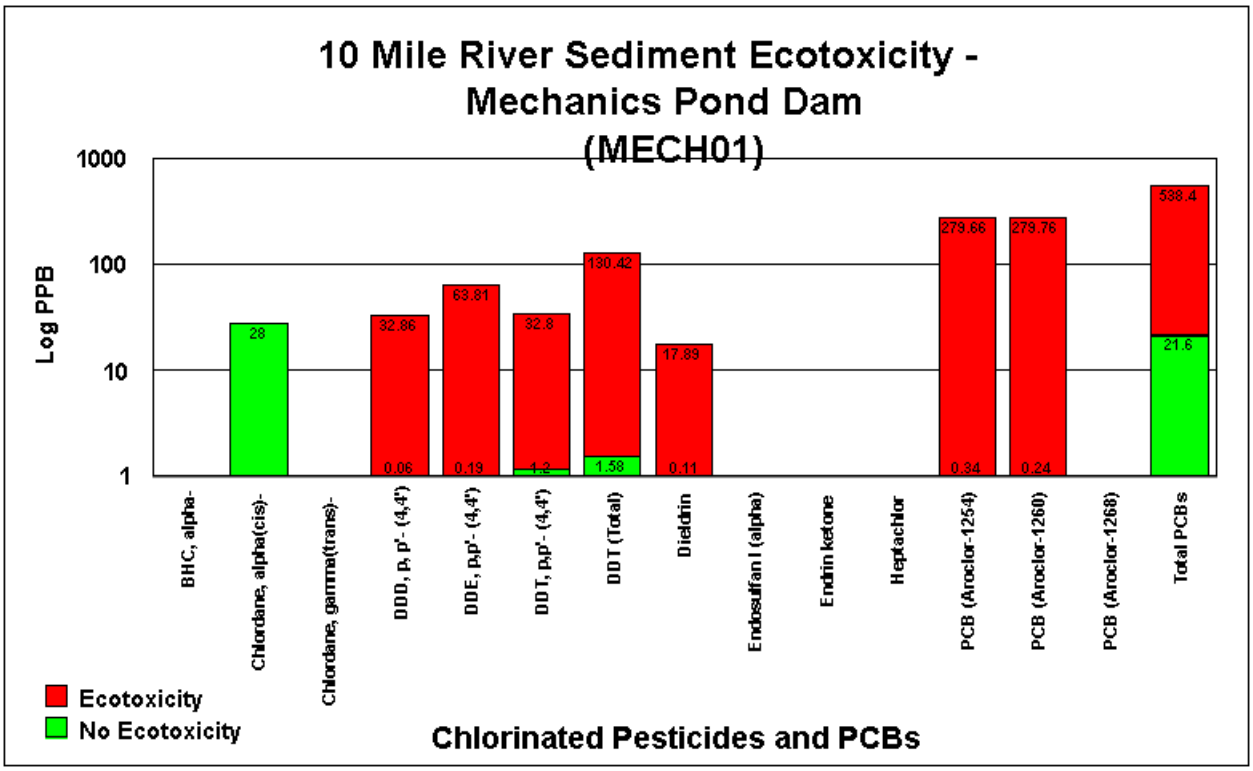


Figure 19. Sediment Ecotoxicity - Mechanic Pond Dam (MECH01) (Chlorinated Pesticides and PCBs)

Table 18. Mechanic Pond Dam (MECH01) Chlorinated Pesticides/PCBs exceeding Ecotoxicological Thresholds

Contaminant	Ecotox Thresholds Exceeded
DDD, p, p' (4,4')	Region IV, AET-L, LEL, MEL, TEL-C, TEL-F, PEL-C, PEL-F
DDE, p,p' (4,4')	AET-L, AET-H, LEL, MEL, TOEL, ERL, ERM, TEL-C, TEL-F, PEL-C, PEL-F
DDT, p,p' (4,4')	Region IV, AET-L, AET-H, TEL-F, PEL-F
DDT, total	OSWER, Region IV, AET-L, AET-H, LEL, SEL, MEL, TOEL, ERL, ERM, TEL-C, TEL-F, PEL-C, PEL-F
Dieldrin	Region IV, LEL, MEL, TEL-C, TEL-F, PEL-C, PEL-F
PCB (Aroclor-1254)	LEL

PCB (Aroclor-1260)	LEL, SEL
PCB, total	OSWER, Region IV, LEL, MEL, ERL, ERM, TEC-ARCS,PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA

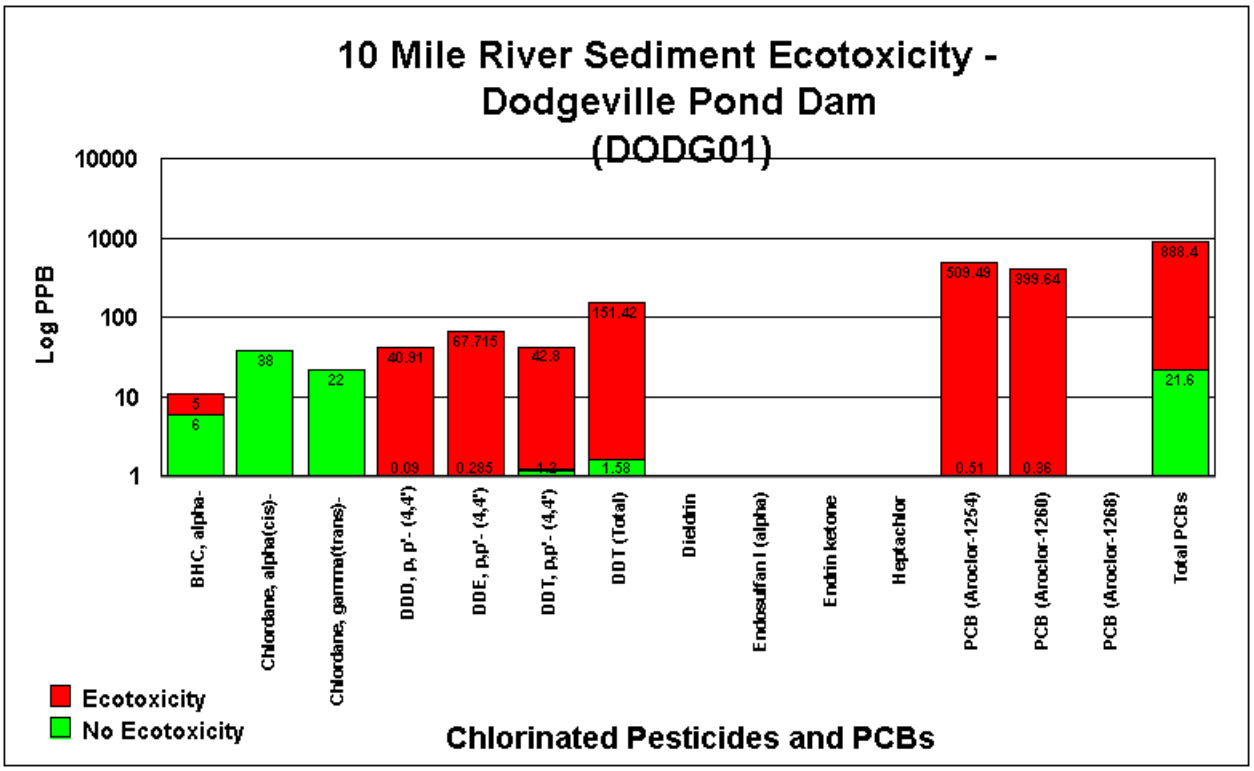


Figure 20. Sediment Ecotoxicity - Dodgeville Pond Dam (DODG01) (Chlorinated Pesticides and PCBs)

Table 19. Dodgeville Pond Dam (DODG01)Chlorinated Pesticides/PCBs exceeding Ecotoxicological Thresholds

Contaminant	Ecotox Thresholds Exceeded
BHC, alpha	LEL
DDD, p, p' (4,4')	Region IV, AET-L, LEL, MEL, TEL-C, TEL-F, PEL-C, PEL-F
DDE, p,p' (4,4')	AET-L, AET-H, LEL, MEL, ERL, ERM, TEL-C, TEL-F, PEL-C, PEL-F
DDT, p,p' (4,4')	Region IV, AET-L, AET-H, TEL-F, PEL-F
DDT, total	OSWER, Region IV, AET-L, AET-H, LEL, SEL, MEL, TOEL, ERL, ERM, TEL-C, TEL-F, PEL-F
PCB (Aroclor-1254)	LEL, SEL
PCB (Aroclor-1260)	LEL, SEL

PCB, total	OSWER, Region IV, LEL, MEL, ERL, ERM, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA

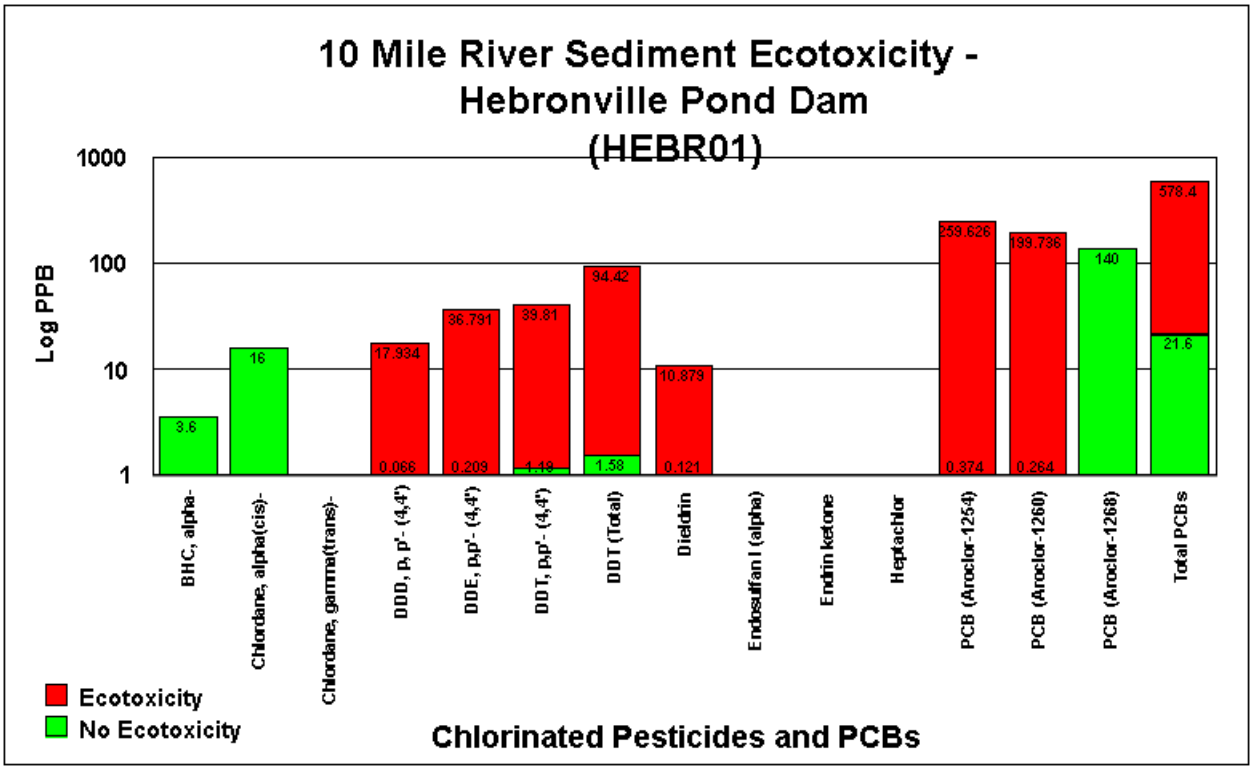


Figure 21. Sediment Ecotoxicity - Hebronville Pond Dam (HEBR01) (Chlorinated Pesticides and PCBs)

Table 20. Hebronville Pond Dam (HEBR01) Chlorinated Pesticides/PCBs exceeding Ecotoxicological Thresholds

Contaminant	Ecotox Thresholds Exceeded
DDD, p, p' (4,4')	Region IV, AET-L, LEL, MEL, TEL-C, TEL-F, PEL-C, PEL-F
DDE, p,p' (4,4')	AET-L, AET-H, LEL, MEL, ERL, ERM, TEL-C, TEL-F, PEL-C, PEL-F
DDT, p,p' (4,4')	Region IV, AET-L, AET-H, TEL-F, PEL-F
DDT, total	OSWER, Region IV, AET-L, AET-H, LEL, MEL, TOEL, ERL, ERM, TEL-C, TEL-F, PEL-F
Dieldrin	Region IV, LEL, MEL, TEL-C, TEL-F, PEL-C, PEL-F
PCB (Aroclor-1254)	LEL
PCB (Aroclor-1260)	LEL
PCB, total	OSWER, Region IV, LEL, MEL, ERL, ERM, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA

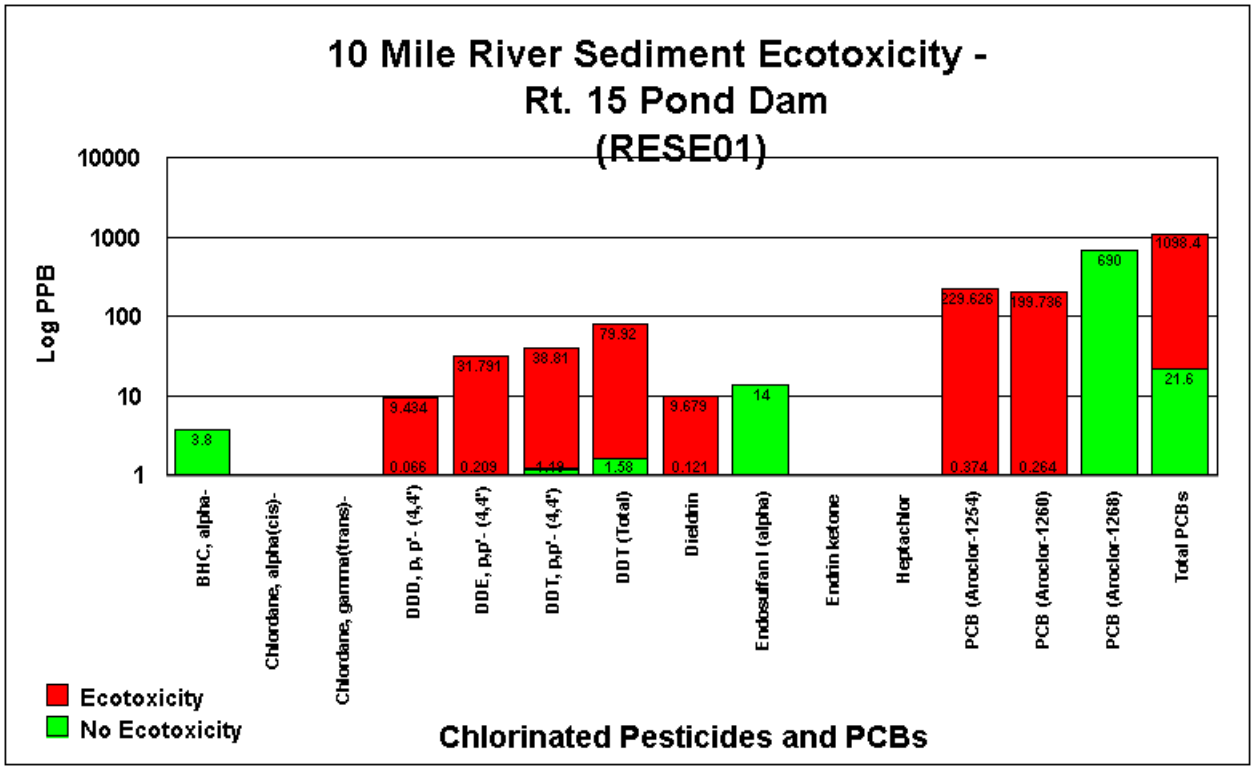


Figure 22. Sediment Ecotoxicity - Rt. 15 Pond Dam (RESE01) (Chlorinated Pesticides and PCBs)

Table 21. Rt. 15 Pond Dam (RESE01) Chlorinated Pesticides/PCBs exceeding Ecotoxicological Thresholds

Contaminant	Ecotox Thresholds Exceeded
DDD, p, p' (4,4')	Region IV, TEL-F, PEL-F
DDE, p,p' (4,4')	AET-L, AET-H, LEL, MEL, ERL, ERM, TEL-C, TEL-F, PEL-C
DDT, p,p' (4,4')	Region IV, AET-L, AET-H, TEL-F, PEL-F
DDT, total	OSWER, Region IV, AET-L, AET-H, LEL, MEL, TOEL, ERL, ERM, TEL-C, TEL-F, PEL-F
Dieldrin	Region IV, LEL, MEL, TEL-C, TEL-F, PEL-C, PEL-F
PCB (Aroclor-1254)	LEL
PCB (Aroclor-1260)	LEL
PCB, total	OSWER, Region IV, LEL, MEL, TOEL, ERL, ERM, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA

Volatile and Semi-Volatile Organic Compounds

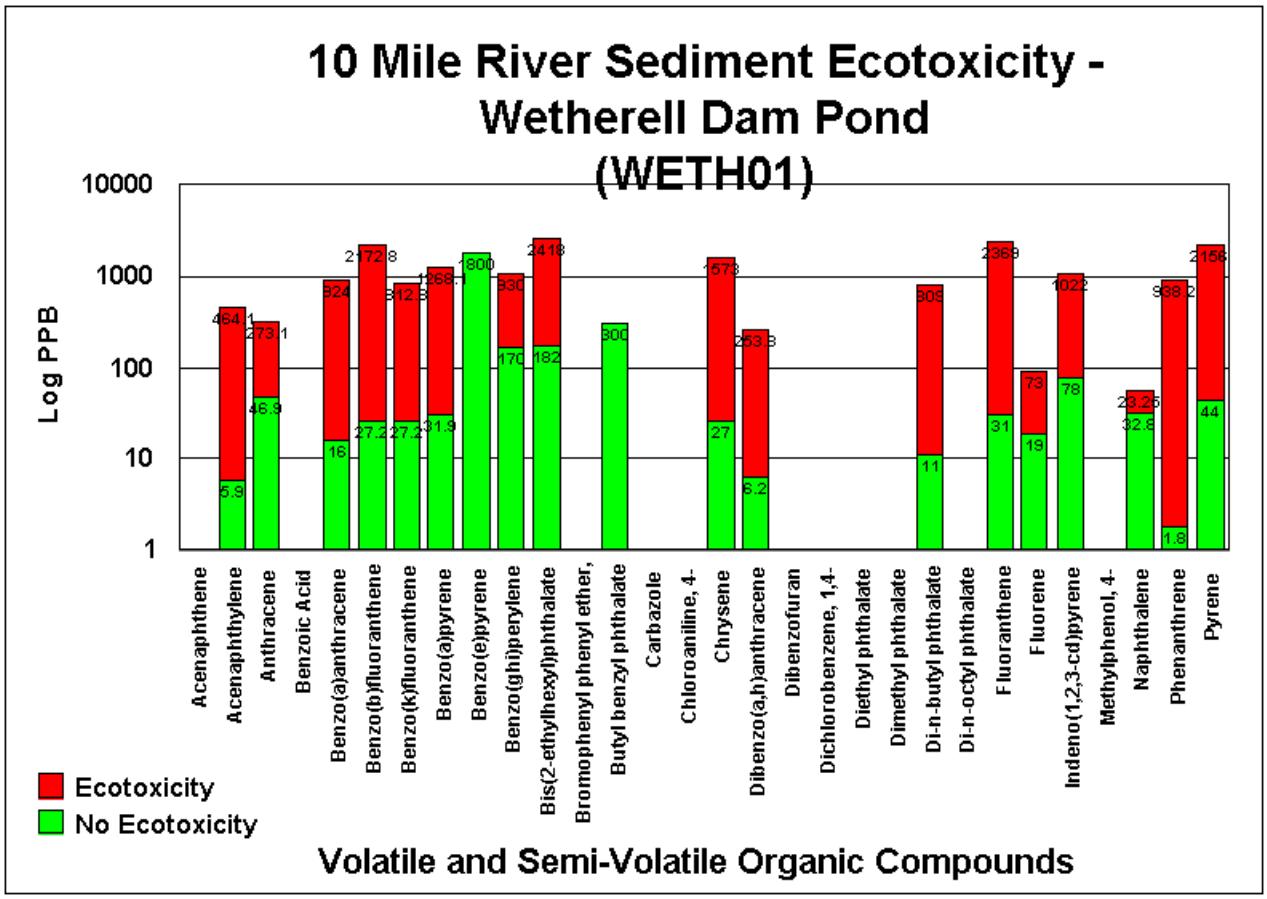


Figure 23. Sediment Ecotoxicity Wetherell Dam Pond (WETH01) - (Volatile and Semi-Volatile Organic Compounds)

Table 22. .Wetherell Dam Pond (WETH01) Volatile and Semi-Volatile Organic Compounds exceeding Ecotoxicological Thresholds

Contaminant	Ecotox Thresholds Exceeded
Acenaphthylene	Region IV, ERL, TEL-F, PEL-F
Anthracene	ORNL-SCV, LEL, ERL, TEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-HA
Benzo(a)anthracene	ORNL-SCV, Region IV, LEL, MEL, TOEL, ERL, TEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Benzo(b)fluoranthene	TEC-ARCS
Benzo(k)fluoranthene	LEL, TEC-ARCS
Benzo(a)pyrene	ORNL-SCV, OSWER, Region IV, LEL, MEL, TOEL, ERL, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA

Benzo(ghi)perylene	AET-L, LEL, TEC-ARCS
Bis(2-ethylhexyl) phthalate	Region IV, AET-L, AET-H, TEL-F
Chrysene	Region IV, LEL, MEL, TOEL, ERL, TEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Dibenzo(a,h)anthracene	AET-L, ERL, ERM, PEC-ARCS, TEL-F, PEL-F
Fluoranthene	OSWER, Region IV, LEL, MEL, TOEL, ERL, TEC-ARCS, PEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Fluorene	ERL, TEC-ARCS, TEL-F
Indeno(1,2,3-cd)pyrene	AET-L, TEC-ARCS
Naphthalene	TEC-ARCS, TEL-F
Phenanthrene	OSWER, Region IV, LEL, MEL, TOEL, ERL, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Pyrene	OSWER, Region IV, LEL, MEL, TOEL, TEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA

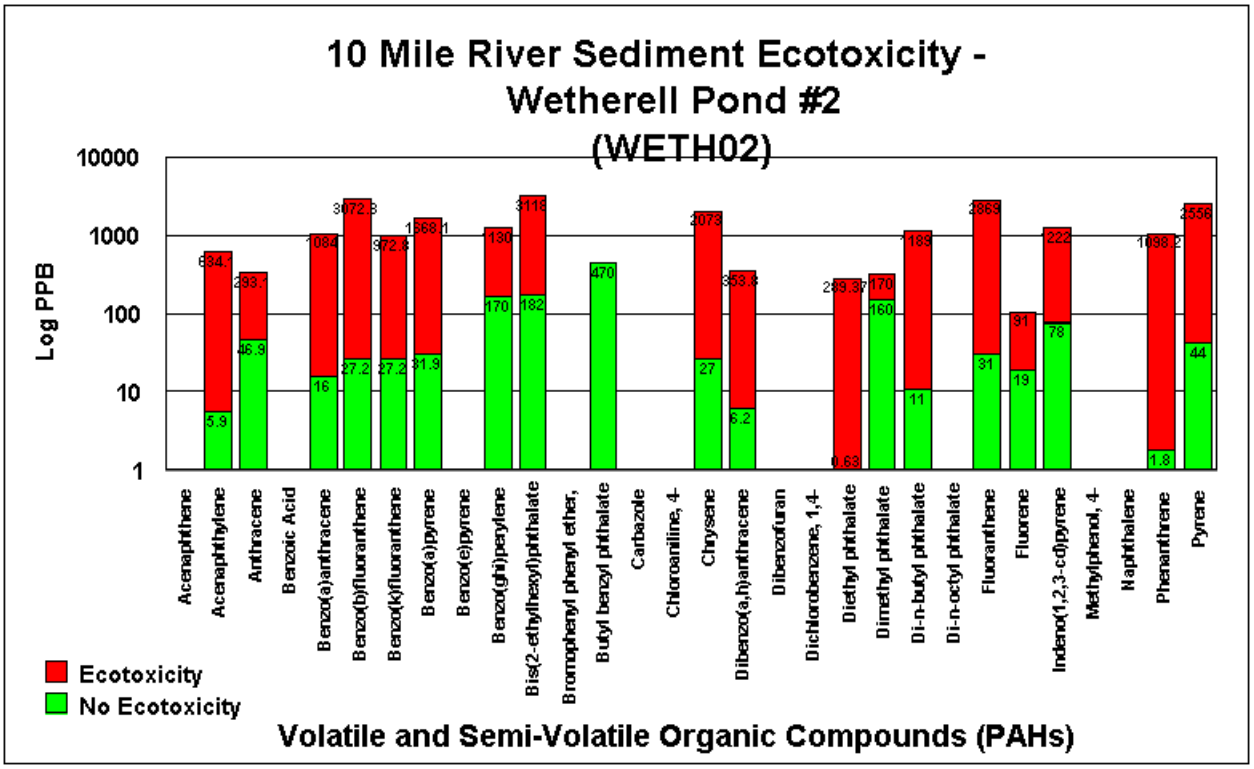


Figure 24. Sediment Ecotoxicity - Wetherell Pond #2 (WETH02) (Volatile and Semi-Volatile Organic Compounds)

Table 23. .Wetherell Pond #2 (WETH02) Volatile and Semi-Volatile Organic Compounds exceeding Ecotoxicological Thresholds

Contaminant	Ecotox Thresholds Exceeded
Acenaphthylene	Region IV, ERL, ERM, TEL-F, PEL-F
Anthracene	ORNL-SCV, Region IV, LEL, ERL, TEC-ARCS, TEL-F, PEL-F
Benzo(a)anthracene	ORNL-SCV, Region IV, LEL, MEL, TOEL, ERL, TEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Benzo(b)fluoranthene	TEC-ARCS
Benzo(k)fluoranthene	LEL, TEC-ARCS
Benzo(a)pyrene	ORNL-SCV, OSWER, Region IV, AET-L, LEL, MEL, TOEL, ERL, ERM, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Benzo(ghi)perylene	AET-L, LEL, TEC-ARCS
Bis(2-ethylhexyl) phthalate	Region IV, AET-L, AET-H, TEL-F, PEL-F

Chrysene	Region IV, AET-L, AET-H, LEL, MEL, TOEL, ERL, SQAL/SQC, TEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Dibenzo(a,h)anthracene	Region IV, LEL, TEL-C, TEL-F, TEL-HA
Diethyl phthalate	AET-L, AET-H
Dimethyl phthalate	AET-L, AET-H
Fluoranthene	OSWER, Region IV, AET-L, LEL, MEL, TOEL, ERL, TEL-ARCS, PEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Fluorene	ERL, TEC-ARCS, TEL-F
Indeno(1,2,3-cd)pyrene	AET-L, LEL, TEC-ARCS, PEC-ARCS
Phenanthrene	OSWER, Region IV, LEL, MEL, TOEL, ERL, ERM, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Pyrene	OSWER, Region IV, LEL, MEL, TOEL, ERL, ERM, TEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA

Wetherell Dam Pond (WETH01) and Wetherell Pond #2 (WETH02) samples differ as to the presence of napthalene and benzo(e)pyrene and the absence of diethyl phthalate and dimethyl phthalate in the Wetherell Dam Pond site. Otherwise these sites have very equivalent volatile and semi-volatile contaminant profiles with ecotoxicological exceedances.

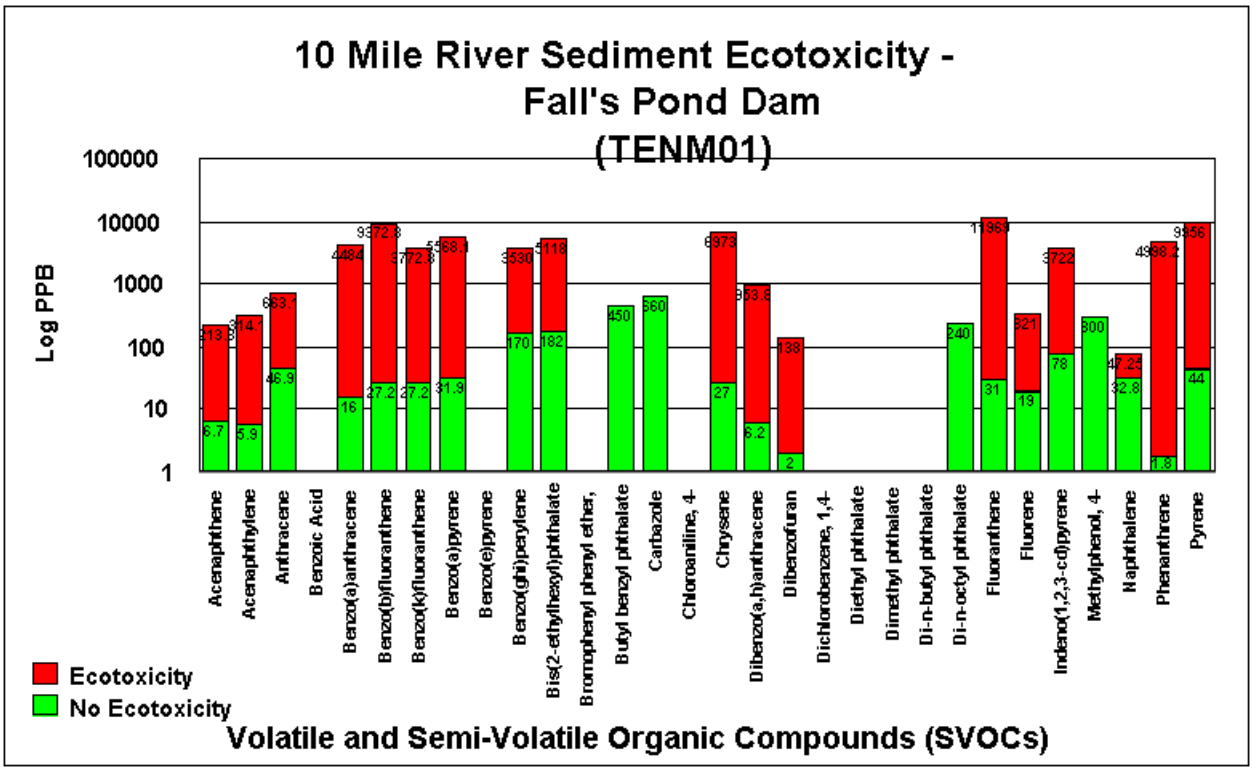


Figure 25. Sediment Ecotoxicity - Fall Pond Dam (TENM01) (Volatile and Semi-Volatile Organic Compounds)

Table 24. .Fall Pond Dam (TENM02) Volatile and Semi-Volatile Organic Compounds exceeding Ecotoxicological Thresholds

Contaminant	Ecotox Thresholds Exceeded
Acenaphthene	ERL, TEL-F, PEL-F
Acenaphthylene	ERL, TEL-F, PEL-F
Anthracene	ORNL-SCV, Region IV, LEL, ERL, TEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Benzo(a)anthracene	ORNL-SCV, Region IV, AET-L, LEL, MEL, TOEL, ERL, ERM, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Benzo(b)fluoranthene	AET-L, TEC-ARCS, NEC-ARCS
Benzo(k)fluoranthene	AET-L, TEC-ARCS
Benzo(a)pyrene	ORNL-SCV, OSWER, Region IV, AET-L, AET-H, LEL, MEL, TOEL, ERL, ERM, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Benzo(ghi)perylene	AET-L, AET-H, LEL, SEL, TEC-ARCS

Bis(2-ethylhexyl) phthalate	Region IV, AET-L, AET-H, TEL-F, PEL-F
Chrysene	Region IV, AET-L, LEL SEL, MEL, TOEL, ERL, ERM, SQAL/SQC, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Dibenzo(a,h)anthracene	Region IV, AET-L, LEL, SEL, MEL, TOEL, ERL, TEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Fluoranthene	ORNL-AWQC, OSWER, Region IV, AET-L, LEL, SEL, MEL, TOEL, ERL, ERM, SQAL/SQC, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Fluorene	Region IV, LEL, ERL, TEC-ARCS, TEL-F, PEL-F
Indeno(1,2,3-cd)pyrene	AET-L, AET-H, LEL, SEL, TEC-ARCS, PEC-ARCS, NEC-ARCS
Naphthalene	TEL-F
Phenanthrene	ORNL-AWQC, OSWER, Region IV, AET-L, LEL, MEL, TOEL, ERL, ERM, SQAL/SQC, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Pyrene	OSWER, Region IV, AET-L, LEL, SEL, MEL, TOEL, ERL, ERM, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA

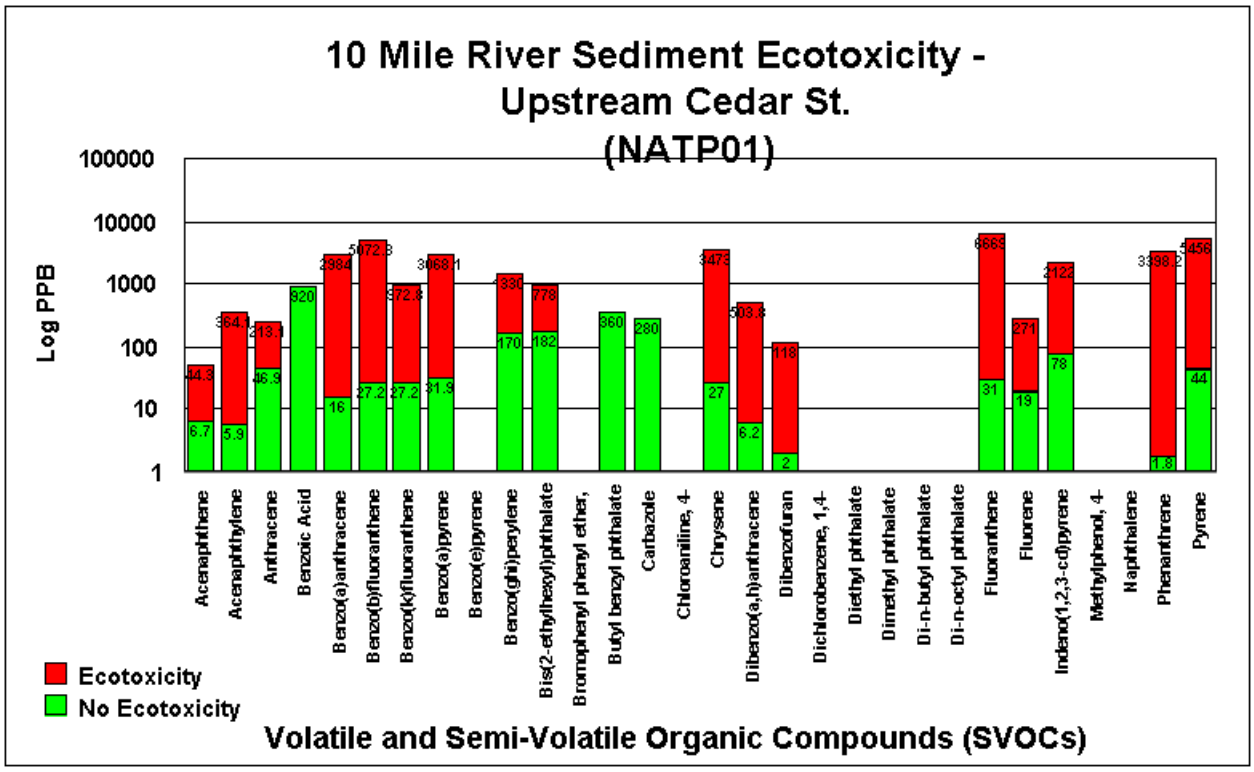


Figure 26. Sediment Ecotoxicity - Upstream Cedar St. (NATP01) (Volatile and Semi-Volatile Organic Compounds)

Table 25. .Upstream Cedar St.(NATP01) Volatile and Semi-Volatile Organic Compounds exceeding Ecotoxicological Thresholds

Contaminant	Ecotox Thresholds Exceeded
Acenaphthene	ERL, TEL-F
Acenaphthylene	Region IV, ERL, TEL-F
Anthracene	ORNL-SCV, LEL, ERL, TEC-ARCS, TEL-F, PEL-F
Benzoic Acid	AET-L, AET-H, WA St.
Benzo(a)anthracene	ORNL-SCV, Region IV, AET-L, LEL, MEL, TOEL, ERL, ERM, TEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Benzo(b)fluoranthene	AET-L, TEC-ARCS, NEC-ARCS
Benzo(k)fluoranthene	LEL, TEC-ARCS
Benzo(a)pyrene	ORNL-SCV, OSWER, Region IV, AET-L, LEL, MEL, TOEL, ERL, ERM, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA

Benzo(ghi)perylene	AET-L, LEL, TEC-ARCS
Bis(2-ethylhexyl) phthalate	Region IV, TEL-F
Chrysene	Region IV, AET-L, LEL, SEL, MEL, TOEL, ERL, ERM, SQAL/SQC, TEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Dibenzo(a,h)anthracene	Region IV, AET-L, LEL, ERL, ERM, PEC-ARCS, TEL-F, PEL-F
Fluoranthene	ORNL-AWQC, OSWER, Region IV, AET-L, LEL, MEL, TOEL, ERL, SQAL/SQC, TEC-ARCS, PEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Fluorene	ERL, TEC-ARCS, TEL-F, PEL-F
Indeno(1,2,3-cd)pyrene	AET-L, LEL, TEC-ARCS, PEC-ARCS
Phenanthrene	ORNL-AWQC, OSWER, Region IV, AET-L, LEL, MEL, TOEL, ERL, ERM, SQAL/SQC, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Pyrene	OSWER, Region IV, AET-L LEL, MEL, TOEL, ERL, ERM, TEC-ARCS, PEC-ARCS, TEL-C, TEL-F, TLE-HA,PEL-C, PEL-F, PEL-HA

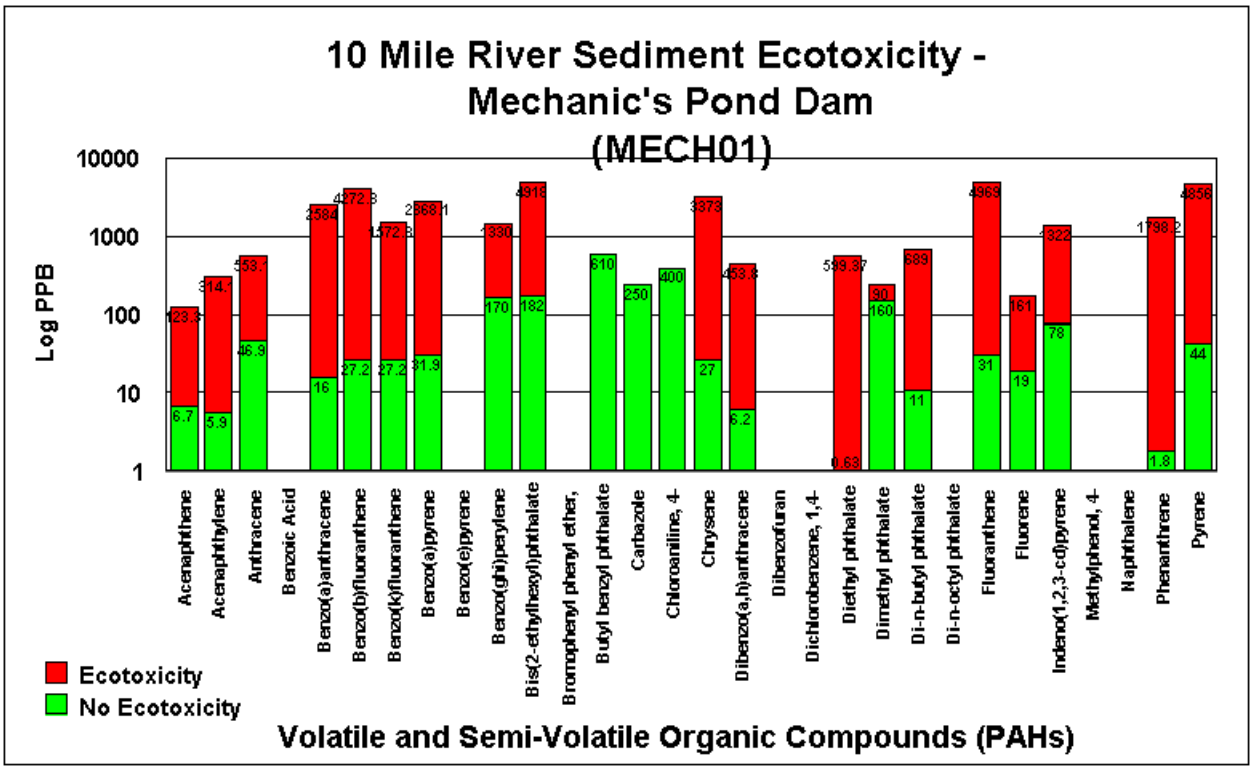


Figure 27. Sediment Ecotoxicity - Mechanic Pond Dam (MECH01) (Volatile and Semi-Volatile Organic Compounds)

Table 26. .Mechanic Pond Dam (MECH01) Volatile and Semi-Volatile Organic Compounds exceeding Ecotoxicological Thresholds

Contaminant	Ecotox Thresholds Exceeded
Acenaphthene	ERL, TEL-F, PEL-F
Acenaphthylene	ERL, TEL-F, PEL-F
Anthracene	ORNL-SCV, Region IV, LEL, ERL, TEC-ARCS, PEC-ARCS, TEL-F, PEL-F
Benzo(a)anthracene	ORNL-SCV, Region IV, AET-L, MEL, TOEL, ERL, ERM, TEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Benzo(b)fluoranthene	AET-L, TEC-ARCS, NEC-ARCS
Benzo(k)fluoranthene	LEL, TEC-ARCS
Benzo(a)pyrene	ORNL-SCV, OSWER, Region IV, AET-L, LEL, MEL, TOEL, ERL, ERM, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Benzo(ghi)perylene	AET-L, LEL, TEC-ARCS

Bis(2-ethylhexyl) phthalate	Region IV, AET-L, AET-H, TEL-F, PEL-F
Chrysene	Region IV, AET-L, LEL, MEL, TOEL, ERL, ERM, SQAL/SQC, TEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Dibenzo(a,h)anthracene	Region IV, AET-L, LEL, ERL, ERM, PEC-RCS, TEL-F, PEL-F
Diethyl phthalate	ORNL-SCV, SQAL/SQC
Dimethyl phthalate	AET-L, AET-H
Fluoranthene	OSWER, Region IV, AET-L, LEL, MEL, TOEL, ERL, TEC-ARCS, PEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Fluorene	ERL, TEC-ARCS, TEL-F, PEL-F
Indeno(1,2,3-cd)pyrene	AET-L, LEL, TEC-ARCS, PEC-ARCS
Phenanthrene	ORNL-AWQC, OSWER, Region IV, AET-L, LEL, MEL, TOEL, ERL, ERM, SQAL/SQC, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Pyrene	OSWER, Region IV, AET-L, LEL, MEL, TOEL, ERL, ERM, TEC-ARCS, PEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA

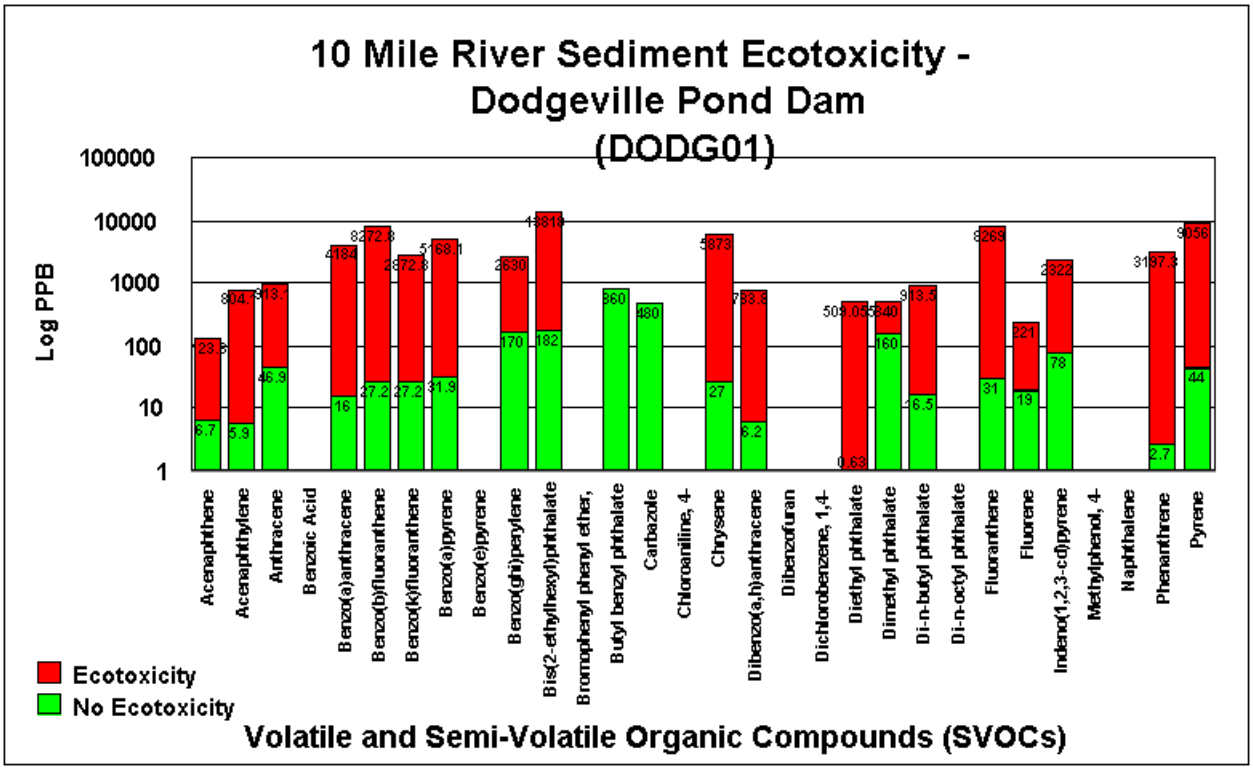


Figure 28. Sediment Ecotoxicity - Dodgeville Pond Dam (DODG01) (Volatile and Semi-Volatile Organic Compounds)

Table 27. .Dodgeville Pond Dam (DODG01) Volatile and Semi-Volatile Organic Compounds exceeding Ecotoxicological Thresholds

Contaminant	Ecotox Thresholds Exceeded
Acenaphthene	ERL, TEL-F, PEL-F
Acenaphthylene	Region IV, ERL, ERM, TEL-F, PEL-F
Anthracene	ORNL-SCV, Region IV, AET-L, LEL, ERL, PEC-ARCS, PEC-ARCS, TEL-F, PEL-F
Benzo(a)anthracene	ORNL-SCV, Region IV, AET-L, LEL, MEL, TOEL, ERL, ERM, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Benzo(b)fluoranthene	AET-L, TEC-ARCS, NEC-ARCS
Benzo(k)fluoranthene	LEL, TEC-ARCS
Benzo(a)pyrene	ORNL-SCV, OSWER, Region IV, AET-L, AET-H, LEL, MEL, TOEL, ERL, ERM, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Benzo(ghi)perylene	AET-L, AET-H, LEL, SEL, TEC-ARCS
Bis(2-ethylhexyl) phthalate	Region IV, AET-L, AET-H, TEL-F, PEL-F

Chrysene	Region IV, AET-L, AET-H, LEL, SEL, MEL, TOEL, ERL, ERM, SQAL/SQC, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Dibenzo(a,h)anthracene	Region IV, AET-L, LEL, ERL, ERM, PEC-ARCS, NEC-ARCS, TEL-F, PEL-F
Diethyl phthalate	AET-L, AET-H
Dimethyl phthalate	AET-L, AET-H
Fluoranthene	ORNL-AWQC, OSWER, Region IV, AET-L, LEL, MEL, TOEL, ERL, ERM, SQAL/SQC, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Fluorene	LEL, ERL, TEC-ARCS, PEC-ARCS, TEL-F, PEL-F
Indeno(1,2,3-cd)pyrene	AET-L, LEL, TEC-ARCS, PEC-ARCS
Phenanthrene	ORNL-AWQC, OSWER, Region IV, LEL, MEL, TOEL, ERL, ERM, SQAL/SQC, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Pyrene	OSWER, Region IV, AET-L, LEL, SEL, MEL, TOEL, ERL, ERM, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA

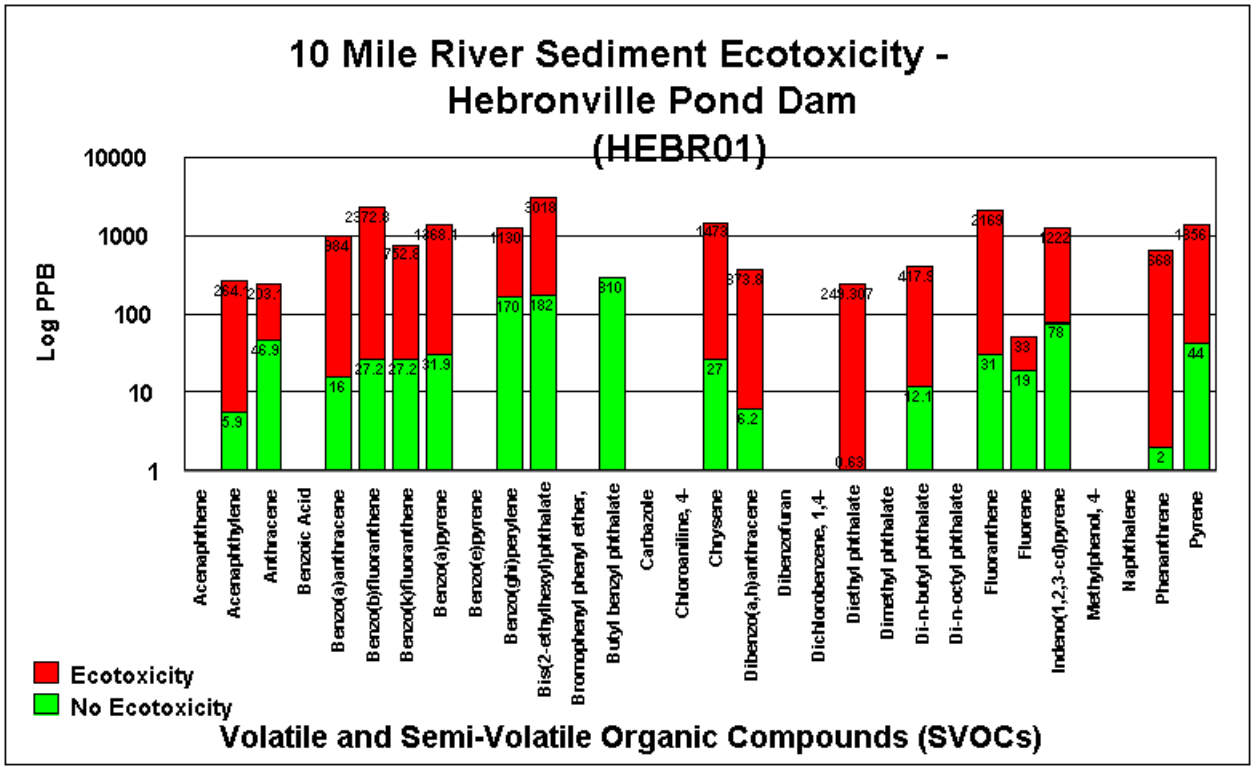


Figure 29. Sediment Ecotoxicity - Hebronville Pond Dam (HEBR01) (Volatile and Semi-Volatile Organic Compounds)

Table 28. .Hebronville Pond Dam (HEBR01) Volatile and Semi-Volatile Organic Compounds exceeding Ecotoxicological Thresholds

Contaminant	Ecotox Thresholds Exceeded
Acenaphthylene	ERL, TEL-F, PEL-F
Anthracene	ORNL-SCV, LEL, ERL, TEC-ARCS, TEL-F, PEL-F
Benzo(a)anthracene	ORNL-SCV, Region IV, LEL, MEL, TOEL, ERL, TEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Benzo(b)fluoranthene	TEC-ARCS
Benzo(k)fluoranthene	LEL, TEC-ARCS
Benzo(a)pyrene	ORNL-SCV, OSWER, Region IV, LEL, MEL, TOEL, ERL, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Benzo(ghi)perylene	AET-L, LEL, TEC-ARCS

Bis(2-ethylhexyl) phthalate	Region IV, AET-L, AET-H, TEL-F, PEL-F
Chrysene	Region IV, LEL, MEL, TOEL, ERL, SQAL/SQC, TEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Dibenzo(a,h)anthracene	Region IV, AET-L, LEL, ERL, ERM, PEC-ARCS, TEL-F, PEL-F
Diethyl phthalate	AET-L, AET-H
Fluoranthene	Region IV, LEL, MEL, TOEL, ERL, TEC-ARCS, PEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-F, PEL-HA
Fluorene	ERL, TEC-ARCS, TEL-F
Indeno(1,2,3-cd)pyrene	AET-L, LEL, TEC-ARCS
Phenanthrene	Region IV, LEL, MEL, ERL, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Pyrene	OSWER, Region IV, LEL, MEL, TOEL, ERL, TEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA

The Hebronville Pond Dam (HEBR01) site has a highly similar SVOC contaminant profile to the Wetherell Pond #2 (WETH02) site with the exception of the absence of dimethyl phthalate, which may be an analytical contaminant..

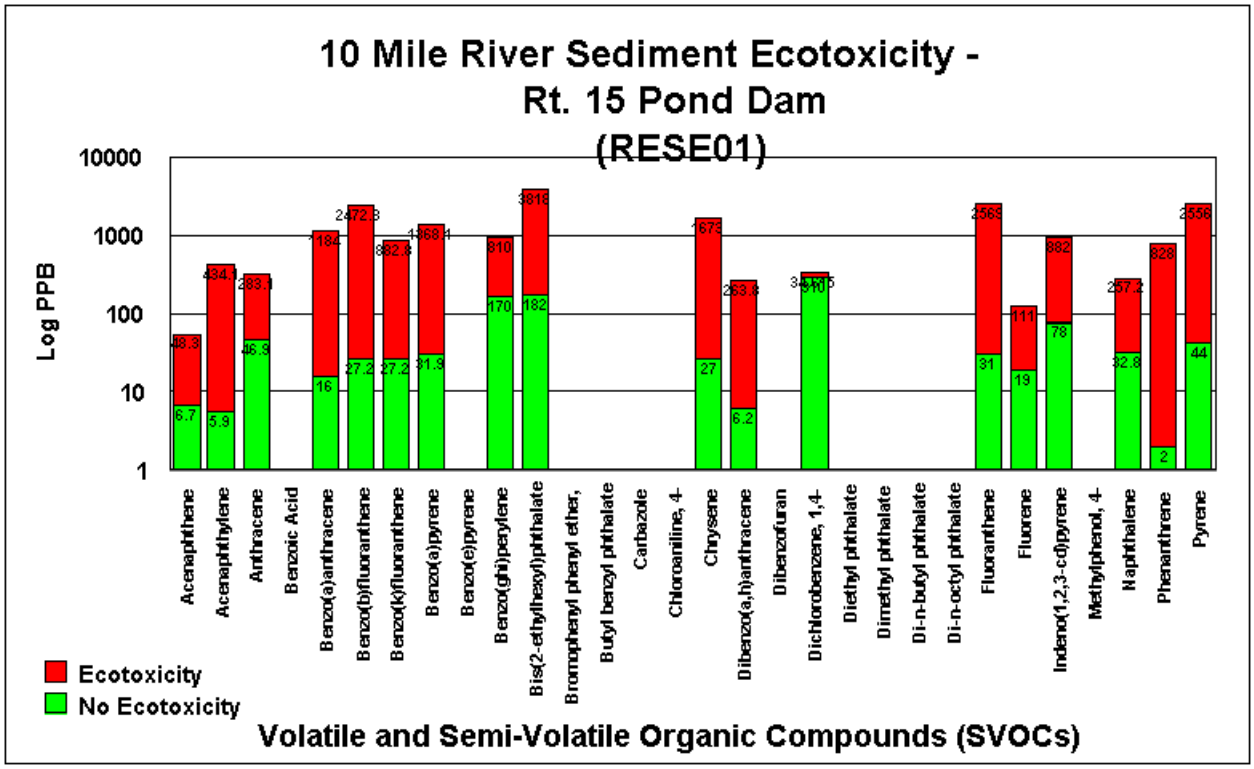


Figure 30. Sediment Ecotoxicity -Rt. 15 Pond Dam (RESE01) (Volatile and Semi-Volatile Organic Compounds)

Table 29. Rt. 15 Pond Dam (RESE01) Volatile and Semi-Volatile Organic Compounds exceeding Ecotoxicological Thresholds

Contaminant	Ecotox Thresholds Exceeded
Acenaphthene	ERL, TEL-F
Acenaphthylene	Region IV, ERL, TEL-F, PEL-F
Anthracene	ORNL-SCV, Region IV, LEL, ERL, TEC-ARCS, TEL-C, TEL-F, TLE-HA, PEL-HA
Benzo(a)anthracene	ORNL-SCV, Region IV, LEL, MEL, TOEL, ERL, TEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Benzo(b)fluoranthene	TEC-ARCS
Benzo(k)fluoranthene	LEL, TEC-ARCS
Benzo(a)pyrene	ORNL-SCV, OSWER, Region IV, LEL, MEL, TOEL, ERL, TEC-ARCS, PEC-ARCS, NEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Benzo(ghi)perylene	AET-L, LEL, TEC-ARCS

Bis(2-ethylhexyl) phthalate	Region IV, AET-L, AET-H, TEL-F, PEL-F
Chrysene	Region IV, LEL, MEL, TOEL, ERL, TEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Dibenzo(a,h)anthracene	AET-L, LEL, ERL, ERM, PEC-ARCS, TEL-F, PEL-F
Dichlorobenzene, 1,4-	AET-L, AET-H
Fluoranthene	Region IV, AET-L, LEL, MEL, TOEL, ERL, TEC-ARCS, PEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Fluorene	ERL, TEC-ARCS, TEL-F, PEL-F
Indeno(1,2,3-cd)pyrene	AET-L, LEL, TEC-ARCS, PEC-ARCS
Naphthalene	ORNL-SCV, ERL, TEC-ARCS, NEC-ARCS, TEL-F
Phenanthrene	Region IV, LEL, MEL, TOEL, ERL, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA
Pyrene	OSWER, Region IV, LEL, MEL, TOEL, ERL, ERM, TEC-ARCS, TEL-C, TEL-F, TEL-HA, PEL-C, PEL-F, PEL-HA

Dodgeville Pond Dam (DODG01) and Mechanic Pond Dam (MECH01) are highly similar sites on SVOCs in addition to other contaminants. As Map 1 shows these sites are close to one another which likely accounts for the similar contaminant histories.

Multivariate Exploratory Data Analysis

Statistical analysis of the chemical data was undertaken using the Multivariate Statistical Package (MVSP, Version 3.1, Kovach Computing Services, www.kovcomp.co.uk) which performs clustering and ordination. Results are shown in Appendix B. All data for cluster analysis was Log_{10} transformed to correct for the effects of extreme values. Cluster Analysis similarity coefficients were calculated using four algorithms (Percent Similarity, Jaccard's Similarity Coefficient, Gower General Similarity Coefficient, and Average Distance). Similarity Coefficients use mathematical means to assess the degree of similarity and difference between a set of samples.

> "Cluster analysis is an exploratory data analysis tool for solving classification problems. Its object is to sort cases (people, things, events, etc) into groups, or clusters, so that the degree of association is strong between members of the same group and weak between members of different groups. Each such cluster thus describes, in terms of the data collected, the class to which its members belong; and this description may be abstracted through use from the particular to the general class or type.
>
> Cluster analysis is thus a tool of discovery. It may reveal associations and structure in data which, though not previously evident, nevertheless are sensible and useful once found."(Clustan 1999)

The cluster analyses of the metals, VOCs/SVOCs, pesticides/PCBs and total chemistry reveal similar patterns. For metals the general order of the clusters of sites are highly similar independent of the similarity coefficient used. The Jaccard Coefficient did not yield a discrimination of the sites and was discarded from the analysis for metals.

For pesticides/PCBs the results were very similar for all four clustering algorithms. Ordination provided discrimination from nominally similar sites such as the cluster of Upstream Cedar St. (NATP01) and Wetherell Pond Dam (WETH01/02). Axis 1 of each of the three ordinations clearly distinguishes these sites from each other together with other proximal sites such as Fall Pond Dam.

These patterns are further clarified by the ordinations. Dodgeville Pond Dam (DODG01) and Mechanic Pond Dam (MECH01) are highly similar sites in all three ordinations.

The patterns observed in all four SVOC cluster analyses were also very similar and were further elucidated by the ordinations.

For total chemistry similar clusters of sites were observed, although specific sites changed position, as for the other parameters, depending on the similarity coefficient used in the analysis. Similar patterns were observable in the ordination graphs, for example, the close association of Hebronville Pond Dam (HEBR01) and Rt. 15 Pond Dam (RESE01) in three of the clusterings

and in the Correspondence Analysis. The other two ordinations and the other cluster analysis differentiated the Rt. 15 Pond Dam site from the Hebronville Pond Dam site.

Ordination was also performed on these data sets using three algorithms in the MVSP 3.1 program (Principal Components, Principal Coordinates and Correspondence Analysis).

Ordination Techniques

Ordination may be defined as, "[T]he ordering of a set of data points with respect to one or more axes. Alternatively, the displaying of a swarm of data points in a two or three-dimensional coordinate frame so as to make the relationships among the points in many-dimensional space visible on inspection" (Pielou 1984). "Ordination primarily endeavors to represent sample and species relationships as faithfully as possible in a low-dimensional space" (Gauch 1982).

Principal Components and Detrended Correspondence Analysis

The axes in Principal Components Analysis are uncorrelated with (orthogonal to) one another and have the characteristic of explaining more of the data variance than subsequent axes (Helsel and Hirsch 1993). "The resulting *p* axes are thus new 'variables', the first few of which often explain the major patterns of the data in multivariate space. The remaining principal components may be treated as residuals, measuring the 'lack of fit' of observations along the first few axes" (Helsel and Hirsch 1993:59). The percentage of data variance explained by successive axes in all three ordinations are given in the attached quantitative ordination output tables.

Palmer (1998) observes that, "[A]lthough PCA is often useful for the analysis of samples in species space, it is still quite appropriate for the analysis of samples in environmental space. This is because it is likely for most environmental variables to be monotonically related to underlying factors, and to each other. Also, PCA allows the use of variables which are not measured in the same units (e.g. elevation, concentration of nutrients, temperature, pH, etc.)."

Kovach (1999) provides background information on PCA:

> "Principal components analysis (PCA) is one of the best known and earliest ordination methods, first described by Karl Pearson (1901). Mathematically, PCA consists of an eigenanalysis of a covariance or correlation matrix calculated on the original measurement data. Graphically, it can be described as a rotation of a swarm of data points in multidimensional space so that the longest axis (the axis with the greatest variance) is the first PCA axis, the second longest axis perpendicular to the first is the second PCA axis, and so forth. Thus these first few PCA axes represent the greatest amount of variation in the data set and hopefully contain some patterns of significance.
>
> "When a PCA is calculated, first the covariance or correlation matrix is calculated for the variables. The correlation matrix is used if standardization is desired; this

is useful if the variables have been measured on different scales or are of different orders of magnitude. Otherwise the covariance matrix should be used. An eigenanalysis is then performed on the matrix.

"There are several sets of results. First the eigenvalues are given. In PCA these equal the variance accounted for by each PCA axis. The eigenvalue for the first axis will be the largest, the second the second largest, and so on. The percentage of the total variance of each axis will also be calculated. Hopefully the first two or three axes will account for a large proportion of the variance, say 50-60% or more. In some cases the first axis might account for over 90-95% of the variance. In all but the most simple data sets this result should be looked at with skepticism. This may occur, for instance, when a few variables have very large values that are one or two orders of magnitude greater than the others. The analysis will be dominated by these few large variables. In these situations you may want to consider using a correlation matrix instead or transforming the data to logs or square roots.

"Also provided will be the eigenvectors for each PCA axis. Each eigenvector is composed of values called the component loadings for that axis. Each variable in the original data matrix has a component loading associated with it in the eigenvector. These loadings may be considered a measure of the relative importance of each variable in the extracted PCA axis The sign of the value indicates which end of the axis the variable is associated with. If, for example, variables A, C, and F have high positive loadings on the first PCA axis and variable H has a high negative loading, this means that the largest proportion of the variance in the data can be accounted for by the trends in these four variables. The different signs indicate that variable H has high values in a certain set of cases whereas A, C, and F have high values in a completely different set of cases.

The third set of results is a matrix of component scores. Again, one set of scores is provided for each PCA axis and each score corresponds to one case. These are computed by simply multiplying the component loadings by the original data. The resulting scores may be plotted on a scatterplot so that the first two PCA axes, for example, may be plotted against each other and the individual points would indicate the cases. In the example above, those cases that have high values of variables A, C, and F would be plotted at the positive end of the first axis, whereas those with variable H would be at the negative end" (Kovach 1999).

However, Palmer (1998) notes at http://www.okstate.edu/artsci/botany/ordinate/PCA.htm one of the central problems with PCA is that, "PCA produces an artifact known as the Horseshoe Effect (similar to the Arch Effect), in which the second axis is curved and twisted relative to the first, and does not represent a true secondary gradient."

Kovach (1999) similarly notes,

"CA is also susceptible to two faults that are common to many ordination methods. The first and most prominent is what is called the arch effect or alternatively the horseshoe effect. With this effect, the points are arranged in an arched pattern along the first two axes, rather than a linear pattern as would be expected....This arch is a result of the data reduction process and represents a mathematical relationship between the first two axes, which are supposed to be independent. The effect is particularly pronounced when a long environmental gradient has been sampled, so that cases from one end are mostly or completely different from those at the other.

The second fault, which is a result of the first, is the compression of data points at the ends of the axes. Pairs of cases that are equally dissimilar will appear closer together at the ends of the axes than in the middle, thus misrepresenting the distance between these pairs. Both of these faults can be corrected with detrended correspondence analysis (DCA).

DCA corrects the arch effect in the following manner: After the first two axes are extracted with the reciprocal averaging technique the first axis is divided into several segments. The scores on the second axis for each point are then adjusted so that the mean score of the points within each segment is the same as that in other segments. This is like cutting the scatterplot into a number of vertical strips and moving each up and down until the points are in a straight line. The scores are then adjusted along the first axis so that they are more evenly spaced.

This method can often give more interpretable results, but it can also introduce distortion or instability of its own. The method can be viewed as using a hammer to smooth out distortions in a sheet of metal. It may work but it may also remove some embossed patterns that were supposed to be there. Therefore it is always a good idea to try both regular and detrended correspondence analysis on a data set and compare the results."

Discussion and Recommendations

This study has estimated, at a survey level, the spatial distribution and magnitude of anthropogenic contamination in the Ten Mile River watershed sediments for inorganic chemicals (primarily metals), chlorinated pesticides and polychlorinated biphenyls, and volatile and semi-volatile organic compounds. All sites demonstrated heavy contamination of complex mixtures of these contaminants. Given the history of this river during and subsequent to the Industrial Revolution in New England, including jewelry, tannery, and electroplating works, such remnant contamination is not unexpected. Should any remediation of this river, such as dredging be proposed, further study would be warranted.

These results were then screened using a new tool recently developed at OEME, the Sediment Ecotoxicological Screening Benchmark (SESB) tables (Appendices D and E). These SESB tables screen inorganics (primarily metals), chlorinated pesticides and polychlorinated biphenyls and volatile and semi-volatile organic hydrocarbons (SVOCs) relative to ecotoxicological screening benchmark values derived from the published scientific and technical literature. These results are depicted in Figures 7-30 and Tables 6-29 and summarized in Appendix D and Tables 30-32. Contamination of potential ecotoxicological concern was observed at all sample locations.

An exploratory multivariate data analysis including clustering and ordination techniques was undertaken of the chemistry data sets. Graphical and numerical results are shown in Appendix B. These depict similarity and dissimilarity between sample sites based on observed contaminants. Clearly spatial contiguity and exposure history are related although not entirely predictive.

Biological tests of these sediment samples were undertaken in which two freshwater invertebrate species (chironomids and amphipods) were exposed under controlled laboratory conditions for a 10 day period. The amphipod test failed to meet test acceptability criteria with excessive mortality in the control animals. Thus these results could not be statistically analyzed and interpreted further. However, the chironomid test observed significant impairment of survival in three test site replicates: Dodgeville Pond Dam (DODG01), Rt. 15 Pond Dam (RESE01) and Wetherell Pond Dam (WETH01/02). No significant impairment in the growth endpoint was observed. However, one site, Hebronville Pond Dam (HEBR01), displayed significantly enhanced growth relative to the control. The implications of this are unclear. Moreover, the potential for adverse effects from these sediments could be underestimated since, for example, tests did not measure subchronic effects, such as reproduction and emergence. Longer term (45-60 day exposure) tests might identify sub-chronic effects.

The chemical and physical characterization of river bed sediments is of interest as sediment quality is often a good indicator of aquatic system “health”. Persistent contaminants associated with past and present cultural and natural influences enter aquatic systems and may be adsorbed onto or absorbed into sediments. These contaminated sediments may pose an ecotoxicological and human health risk if their contaminants are able to enter the aquatic food chain, or if people or organisms are otherwise exposed to them.

The 2000-2001 Edition of the Massachusetts Natural Heritage Atlas (MANHESP 2000) identifies estimated habitats of rare wildlife and priority habitats of rare plant and animal species. The Attleboro 7 ½ x 7 ½ minute USGS quadrangle maps cover the area of this study. These quad maps identify estimated and priority habitat proximal to or overlaying the study sites and the Ten Mile watershed. These would be the ecological receptors of greatest concern and requiring the highest level of conservation concern and management in this landscape.

Table 30. The Number of Ecotoxicological Thresholds Exceeded by Site for Inorganic Chemicals (Metals)

Inorganic Chemicals (Metals) Detected	**Number of Ecotoxicological Thresholds Exceeded by Site**							
	Wetherell Pond Dam #1 (WETH01)	**Wetherell Pond Dam #2 (WETH02)**	**Fall Pond Dam (TENM01)**	**Upstream Cedar St. (NATP01)**	**Mechanic Pond Dam (MECH01)**	**Dodgeville Pond Dam (DODG01)**	**Hebronville Pond Dam (HEBR01)**	**Rt. 15 Pond Dam (RESE01)**
Aluminum (Al)								
Antimony (Sb)								
Arsenic (As), Total	11	7	11	12	11	12	12	14
Barium (Ba)								
Beryllium (Be)								
Calcium (Ca)								
Cadmium (Cd)	14	13	13	10	18	19	19	19
Chromium (Cr), Total	19	19	12	7	19	19	19	19
Cobalt (Co)								
Copper (Cu)	19	19	18	17	19	19	19	19
Cyanide (Cn), Total								
Gold (Au)								
Iron (Fe)		1	1	1	1	1	1	1
Lead (Pb)	17	19	18	13	16	19	16	16
Manganese (Mn)								
Magnesium (Mg)				5	4	2	5	5
Mercury (Hg), Total	14	14	14	14	14	14	14	14
Nickel (Ni)	17	17	17	17	17	17	17	17
Selenium (Se)								
Silver (Ag)	7	7	7	7	7	7	7	7
Thallium (Tl)								

Vanadium (V)								
Zinc (Zn)	17	17	14	9	16	19	17	18

Table 31. The Number of Ecotoxicological Thresholds Exceeded by Site for Chlorinated Pesticides and Polychlorinated Biphenyls

Chlorinated Pesticides and Polychlorinated Biphenyls Detected	**Number of Ecotoxicological Thresholds Exceeded by Site**							
	Wetherell Pond Dam #1 (WETH01)	**Wetherell Pond Dam #2 (WETH02)**	**Fall Pond Dam (TENM01)**	**Upstream Cedar St. (NATP01)**	**Mechanic Pond Dam (MECH01)**	**Dodgeville Pond Dam (DODG01)**	**Hebronville Pond Dam (HEBR01)**	**Rt. 15 Pond Dam (RESE01)**
BHC, alpha-		1	1			1		
Chlordane, alpha(cis)-								
Chlordane, gamma(trans)-								
DDD, p, p'- (4,4')	8	11	11	6	8	8	8	3
DDE, p,p'- (4,4')	9	11	11	8	11	10	10	9
DDT, p,p'- (4,4')	3	10	5	3	5	5	5	5
DDT (Total)	10	13	13	9	14	13	12	12
Dieldrin	6			7	7		7	7
Endosulfan I (alpha)								
Endrin ketone								
Heptachlor								
PCB (Aroclor-1254)	1	1	1	1	1	2	1	1
PCB (Aroclor-1260)	1	1	1	1	2	2	1	1
PCB (Aroclor-1268)								
Total PCBs	8	14	10	8	15	15	15	16

Table 32. The Number of Ecotoxicological Thresholds Exceeded by Site for Volatile and Semi-Volatile Organic Compounds

Volatile and Semi-Volatile Organic Compounds Detected	Number of Ecotoxicological Thresholds Exceeded by Site							
	Wetherell Pond Dam #1 (WETH01)	Wetherell Pond Dam #2 (WETH02)	Fall Pond Dam (TENM01)	Upstream Cedar St. (NATP01)	Mechanic Pond Dam (MECH01)	Dodgeville Pond Dam (DODG01)	Hebronville Pond Dam (HEBR01)	Rt. 15 Pond Dam (RESE01)
Acenaphthene			3	2	3	3		2
Acenaphthylene	4	5	3	3	3	5	3	4
Anthracene	8	7	11	6	8	9	6	9
Benzoic Acid				3				
Benzo(a)anthracene	13	13	17	16	14	17	13	13
Benzo(b)fluoranthene	1	1	3	3	3	3	1	1
Benzo(k)fluoranthene	2	2	2	2	2	2	2	2
Benzo(a)pyrene	16	18	19	18	18	19	16	16
Benzo(e)pyrene								
Benzo(ghi)perylene	3	3	5	3	3	5	3	3
Bis(2-ethylhexyl)phthalate	4	5	5	2	5	5	5	5
Butyl benzyl phthalate								
Carbazole								
Chloroaniline, 4-								
Chrysene	12	15	18	16	15	19	13	12
Dibenzo(a,h)anthracene	6	5	14	8	8	9	8	7
Dibenzofuran								
Dichlorobenzene, 1,4-								2
Diethyl phthalate		2			2	2	2	
Dimethyl phthalate		2			2	2		
Di-n-butyl phthalate								
Di-n-octyl phthalate								
Fluoranthene	14	15	20	17	15	19	12	14
Fluorene	3	3	6	4	4	6	3	4
Indeno(1,2,3-cd)pyrene	2	4	7	4	4	4	3	4
Methylphenol, 4-								
Naphthalene	2		1					5

Acenaphthene			3	2	3	3		2
Acenaphthylene	4	5	3	3	3	5	3	4
Anthracene	8	7	11	6	8	9	6	9
Benzoic Acid				3				
Benzo(a)anthracene	13	13	17	16	14	17	13	13
Benzo(b)fluoranthene	1	1	3	3	3	3	1	1
Benzo(k)fluoranthene	2	2	2	2	2	2	2	2
Phenanthrene	12	13	16	16	16	15	10	11
Pyrene	12	14	18	16	16	18	13	14

References

Report References

Hellyer, G.M. and G.E. Balog. Submitted. Derivation, Application, Strengths and Limitations of Sediment Ecotoxicological Screening Benchmarks (ESBs), Submitted to Journal of Hazardous Materials, May, 2000.

MANHESP. 2000. Massachusetts Natural Heritage Atlas 2000-2001 Edition, MA Natural Heritage and Endangered Species Program, Westborough, MA.

Rand, G.M. (Ed.). 1995. Fundamentals of Aquatic Toxicology, 2nd Edition, Taylor and Francis, Washington, D.C.

U.S.EPA. 1994. Methods For Measuring The Toxicity and Bioaccumulation Of Sediment-Associated Contaminants With Freshwater Invertebrates, EPA/600/R-94/024, June 1994, United States Environmental Protection Agency, Office Of Research and Development, Washington, D.C.

Analytical Chemistry References:

“Standard Operating Procedures for the Extraction and Analysis of Base/Neutral and Acid Extractables in Solid Samples Using Sonication and GC/MS Analysis”, BNA in Soil (CLP) SOP, 10/04/1999, U.S. EPA, Region I, Lexington, MA.

“Standard Operating Procedures for the Extraction and Analysis of Polynuclear Aromatic Hydrocarbons (PAH) in Solid Samples Using SIM-GC/MS Analysis”, PAH in Soil (SIM) SOP, 10/1998, U.S. EPA, Region I, Lexington, MA.

“Determination of Acid Volatile Sulfide and Simultaneously Extracted Metals in Sediments", AVS/SEM 97, Jan., 1997, Rev. 1 U.S. EPA, Region I, Lexington, MA 02173.

ICP Method 200.7 - "Methods for the Determination of Metals in Environmental Samples, Supplement I (EPA/600/R-94/111), May, 1994."

ICP Method 200.7 CLP-M - "The U.S. EPA Contract Laboratory Program, Statement of Work for Inorganics Analysis, Doc. #ILM04.0, EPA/540/R95/121." (Sample Prep. SOP, 10/92 and ICP SOP, Rev. #2, 8/96)

Mercury Method 245.1, Rev. 3.0 - "Methods for the Determination of Metals in Environmental Samples, Supplement I (EPA/600/R-94/111), May, 1994."

Method 245.5, " Methods for Chemical Analysis of Water and Wastes, U.S. EPA, Cinn., OH., EPA-600/4-79-020, March, 1979, Revised March, 1983."

Method 245.1, Rev. 3.0 - " Methods for the Determination of Metals in Environmental Samples, Supplement I", May 1994.

Statistical References

Clustan. 1999. Clustan Website (http://www.clustan.com/WhatIsClusterAnalysis.htm)

Gauch, H. G., Jr. 1982. Multivariate Analysis in Community Structure. Cambridge University Press, Cambridge.

Gulley, D.D., A.M. Boelter, and H.L. Bergman. N.D. TOXSTAT Version 3.0, University of Wyoming.

Helsel, D.R. and R.M. Hirsch. 1993. Statistical Methods in Water Resources, Elsevier, Amsterdam, The Netherlands.

Kovach, W. 1999. MVSP (Multi-Variate Statistical Package), Version 3.1 for Windows 95, Kovach Computing Services, Anglesey, Wales (http://www.kovcomp.co.uk/mvsp/mvspwbro.html)

Palmer, M. 1998. The Ordination Web Page (http://www.okstate.edu/artsci/botany/ordinate/), Botany Department, Oklahoma State University.

Pielou, E. C. 1984. The Interpretation of Ecological Data: A Primer on Classification and Ordination. Wiley, New York.

Zar, J.H. 1974. Biostatistical Analysis, Prentice-Hall, Inc., Englewood Cliffs, N.J.

APPENDICES

Appendix A: Chemistry Analytical Results

INORGANIC CHEMICALS - METALS

MEMORANDUM **PN: 98177**

DATE: May 5, 1998

SUBJ: **Ten Mile River - Total Metals Results**

FROM: **Michael Dowling, Dan Curran**
Chemists

TO: **Greg Hellyer**
OEME

THRU: **Dr. William J. Andrade**
Senior Analytical Chemistry Specialist

Analytical Reference:

ICP Method 200.7 CLP-M - "The U.S. EPA Contract Laboratory Program, Statement of Work for Inorganics Analysis, Doc. #ILM04.0, EPA/540/R95/121." (Sample Prep. SOP, 10/92 and ICP SOP, Rev. #2, 8/96)

Date Samples Received by Laboratory: 3/26/98

Sample Analysis Starting Date: 3/31/98

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
TOTAL METALS

File name: 98177SO.ICP

Results (mg/kg, dry wt.)

Parameter	07697 (ave.)	07698	07699	07700	07701
Ag	669	39.2	16.8	95.6	568
Al*	1.3	1.4	0.97	1.6	2.4
As	20.0U	25.0U	15.0U	30.0U	35.0U
Au	71.0U	62.4U	40.8U	52.6U	83.4U
Ba	328	152	129	402	703
Be	3.6U	3.1U	2.0U	2.6U	4.2U
Ca	4860	4650	2920	6820	7600
Cd	8.7	5.0	3.1U	26.3	122
Co	15.3	15.3	14.9	22.3	44.3
Cr	1840	118	69.3	1170	1400
Cu	4700	462	334	1450	4950
Fe*	1.8	2.7	2.2	3.2	3.5
Mg	1960	3900	2080	3220	4200
Mn	324	715	3020	1520	838
Ni	450	89.0	92.0	292	1490
Pb	449	451	173	387	838
Sb	18UJ	16UJ	10UJ	13UJ	21UJ
Se	35.5U	31.2U	20.4U	26.3U	20.8U
Tl	35.5U	31.2U	20.4U	26.3U	20.8U
V	17.6	43.3	23.8	35.0	59.6
Zn	820	527	211	675	1610

***Note: Al and Fe results are expressed in %, where 1% = 10,000 ppm.**

U = not detected above the reporting limit

J = approximate

Results (mg/kg, dry wt.)

Parameter	07702	07703	07704
Ag	136	82.6	902
Al*	1.7	1.3	1.6
As	35.0U	41.1	10.0U
Au	71.4U	46.6U	111U

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
TOTAL METALS

Ba	392	218	533
Be	3.6U	2.3U	5.6U
Ca	6960	5160	6320
Cd	46.6	77.2	9.2
Co	57.0	45.2	25.2
Cr	783	704	3610
Cu	1960	2590	6200
Fe*	3.4	3.6	2.8
Mg	3530	2290	2680
Mn	1790	508	425
Ni	988	1660	747
Pb	386	341	714
Sb	18UJ	12UJ	28UJ
Se	35.7U	23.3U	55.6U
Tl	35.7U	23.3U	55.6U
V	45.2	25.2	18.3
Zn	959	1560	1170

*** Note: Al and Fe results are expressed in %, where 1% = 10,000 ppm.**

U = not detected above the reporting limit

J = approximate

Matrix Spike Results

Sample 07697

Parameter	Accuracy Ave. % Recovery
Ag	**
As	92
Au	94 (sample 07704)
Ba	96
Be	106
Cd	130
Co	94
Cr	**
Cu	**
Mn	89
Ni	91
Pb	92

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
TOTAL METALS

Sb	45
Se	96
Tl	92
V	91
Zn	85

No spike required for Al, Ca, Fe and Mg.

**** = no recovery could be calculated since the analyte concentration in the sample is > 4 times the spike level.**

Laboratory Duplicate Results

	Sample 07697
Parameter	**Precision RPD**
Ag	1.2
Al	9.8
As	***
Au	***
Ba	2.7
Be	***
Ca	5.1
Cd	1.0
Co	6.5
Cr	0.54
Cu	1.1
Fe	4.3
Mg	6.7
Mn	6.5
Ni	6.0
Pb	1.8
Sb	***
Se	***
Tl	***
V	12
Zn	3.6

***** = non detect**

Aqueous Laboratory Fortified Blank and Solid Laboratory Control Sample Results

% Recovery

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
TOTAL METALS

Parameter	LFB	LCS
Ag	73	107
Al	N/A	104
As	95	118
Ba	98	116
Be	102	102
Cd	131	123
Co	98	103
Cr	98	100
Cu	94	109
Fe	N/A	98
Mg	N/A	101
Mn	93	98
Ni	98	105
Pb	92	99
Sb	92	115
Se	95	116
Tl	96	151
V	94	97
Zn	92	103

Data Quality Statements

Chemists who reviewed data:	Mike Dowling, Scott Clifford
Method modifications:	The volume of hydrochloric acid used in the digestion was doubled.
Limitations of data:	Sb results are approximated due to the low MS recovery.
Comments:	The Ag and Cd LFB recoveries are outside the ± 20% criteria; however, the LCS and MS/MSD recoveries are acceptable. The Tl LCS recovery is high; however, the LFB and MS/MSD recoveries are acceptable.
Instrument performance:	Excellent
Matrix spike recovery problems:	Sb
Unusual visual characteristics:	None

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
TOTAL METALS

Chain of custody abnormalities: None

PN:98177

MEMORANDUM

DATE: April 21, 1998

SUBJ: **Ten Mile River - Total Hg Results**

FROM: Janet Paquin and H.D. Curran
Chemists

TO: G. Hellyer

THRU: Dr. William J. Andrade
Advanced Analytical Chemistry Expert

Analytical Procedure: Method 245.5, " Methods for Chemical Analysis of Water and Wastes, U.S. EPA, Cinn., OH., EPA-600/4-79-20, March, 1979, Revised March, 1983."

Samples Received by Laboratory: 03/26/98

Samples Analyzed by Laboratory: 04/07/98 and 04/15/98

File Name: 98177SO.HG
Results:

Sample	Mercury ug/gm (ppm) *
07697	166
07698	3.9
07699	6.3
07700	20.4
07701	38.9
07702	24.7
07703	13.2
07704	112

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
TOTAL METALS

*** Results on a dry weight basis**

Quality Control:

Quality Control Sample

ICV (04/07/98)	106% Recovery
ICV (04/15/98)	102% Recovery

Lab Fortified Blank

LFB (04/07/98)	89% Recovery
LFB (04/15/98)	106% Recovery

Matrix Spikes

07702spk	**
07704spk	**

Laboratory Control Sample (sediment)

PACS-1 (04/07/98)	111% Recovery
PACS-1 (04/15/98)	91% Recovery

** No spike recovery reported since concentration in sample was greater than four times the spike level.

Data Quality Statements

Chemist that reviewed data: **Mike Dowling**

Method modifications and why: **Analysis performed on an automated cold vapor atomic absorption spectrometry system, equivalent to manual technique. Some reagent volumes were reduced in order to reduce waste volumes.**

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
TOTAL METALS

Limitations of Data: **None.**
List of method contaminants: **None**

Instrument Performance: **Good**

Spike recovery problems: **None**

Comments:
Unusual visual characteristics of the samples: **None**
Chain of custody abnormalities:**None**

PN:98177

MEMORANDUM

DATE: April 7, 1998

SUBJ: **Ten Mile River - Cyanide Results**

FROM: Janet Paquin
Chemist

TO: G. Hellyer

THRU: Dr. William J. Andrade
Advanced Analytical Chemistry Expert

Analytical Procedure: Method 335.2 C.L.P.-M, Method for Total Cyanide Analysis by Midi Distillation, " USEPA Contract Laboratory Program, Statement of Work for Inorganic Analysis, Multi-media Multi Concentration, ILMO 4.0, EPA/540/R95/121".

Samples Received by Laboratory: 03/26/98

Samples Analyzed by Laboratory: 03/31/98

File Name: 98177SO.CN

Results:

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
TOTAL METALS

Sample#	**Total Cyanide (ug/gm)***
07697	3.6U
07698	4.8
07699 (ave.)	2.6U
07700	4.0
07701	15.0
07702	5.7
07703	2.8U
07704	4.2U

*** Soil results based on dry weight**

U = None detected above the associated reporting limit

Quality Control:

Quality Control Samples

ICV-6	93% Recovery
0996 LCS	109% Recovery

Laboratory Fortified Blank

LFB (low)	96% Recovery
LFB (high)	102% Recovery

Laboratory Duplicates

Sample 07699	Sample 07699 Dup.	Average	RPD
3.2U ug/gm	2.1U ug/gm	2.6U ug/gm	**

** = Non detect

Laboratory Fortified Matrix

	Sample	% Spike Recovery
	07699	84%

Data Quality Statements

Chemist that reviewed data: Mike Dowling

Method modifications and why: None

Limitations of Data: None

List of method contaminants: None

Instrument Performance: Good

Spike recovery problems: None

Comments: None

Unusual visual characteristics of the samples: None

Chain of custody abnormalities: None

Total Organic Carbon

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION I
OFFICE OF ENVIRONMENTAL MEASUREMENT & EVALUATION
60 WESTVIEW STREET, LEXINGTON, MA. 02173-3185

MEMORANDUM

DATE: April 28, 1998

SUBJECT: TEN MILE RIVER

FROM: William J. Andrade, Ph.D.
Chemist, EIA

TO: Greg Hellyer
ECA

Project Number : 98177

Analytical Procedure

New England Regional Laboratory Standard Operating Procedure (SOP) 14.1

Equipment

Dohrmann DC-190 TOC Analyzer

The analytical support for this project was performed by the ESAT contractor, Paul Bedrosian.

Date samples received: March 26, 1998
Date samples analyzed: April 8-9, 1998

file name: 98177SO.TOC

Data Quality Statement

-Chemist who reviewed the data: William J. Andrade, Ph.D.
-Method modification: none
-Instrument performance:
-Spike recovery problem: ok
-Limitations to the data: none
-Unusual visual characteristics:
Chain of Custody abnormalities: none

Comments:
The percent recovery for one set of data for the low level (61.6 mg/kg) laboratory control sample ERA 29003 was slightly elevated. The recovery for the higher level (3750 mg/kg) laboratory control samples ERA was within the acceptance range.

SAMPLE TOC RESULTS

Tag Number	Station Location	Result (mg/Kg)
07697	WETH01	97391ave
07698	TENM01	68767
07699	NATP01	70299
07700	MECH01	89850
07701	DODG01	153822
07702	HEBR01	114020
07703	RESC01	115798ave
07704	WETH02	95715

QUALITY CONTROL

Laboratory Control TOC Samples

Lot No:	Result	True Value (mg/Kg)	% REC (mg/Kg)	Windows (mg/Kg)
ERA 29003	77.14	61.6	125.2	46.2-77.0
ERA 29003	73.85	61.6	119.9	46.2-77.0
ERA 06086	3686	3750	98.29	2610-4890
ERA 06086	3696	3750	98.56	2610-4890

Laboratory Duplicates

Sample	Sample (mg/Kg)	Duplicate (mg/Kg)	Avg	RPD	Acceptance (Range)
07697	94724	100059	97391	5.48	± 20%
07703	123028	108569	115798	12.5	± 20%

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
ACID VOLATILE SULFIDES/SIMULTANEOUSLY EXTRACTABLE METALS(AVS/SEM)

Acid Volatile Sulfides/Simultaneously Extractable Metals (AVS/SEM)

MEMORANDUM PN: 98177

DATE: May 12, 1998

SUBJ: Ten Mile River - AVS/SEM Results

FROM: William J. Andrade, Michael Dowling, Dan Curran
Chemists

TO: Tim Bridges
OEME

THRU: Dr. William J. Andrade
Senior Chemistry Analytical Specialist

Analytical References:

Determination of Acid Volatile Sulfide and Simultaneously Extracted Metals in Sediments", AVS/SEM 97, Jan., 1997, Rev. 1, U.S. EPA, Region I, Lexington, MA 02173.

ICP Method 200.7 - "Methods for the Determination of Metals in Environmental Samples, Supplement I (EPA/600/R-94/111), May, 1994."

Mercury Method 245.1, Rev. 3.0 - "Methods for the Determination of Metals in Environmental Samples, Supplement I (EPA/600/R-94/111), May, 1994."

Date Samples Received by Laboratory: 3/26/98

Sample Analysis Starting Date: 4/6/98

File name: 98177SE.AVS

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
ACID VOLATILE SULFIDES/SIMULTANEOUSLY EXTRACTABLE METALS(AVS/SEM)

Results (umole/gm, dry wt.)

Parameter	07697	07698	07699	07700
Cd	0.11	0.03	0.04U	0.12
Cr	23.9	0.79	0.51	9.7
Cu	83.0	5.1	5.7	11.5
Hg	0.0011	0.0005U	0.0008	0.0011U
Ni	4.7	0.93	1.6	1.9
Pb	2.3	1.7	0.99	1.2
Zn	18.0	6.1	3.3	6.9
AVS	3.7	57.9	0.20U	91.3
SEM / AVS ratio	29.2	0.24	0	0.24

U = not detected above the reporting limit.

Results (umole/gm, dry wt.)

Parameter	07701	07702	07703	07704
Cd	1.3	1.1	1.3	0.12
Cr	18.8	13.8	7.4	47.3
Cu	64.7	64.5	42.9	102
Hg	0.0011U	0.0012U	0.0010U	0.0049
Ni	14.4	14.6	12.5	7.7
Pb	4.3	2.6	1.8	3.4
Zn	26.6	22.8	22.4	20.3
AVS	46.6	43.6	22.8	6.9
SEM / AVS ratio	2.4	2.4	3.5	19.4

U = not detected above the reporting limit

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
ACID VOLATILE SULFIDES/SIMULTANEOUSLY EXTRACTABLE METALS(AVS/SEM)

SEM Analytical Spike Recovery Results

Sample 07704

Parameter	Accuracy % Spike Recovery
Cd	99
Cr	*
Cu	*
Hg	109 (sample 07703)
Ni	103
Pb	103
Zn	*

* No recovery could be determined since the analyte concentration in the sample is > 4 times the spike level.

AVS Matrix Spike Recovery Results

Sample 07697

Accuracy % Spike Recovery
88

SEM Laboratory Duplicate Sample Results

Sample 07700

Parameter	Precision RPD
Cd	8.0
Cr	0
Cu	3.5
Hg	**
Ni	0
Pb	0
Zn	2.9

** = non detect

AVS Laboratory Duplicate Sample Results

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
ACID VOLATILE SULFIDES/SIMULTANEOUSLY EXTRACTABLE METALS(AVS/SEM)

Sample	Precision RPD
07700	3.8

AVS Laboratory Fortified Blank Sample Results

% Recovery
89

Mercury Laboratory Fortified Blank Sample Results

% Recovery
97

Data Quality Statements

Chemists who reviewed data:	Mike Dowling, Scott Clifford, William Andrade, Dan Curran
Method modifications:	None
Limitations of data:	None
Comments:	The Cr values are not used in calculating the SEM/AVS ratio.
List of method contaminants:	None
Instrument performance:	Excellent
Matrix spike recovery problems:	None
Unusual visual characteristics:	None
Chain of custody abnormalities:	None

Volatile and Semi-Volatile Organic Compounds
(GC/MS Extractable Organic Analysis)

DATE: April 24, 1998

SUBJ: TEN MILE RIVER

FROM: Dick Siscanaw, Chemistry Section

THRU: Dr. William J. Andrade, Advanced Analytical Chemistry Specialist

TO: Greg Hellyer

PROJECT NUMBER: 98177

ANALYTICAL PROCEDURE:

All samples were received and logged in by the laboratory according to the SOP for Sample Log-in (EIA-ADMLOGN1.SOP, 7/97).

EPA Region I Procedure for Polyaromatic Hydrocarbons in Sediment Samples PAHSELL1.SOP. The extracts were analyzed on the gas chromatograph/mass spectrometer using the selected ion monitoring.

The analytical support for this report was performed by ESAT contractors.

Date(s) Samples Received by the Laboratory: 03/26/98

Date Analysis Started: 03/27/98

File: J:\CHEMSTRY\REPORTS\BNA\98177SO.PAH

QUALITY CONTROL:

1. A laboratory blank was analyzed before the sample analysis.

2. Each sample was spiked with the following surrogate compounds, fluorobiphenyl and p-terphenyl,d14, at 2 ppb. The results for the surrogate recoveries are reported out for each sample.

3. One sample, 07697, was spiked with the following compounds at 2 ppb.

	MS	MSD

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
GC/MS EXTRACTABLE ORGANIC ANALYSIS

Compound	Rec. (%)	Rec. (%)	RPD %
Acenaphthene	92	81	12.7
Acenaphthylene	85	73	13.9
Fluorene	84	72	15.4
Naphthalene	96	85	12.2

SAMPLES ANALYZED: BLANK, 07697, 07697MS, 07697MSD, 07698, 07699, 07700, 07701, 07702, 07703, 07704

Chemist who reviewed data: Dick Siscanaw

Holding times meet (Y/N): Yes
Extraction (Water - 7 days, Soils - 14 days)
Analytical (40 days after extraction)

Method modifications: None

Limitations of data: None

Laboratory blank problems: None

Instrument performance problems: None

Surrogate and spike recovery problems:
The sample 07697 had concentrations higher than the spiked level. The analyses requested was a low level method. Only 4 PAH'S could be reported out in which the matrix spike was higher than the sample's concentration.

Additional comments: None

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
GC/MS EXTRACTABLE ORGANIC ANALYSIS

SAMPLE NO.: BLANK		Matrix:	Soil
DATE OF COLLECTION:	NOT APPLICABLE	Sample pH:	6.395
DATE OF EXTRACTION:	03/27/98	Percent Moisture	0
DATE SILICA GEL CLEAN-UP:		Conc. Final Vol.	1 mL
DATE OF ANALYSIS:	04/06/98	Dilution Factor:	NONE
WET WEIGHT EXTRACTED:	31.227g	Report Factor:	0.94
DRY WEIGHT EXTRACTED:	31.227g		

SAMPLE RESULTS:

CAS NO.	STORET NO.	Compound	Conc. (ug/Kg)	RL (ug/Kg)	Qualifier or Comment
		Priority Pollutants			
		_____			
83-32-9	34205	Acenaphthene	ND	1.6	
208-96-8	34200	Acenaphthylene	ND	1.6	
120-12-7	34220	Anthracene	ND	1.6	
56-55-3	34526	Benzo(a)anthracene	ND	1.6	
205-99-2	34230	Benzo(b)fluoranthene	ND	1.6	
207-08-9	34242	Benzo(k)fluoranthene	ND	1.6	
50-32-8	34247	Benzo(a)pyrene	ND	1.6	
191-24-2	34521	Benzo(ghi)perylene	ND	1.6	
218-01-9	34320	Chrysene	ND	1.6	
53-70-3	34556	Dibenzo(a,h)anthracene	ND	1.6	
206-44-0	34376	Fluoranthene	1	1.6	L
86-73-7	34381	Fluorene	ND	1.6	
193-39-5	34403	Indeno(1,2,3-cd)pyrene	ND	1.6	
91-20-3	34696	Naphthalene	ND	1.6	
85-01-8	34461	Phenanthrene	2.7	1.6	
129-00-0	34469	Pyrene	1	1.6	L
		Other Compounds Quantitated			
		_____			
			ND	1.6	

Sample Recoveries For Surrogate Compounds:	Recoveries (%)	QC Range (%)
Fluorobiphenyl	60	30-115
p-Terphenyl,d14	57	18-137

Notes:

RL = Reporting limit
ND = None detected
~ = Approximate

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
GC/MS EXTRACTABLE ORGANIC ANALYSIS

< = Less than
> = Greater than
NA = Not available, due to sample dilution or interference
E = Estimated value exceeds the calibration range
B = Analyte is associated with lab blank.
J = Estimated, below reporting limit

SAMPLE NO.: 07697		Matrix:	Soil
DATE OF COLLECTION:	03/24/98	Sample pH:	6.008
DATE OF EXTRACTION:	03/27/98	Percent Moisture	83.13
DATE SILICA GEL CLEAN-UP:		Conc. Final Vol.	1 mL
DATE OF ANALYSIS:	04/06/98	Dilution Factor:	1:10
WET WEIGHT EXTRACTED:	7.687g	Report Factor:	38.26
DRY WEIGHT EXTRACTED:	45.586g		

SAMPLE RESULTS:

CAS NO.	STORET NO.	Compound	Conc. (ug/Kg)	RL (ug/Kg)	Qualifier or Comment
		Priority Pollutants			
83-32-9	34205	Acenaphthene	ND	65	
208-96-8	34200	Acenaphthylene	140	65	
120-12-7	34220	Anthracene	91	65	
56-55-3	34526	Benzo(a)anthracene	820	65	
205-99-2	34230	Benzo(b)fluoranthene	2200	65	
207-08-9	34242	Benzo(k)fluoranthene	840	65	
50-32-8	34247	Benzo(a)pyrene	1300	65	
191-24-2	34521	Benzo(ghi)perylene	1100	65	
218-01-9	34320	Chrysene	1700	65	
53-70-3	34556	Dibenzo(a,h)anthracene	260	65	
206-44-0	34376	Fluoranthene	2400	65	
86-73-7	34381	Fluorene	92	65	
193-39-5	34403	Indeno(1,2,3-cd)pyrene	950	65	
91-20-3	34696	Naphthalene	56	65	L
85-01-8	34461	Phenanthrene	870	65	
129-00-0	34469	Pyrene	2000	65	
		Other Compounds Quantitated			
			ND	65	

Sample Recoveries For	Recoveries	QC Range

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
GC/MS EXTRACTABLE ORGANIC ANALYSIS

Surrogate Compounds:	(%)	(%)
Fluorobiphenyl	73	30-115
p-Terphenyl,d14	90	18-137

SAMPLE NO.: 07698 Matrix: Soil
DATE OF COLLECTION: 03/24/98 Sample pH: 6.384
DATE OF EXTRACTION: 03/27/98 Percent Moisture 70.64
DATE SILICA GEL CLEAN-UP: Conc. Final Vol. 1 mL
DATE OF ANALYSIS: 04/07/98 Dilution Factor: 1:10*, 1:100
WET WEIGHT EXTRACTED: 13.859g Report Factor: 22.12*, 212.2
DRY WEIGHT EXTRACTED: 47.202g

SAMPLE RESULTS:

CAS NO.	STORET NO.	Compound	Conc. (ug/Kg)	RL (ug/Kg)	Qualifier or Comment
		Priority Pollutants			
83-32-9	34205	Acenaphthene	190*	36	
208-96-8	34200	Acenaphthylene	140*	36	
120-12-7	34220	Anthracene	540	360	
56-55-3	34526	Benzo(a)anthracene	4100	360	
205-99-2	34230	Benzo(b)fluoranthene	8400	360	
207-08-9	34242	Benzo(k)fluoranthene	3800	360	
50-32-8	34247	Benzo(a)pyrene	4900	360	
191-24-2	34521	Benzo(ghi)perylene	3700	360	
218-01-9	34320	Chrysene	6700	360	
53-70-3	34556	Dibenzo(a,h)anthracene	960	360	
206-44-0	34376	Fluoranthene	12000	360	
86-73-7	34381	Fluorene	340*	36	
193-39-5	34403	Indeno(1,2,3-cd)pyrene	3200	360	
91-20-3	34696	Naphthalene	80*	36	
85-01-8	34461	Phenanthrene	4800	360	
129-00-0	34469	Pyrene	2500	360	

* 1:10 DILUTION

		Other Compounds Quantitated		
			ND	360

Sample Recoveries For Surrogate Compounds:	Recoveries (%)	QC Range (%)

Fluorobiphenyl	78*	30-115
p-Terphenyl,d14	104*	18-137

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
GC/MS EXTRACTABLE ORGANIC ANALYSIS

FACILITY SAMPLED: TEN MILE RIVER

SAMPLE NO.: 07699 Matrix: Soil
DATE OF COLLECTION: 03/24/98 Sample pH: 6.341
DATE OF EXTRACTION: 03/27/98 Percent Moisture 69.26
DATE SILICA GEL CLEAN-UP: Conc. Final Vol. 1 mL
DATE OF ANALYSIS: 04/07/98 Dilution Factor: 1:20
WET WEIGHT EXTRACTED: 14.173g Report Factor: 41.5
DRY WEIGHT EXTRACTED: 46.107g

SAMPLE RESULTS:

CAS NO.	STORET NO.	Compound	Conc. (ug/Kg)	RL (ug/Kg)	Qualifier or Comment
		Priority Pollutants			
83-32-9	34205	Acenaphthene	51	71	L
208-96-8	34200	Acenaphthylene	79	71	
120-12-7	34220	Anthracene	260	71	
56-55-3	34526	Benzo(a)anthracene	1500	71	
205-99-2	34230	Benzo(b)fluoranthene	2600	71	
207-08-9	34242	Benzo(k)fluoranthene	920	71	
50-32-8	34247	Benzo(a)pyrene	1600	71	
191-24-2	34521	Benzo(ghi)perylene	1100	71	
218-01-9	34320	Chrysene	1900	71	
53-70-3	34556	Dibenzo(a,h)anthracene	300	71	
206-44-0	34376	Fluoranthene	3100	71	
86-73-7	34381	Fluorene	70	71	L
193-39-5	34403	Indeno(1,2,3-cd)pyrene	1000	71	
91-20-3	34696	Naphthalene	ND	71	
85-01-8	34461	Phenanthrene	1300	71	
129-00-0	34469	Pyrene	2500	71	
		Other Compounds Quantitated			
			ND	71	

Sample Recoveries For Surrogate Compounds:	Recoveries (%)	QC Range (%)
Fluorobiphenyl	68	30-115
p-Terphenyl,d14	99	18-137

SAMPLE NO.: 07700 Matrix: Soil

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
GC/MS EXTRACTABLE ORGANIC ANALYSIS

DATE OF COLLECTION:	03/25/98	Sample pH:	7.786
DATE OF EXTRACTION:	03/27/98	Percent Moisture	85.29
DATE SILICA GEL CLEAN-UP:		Conc. Final Vol.	1 mL
DATE OF ANALYSIS:	04/07/98	Dilution Factor:	1:10
WET WEIGHT EXTRACTED:	6.604g	Report Factor:	44.54
DRY WEIGHT EXTRACTED:	44.894g		

SAMPLE RESULTS:

CAS NO.	STORET NO.	Compound	Conc. (ug/Kg)	RL (ug/Kg)	Qualifier or Comment
		Priority Pollutants			
83-32-9	34205	Acenaphthene	130	76	
208-96-8	34200	Acenaphthylene	95	76	
120-12-7	34220	Anthracene	440	76	
56-55-3	34526	Benzo(a)anthracene	2200	76	
205-99-2	34230	Benzo(b)fluoranthene	4000	76	
207-08-9	34242	Benzo(k)fluoranthene	1200	76	
50-32-8	34247	Benzo(a)pyrene	2400	76	
191-24-2	34521	Benzo(ghi)perylene	1500	76	
218-01-9	34320	Chrysene	2700	76	
53-70-3	34556	Dibenzo(a,h)anthracene	460	76	
206-44-0	34376	Fluoranthene	4600	76	
86-73-7	34381	Fluorene	180	76	
193-39-5	34403	Indeno(1,2,3-cd)pyrene	1300	76	
91-20-3	34696	Naphthalene	ND	76	
85-01-8	34461	Phenanthrene	1600	76	
129-00-0	34469	Pyrene	3700	76	
		Other Compounds Quantitated			
			ND	76	

Sample Recoveries For Surrogate Compounds:	Recoveries (%)	QC Range (%)
Fluorobiphenyl	96	30-115
p-Terphenyl,d14	117	18-137

SAMPLE NO.:	07701	Matrix:	Soil
DATE OF COLLECTION:	03/25/98	Sample pH:	6.565
DATE OF EXTRACTION:	03/27/98	Percent Moisture	87.05
DATE SILICA GEL CLEAN-UP:		Conc. Final Vol.	1 mL
DATE OF ANALYSIS:	04/07/98	Dilution Factor:	1:20

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
GC/MS EXTRACTABLE ORGANIC ANALYSIS

WET WEIGHT EXTRACTED: 6.364g Report Factor: 92.43
DRY WEIGHT EXTRACTED: 49.145g

SAMPLE RESULTS:

CAS NO.	STORET NO.	Compound	Conc. (ug/Kg)	RL (ug/Kg)	Qualifier or Comment
		Priority Pollutants			
83-32-9	34205	Acenaphthene	130	157	L
208-96-8	34200	Acenaphthylene	280	157	
120-12-7	34220	Anthracene	390	157	
56-55-3	34526	Benzo(a)anthracene	3100	157	
205-99-2	34230	Benzo(b)fluoranthene	7200	157	
207-08-9	34242	Benzo(k)fluoranthene	2900	157	
50-32-8	34247	Benzo(a)pyrene	4200	157	
191-24-2	34521	Benzo(ghi)perylene	2800	157	
218-01-9	34320	Chrysene	4800	157	
53-70-3	34556	Dibenzo(a,h)anthracene	730	157	
206-44-0	34376	Fluoranthene	7400	157	
86-73-7	34381	Fluorene	240	157	
193-39-5	34403	Indeno(1,2,3-cd)pyrene	2400	157	
91-20-3	34696	Naphthalene	ND	157	
85-01-8	34461	Phenanthrene	2500	157	
129-00-0	34469	Pyrene	6700	157	
		Other Compounds Quantitated			
			ND	157	

Sample Recoveries For Surrogate Compounds:	Recoveries (%)	QC Range (%)
Fluorobiphenyl	60	30-115
p-Terphenyl,d14	78	18-137

SAMPLE NO.: 07702 Matrix: Soil
DATE OF COLLECTION: 03/25/98 Sample pH: 6.477
DATE OF EXTRACTION: 03/27/98 Percent Moisture 83.31
DATE SILICA GEL CLEAN-UP: Conc. Final Vol. 1 mL
DATE OF ANALYSIS: 04/07/98 Dilution Factor: 1:10
WET WEIGHT EXTRACTED: 7.629g Report Factor: 38.55
DRY WEIGHT EXTRACTED: 83.31g

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
GC/MS EXTRACTABLE ORGANIC ANALYSIS

SAMPLE RESULTS:

CAS NO.	STORET NO.	Compound	Conc. (ug/Kg)	RL (ug/Kg)	Qualifier or Comment
		Priority Pollutants			
		_____			
83-32-9	34205	Acenaphthene	ND	66	
208-96-8	34200	Acenaphthylene	78	66	
120-12-7	34220	Anthracene	80	66	
56-55-3	34526	Benzo(a)anthracene	680	66	
205-99-2	34230	Benzo(b)fluoranthene	1700	66	
207-08-9	34242	Benzo(k)fluoranthene	610	66	
50-32-8	34247	Benzo(a)pyrene	960	66	
191-24-2	34521	Benzo(ghi)perylene	780	66	
218-01-9	34320	Chrysene	1100	66	
53-70-3	34556	Dibenzo(a,h)anthracene	190	66	
206-44-0	34376	Fluoranthene	1500	66	
86-73-7	34381	Fluorene	52	66	L
193-39-5	34403	Indeno(1,2,3-cd)pyrene	650	66	
91-20-3	34696	Naphthalene	ND	66	
85-01-8	34461	Phenanthrene	450	66	
129-00-0	34469	Pyrene	1400	66	
		Other Compounds Quantitated			
		_____			
			ND	66	

Sample Recoveries For Surrogate Compounds:	Recoveries (%)	QC Range (%)
Fluorobiphenyl	60	30-115
p-Terphenyl,d14	81	18-137

SAMPLE NO.: 07703
DATE OF COLLECTION: 03/25/98
DATE OF EXTRACTION: 03/27/98
DATE SILICA GEL CLEAN-UP:
DATE OF ANALYSIS: 04/07/98
WET WEIGHT EXTRACTED: 9.217g
DRY WEIGHT EXTRACTED: 44.872g

Matrix: Soil
Sample pH: 6.487
Percent Moisture 79.46
Conc. Final Vol. 1 mL
Dilution Factor: 1:10
Report Factor: 31.91

SAMPLE RESULTS:

CAS NO.	STORET NO.	Compound	Conc. (ug/Kg)	RL (ug/Kg)	Qualifier or Comment

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
GC/MS EXTRACTABLE ORGANIC ANALYSIS

		Priority Pollutants		
83-32-9	34205	Acenaphthene	55	54
208-96-8	34200	Acenaphthylene	160	54
120-12-7	34220	Anthracene	190	54
56-55-3	34526	Benzo(a)anthracene	1100	54
205-99-2	34230	Benzo(b)fluoranthene	2600	54
207-08-9	34242	Benzo(k)fluoranthene	910	54
50-32-8	34247	Benzo(a)pyrene	1400	54
191-24-2	34521	Benzo(ghi)perylene	980	54
218-01-9	34320	Chrysene	1700	54
53-70-3	34556	Dibenzo(a,h)anthracene	270	54
206-44-0	34376	Fluoranthene	2600	54
86-73-7	34381	Fluorene	130	54
193-39-5	34403	Indeno(1,2,3-cd)pyrene	870	54
91-20-3	34696	Naphthalene	290	54
85-01-8	34461	Phenanthrene	830	54
129-00-0	34469	Pyrene	2300	54
		Other Compounds Quantitated		
			ND	54

Sample Recoveries For Surrogate Compounds:	Recoveries (%)	QC Range (%)
Fluorobiphenyl	79	30-115
p-Terphenyl,d14	94	18-137

SAMPLE NO.: 07704
DATE OF COLLECTION: 03/24/98
DATE OF EXTRACTION: 03/27/98
DATE SILICA GEL CLEAN-UP:
DATE OF ANALYSIS: 04/07/98
WET WEIGHT EXTRACTED: 6.222g
DRY WEIGHT EXTRACTED: 45.184g

Matrix: Soil
Sample pH: 6.431
Percent Moisture 86.23
Conc. Final Vol. 1 mL
Dilution Factor: 1:10
Report Factor: 47.27

SAMPLE RESULTS:

CAS NO.	STORET NO.	Compound	Conc. (ug/Kg)	RL (ug/Kg)	Qualifier or Comment
		Priority Pollutants			
83-32-9	34205	Acenaphthene	ND	80	
208-96-8	34200	Acenaphthylene	270	80	

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
GC/MS EXTRACTABLE ORGANIC ANALYSIS

120-12-7	34220	Anthracene	180	80
56-55-3	34526	Benzo(a)anthracene	1100	80
205-99-2	34230	Benzo(b)fluoranthene	3100	80
207-08-9	34242	Benzo(k)fluoranthene	1000	80
50-32-8	34247	Benzo(a)pyrene	1700	80
191-24-2	34521	Benzo(ghi)perylene	1300	80
218-01-9	34320	Chrysene	2100	80
53-70-3	34556	Dibenzo(a,h)anthracene	350	80
206-44-0	34376	Fluoranthene	2900	80
86-73-7	34381	Fluorene	110	80
193-39-5	34403	Indeno(1,2,3-cd)pyrene	1200	80
91-20-3	34696	Naphthalene	ND	80
85-01-8	34461	Phenanthrene	1100	80
129-00-0	34469	Pyrene	2500	80
		Other Compounds Quantitated	ND	80

Sample Recoveries For Surrogate Compounds:	Recoveries (%)	QC Range (%)
Fluorobiphenyl	71	30-115
p-Terphenyl,d14	94	18-137

DATE: April 28, 1998

SUBJ: Gas Chromatography-Mass Spectrometry Analysis of Extractable Organics in Soils and Sediments - TEN MILE RIVER

FROM: Dick Siscanaw, Chemistry Section

THRU: Dr. William J. Andrade, Advanced Analytical Chemistry Specialist

TO: Greg Hellyer

PROJECT NUMBER: 98177

ANALYTICAL PROCEDURE:

All samples were received and logged in by the laboratory according

to the SOP for Sample Log-in (EIA-ADMLOGN1.SOP, 7/97).

Sample processing and analysis was done following the EPA Region 1 Standard Operating Procedures BNASOLL2.SOP and BNAENVI1.MOD. The methods are based on the US EPA, Contract Laboratory Program, Statement of Work for Organic Analysis, Multi-Media, Multi-Concentration, Low Level Preparation for Screening and Analysis of Semivolatiles (BNA), OLM01.2, 1/91. The sample extracts were screened on a gas chromatograph prior to the gas chromatography-mass spectrometry analysis. All values are reported out on a dry weight basis.

The analytical support for this report was performed by ESAT contractors.

Date(s) Samples Received by the Laboratory: 03/26/98

Date Analysis Started: 04/02/98

cc:
File: J:\CHEMSTRY\REPORTS\BNA\98177SO.BNA

QUALITY CONTROL:

1. A laboratory blank was processed with the samples.

2. Each sample was spiked with 100 ug of base/neutral and 200 ug of acid surrogate compounds. The results for the surrogate recoveries are reported out for each sample.

3. One sample, 07700, was spiked with 100 ug of base/neutral and 200 ug of acid matrix spike compounds. The results for the analyses are reported on the following page.

SOIL MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Sample No.: 07700
Date(s) Analyzed: 04/02/98

Compound	Spike Added (ug/Kg)	Sample Conc. (ug/Kg)	MS Conc. (ug/Kg)	MS % Rec	QC Limits Rec

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
GC/MS EXTRACTABLE ORGANIC ANALYSIS

Phenol	21000	0	18000	86	26-90
2-Chlorophenol	21000	0	17000	81	25-102
1,4-Dichlorobenzene	10000	0	8200	82	28-104
N-Nitroso-di-n-prop.(1)	10000	0	8600	86	41-126
1,2,4-Trichlorobenzene	10000	0	8200	82	38-107
4-Chloro-3-methylphenol	21000	0	18000	86	26-103
Acenaphthene	10000	0	8300	83	31-137
4-Nitrophenol	21000	0	18000	86	11-114
2,4-Dinitrotoluene	10000	0	7700	77	28-89
Pentachlorophenol	21000	0	14000	67	17-109
Pyrene	10000	4900	13000	81	35-142

Compound	Spike Added (ug/Kg)	MSD Conc. (ug/Kg)	MSD % Rec	% RPD	QC LIMITS RPD	QC LIMITS Rec
Phenol	22000	19000	86	0	35	26-90
2-Chlorophenol	22000	19000	86	0	50	25-102
1,4-Dichlorobenzene	11000	8600	78	5	27	28-104
N-Nitroso-di-n-prop.(I)	11000	9400	85	1	38	41-126
1,2,4-Trichlorobenzene	11000	8800	80	2	23	38-107
4-Chloro-3-methylphenol	22000	19000	86	0	33	26-103
Acenaphthene	11000	8900	81	2	19	31-137
4-Nitrophenol	22000	18000	82	5	50	11-114
2,4-Dinitrotoluene	11000	8000	73	5	47	28-89
Pentachlorophenol	22000	15000	68	1	47	17-109
Pyrene	11000	15000	92	13	36	35-142

(1) N-Nitroso-di-n-propylamine

* Values outside of QC limits

RPD: 0 out of 11 outside limits
Spike Recovery: 0 out of 22 outside limits

Comments:

Matrix Spike Analysis Sample No.: 07700 (continued)

COMPOUNDS NOT IN THE SPIKING SOLUTION:

Target	Matrix	Matrix Dup

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
GC/MS EXTRACTABLE ORGANIC ANALYSIS

Compounds	(ug/Kg)		(ug/Kg)	
4-Chloraniline	290	L	440	L
Dimethylphthalate	ND		250	L
Acenaphthylene	260	L	300	L
Diethylphthalate	ND		520	L,B
Phenanthrene	1800	L	1900	L
Anthracene	540	L	640	L
Carbazole	240	L	300	L
Dibutylphthalate	630	L,B	910	L,B
Fluoranthene	4900		5300	
Butylbenzyphthalate	540	L,B	540	L,B
Benz(a)Anthracene	2700		2800	
Chrysene	3100		3600	
Bis(2-Ethylhexyl)Phthalate	4600	B	5000	B
Benzo(b)Fluoranthene	4300		4800	
Benzo(k)Fluoranthene	1600	L	1800	L
Benzo(a)Pyrene	2800		3000	
Indeno(1,2,3-CD)Pyrene	1300	L	1400	L
Dibenzo(a,h)Anthracene	430	L	450	L
Benzo(ghi)Perylene	1200	L	1100	L

Tentatively Identified Compounds	MS Est. Conc. (ug/Kg)		MSD Est. Conc. (ug/Kg)	
C12 Hydrocarbon	1200	J	1100	J
Hexane,2,2,5-trimethyl chloro-isocyanato Benzene isomer	1400	J	1100	J
	850	J	ND	
Unknown	1300	J	ND	
C18 Hydrocarbon	1500	J	1500	J
Unknown	2300	J	2200	J
Unknown	990	J	940	J
Benzene,(pentylheptyl)-	ND		1200	J
Unknown	870	J	930	J
Unknown	1100	J	1200	J
C18 Hydrocarbon	1800	J	1700	J
Unknown	ND		1800	J
Unknown	910	J	950	J
Unknown	1300	J	1600	J
Unknown	1300	J	1200	J
Unknown	2000	J	2000	J
Unknown	8700	J	8700	J

Unknown	2400	J	2500	J
Unknown	ND		1500	J
Unknown	3300	J	3200	J
Unknown	5200	J	5400	J
C28 Hydrocarbon	6000	J,B	6100	J,B
Benzo(e)pyrene	2600	J	2900	J

Unknown	1400	J	ND	
C30 Hydrocarbon	3500	J	2500	J
Unknown	2400	J	2700	J
Unknown	5800	J	ND	

Matrix Spike Analysis Sample No.: 07700 (continued)

Recoveries for Surrogate Compounds:	MS Rec. (%)	MSD Rec. (%)	QC Range (%)
2-Fluorophenol	84	85	25-121
Phenol,d5	84	87	24-113
Nitrobenzene,d5	80	81	23-120
Fluorobiphenyl	84	84	30-115
2,4,6-Tribromophenol	84	89	19-122
p-Terphenyl,d14	112	110	18-137
2-Chlorophenol-d4	84	86	20-130
1,2-Dichlorobenzene-d4	77	78	20-130

NOTE: Phthalates (1,2-Benzenedicarboxylic esters) and adipates (hexanedioic esters) are common method contaminants. Values at the detection levels are most likely due to method contamination.

SAMPLES ANALYZED: BLANK 1, BLANK 2, 07697, 07698, 07699, 07700, 07700MS, 07700MSD, 07701, 07702, 07703, 07704

ANALYTICAL PARAMETERS

INSTRUMENTS:

Hewlett Packard 5890 Gas Chromatograph
Hewlett Packard 5987 Gas Chromatograph-Mass Spectrometer

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
GC/MS EXTRACTABLE ORGANIC ANALYSIS

GC/FID Screening Conditions:

Gas:	Hydrogen
Capillary Column:	DB-1, 30m, 0.32mm ID, 0.10 micron film thickness
Injection Mode:	Splitless
Temperature Program:	Isothermal for 3 min at 40°C, programmed at 15°C/min to 320°C for 3 min

GC-MS Conditions:

Gas:	Helium
Capillary Column:	DB-5, 60m, 0.25mm ID, 0.25 micron film thickness
Injection Mode:	Splitless
Temperature Program:	Isothermal for 4 min at 40°C, programmed at 7°C/min to 300°C
Injector, Transfer Temperatures:	300°C, 290°C
Electron Energy:	70 V
Mass Range:	35-550
Scan Rate:	0.9 seconds

Chemist who reviewed data: Dick Siscanaw

Holding times met (Y/N): Yes
Extraction (Water - 7 days, Soils - 14 days)
Analytical (40 days after extraction)

Method modifications:

Two 30 g extractions were done. The extracts were combined for one sample because of the high moisture content.

Limitations of data: None

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
GC/MS EXTRACTABLE ORGANIC ANALYSIS

Laboratory blank problems: None

Instrument performance problems: None

Surrogate and spike recovery problems: None

Additional comments: None

FACILITY SAMPLED: TEN MILE RIVER

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY

SAMPLE NO.: BLANK 1		Matrix:	Soil
DATE OF COLLECTION:	Not Applicable	Sample pH:	6.395
DATE OF EXTRACTION:	04/02/98	Percent Moisture	0
DATE OF ANALYSIS:	04/09/98	Conc. Final Vol.	500 uL
WET WEIGHT EXTRACTED:	61.4 g	Dilution Factor:	1.0
DRY WEIGHT EXTRACTED:	61.4 g	Report Factor:	0.5

SAMPLE RESULTS:

CAS NO.	STORET NO.	Compound	Conc. (ug/Kg)	RL (ug/Kg)	Qualifier or Comment
		Priority Pollutants			
83-32-9	34205	Acenaphthene	ND	110	
208-96-8	34200	Acenaphthylene	ND	110	
120-12-7	34220	Anthracene	ND	110	
309-00-2	39330	Aldrin	ND	110	
56-55-3	34526	Benzo(a)anthracene	ND	110	
205-99-2	34230	Benzo(b)fluoranthene	ND	110	
207-08-9	34242	Benzo(k)fluoranthene	ND	110	
50-32-8	34247	Benzo(a)pyrene	ND	110	
191-24-2	34521	Benzo(ghi)perylene	ND	110	
85-68-7	34292	Butyl Benzyl Phthalate	17	110	L
319-85-7	39338	beta-BHC	ND	110	
319-86-8	34259	delta-BHC	ND	110	
111-44-4	34273	Bis(2-chloroethyl)ether	ND	110	
111-91-1	34278	Bis(2-chloroethoxy)methane	ND	110	
117-81-7	39100	Bis(2-ethylhexyl)phthalate	81	110	L
108-60-1	34283	Bis(2-chloroisopropyl)ether	ND	110	
101-55-3	34636	4-Bromophenylphenyl ether	ND	110	
86-74-8		Carbazole	ND	110	
59-50-7	34452	4-Chloro-3-methylphenol	ND	210	

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
GC/MS EXTRACTABLE ORGANIC ANALYSIS

91-58-7	34581	2-Chloronaphthalene	ND	110	
95-57-8	34586	2-Chlorophenol	ND	210	
7005-72-3	34641	4-Chlorophenylphenyl ether	ND	110	
218-01-9	34320	Chrysene	ND	110	
72-54-8	39310	4,4'-DDD	ND	110	
72-55-9	39320	4,4'-DDE	ND	110	
50-29-3	39300	4,4'-DDT	ND	110	
53-70-3	34556	Dibenzo(a,h)anthracene	ND	110	
84-74-2	39110	Di-n-butylphthalate	70	110	L
541-73-1	34566	1,3-Dichlorobenzene	ND	110	

Note: For samples 07699, 07700, 07701, 07702, 07703, 07704

SAMPLE NO.: BLANK 1
Sample Results Continued:

CAS NO.	STORET NO.	Compound	Conc. (ug/Kg)	RL (ug/Kg)	Qualifier or Comment
95-50-1	34536	1,2-Dichlorobenzene	ND	110	
106-46-7	34571	1,4-Dichlorobenzene	ND	110	
91-94-1	34631	3,3'-Dichlorobenzidine	ND	110	
120-83-2	34601	2,4-Dichlorophenol	ND	210	
60-57-1	39380	Dieldrin	ND	110	
84-66-2	34336	Diethylphthalate	35	110	L
105-67-9	34606	2-4-Dimethylphenol	ND	210	
131-11-3	34341	Dimethylphthalate	ND	110	
51-28-5	34616	2,4-Dinitrophenol	ND	210	
121-14-2	34611	2,4-Dinitrotoluene	ND	110	
606-20-2	34626	2,6-Dinitrotoluene	ND	110	
117-84-0	34596	Di-n-octylphthalate	ND	110	
206-44-0	34376	Fluoranthene	ND	110	
86-73-7	34381	Fluorene	ND	110	
76-44-8	39410	Heptachlor	ND	110	
1024-57-3	39420	Heptachlor epoxide	ND	110	
118-74-1	39700	Hexachlorobenzene	ND	110	
87-68-3	34391	Hexachlorobutadiene	ND	110	
77-47-4	34386	Hexachlorocyclopentadiene	ND	110	
67-72-1	34396	Hexachloroethane	ND	110	
193-39-5	34403	Indeno(1,2,3-cd)pyrene	ND	110	
78-59-1	34408	Isophorone	ND	110	
534-52-1	34657	2-Methyl-4,6-dinitrophenol	ND	210	

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
GC/MS EXTRACTABLE ORGANIC ANALYSIS

91-20-3	34696	Naphthalene	ND	110
98-95-3	34447	Nitrobenzene	ND	110
88-75-5	34591	2-Nitrophenol	ND	210
100-02-7	34646	4-Nitrophenol	ND	210
86-30-3	34433	N-Nitrosodiphenylamine	ND	110
621-64-7	34428	N-Nitrosodi-n-propylamine	ND	110
87-86-5	39032	Pentachlorophenol	ND	210
85-01-8	34461	Phenanthrene	ND	110
108-95-2	34694	Phenol	ND	210
129-00-0	34469	Pyrene	ND	110

SAMPLE NO.: BLANK 1
Sample Results Continued:

CAS NO.	STORET NO.	Compound	Conc. (ug/Kg)	RL (ug/Kg)	Qualifier or Comment
120-82-1	34551	1,2,4-Trichlorobenzene	ND	110	
88-06-2	34621	2,4,6-Trichlorophenol	ND	210	
		Hazardous Substances			
65-53-3	77089	Aniline	ND	110	
65-85-0	77247	Benzoic Acid	ND	210	
100-51-6	77147	Benzyl Alcohol	ND	110	
106-47-8		4-Chloroaniline	ND	110	
132-64-9	81302	Dibenzofuran	ND	110	
91-57-6		2-Methylnaphthalene	ND	110	
95-48-7		2-Methylphenol	ND	110	
106-44-5		4-Methylphenol	ND	110	
88-74-4		2-Nitroaniline	ND	110	
99-09-2		3-Nitroaniline	ND	110	
100-01-6		4-Nitroaniline	ND	110	
95-95-4	34621	2,4,5-Trichlorophenol	ND	110	
		Other Compounds Quantitated			
		Diphenylhydrazine	ND	110	

SAMPLE NO.: BLANK 1
Sample Results Continued:

Tentatively Identified Compounds	Est. Conc. (ug/Kg)

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
GC/MS EXTRACTABLE ORGANIC ANALYSIS

Unknown	97	J
Unknown	110	J
Unknown	1800	J
Unknown	110	J
Unknown	260	J
Ethanol,2-(2-ethoxyethoxy)-	99	J
Unknown	81	J
2,5-Cyclohexadiene-1,4-dione,2,6-bis(1,1-dimethylethyl)	68	J
Propanoic acid,2-methyl-,1-(1,1-dimethylethyl)-2-methyl-1	67	J
Unknown	110	J
Unknown	90	J
Unknown	67	J
Decanedioic acid,bis(2-ethylhexyl) ester	160	J
Unknown	110	J
C28 Hydrocarbon	100	J
Unknown	250	J
Unknown	82	J

SAMPLE NO.: BLANK 1
Sample Results Continued:

Sample Recoveries For Surrogate Compounds:	Recoveries (%)	QC Range (%)
2-Fluorophenol	82	25-121
Phenol,d5	80	24-113
Nitrobenzene,d5	66	23-120
Fluorobiphenyl	64	30-115
2,4,6-Tribromophenol	58	19-122
p-Terphenyl,d14	63	18-137
2-Chlorophenol-d4	73	20-130
1,2-Dichlorobenzene-d4	68	20-130

Notes:
RL = Reporting limit
ND = None detected
~ = Approximate
< = Less than
> = Greater than
NA = Not available, due to sample dilution or interference
E = Estimated value exceeds the calibration range
L = Estimated value is below the calibration range

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
GC/MS EXTRACTABLE ORGANIC ANALYSIS

B = Analyte is associated with lab blank or trip blank contamination. Values are qualified when the observed concentration of the contaminant in the sample extract is less than ten times the concentration in the blank extract for the common contaminants (phthalates and adipates), or less than five times for the remaining contaminants.
C = This compound is confirmation for the pesticide analyses. See the pesticide report for the quantitation.
A = Suspected aldolcondensation product
J = Estimated Value.

SAMPLE NO.:	BLANK 2	Matrix:	Soil
DATE OF COLLECTION:	Not Applicable	Sample pH:	6.395
DATE OF EXTRACTION:	04/07/98	Percent Moisture	0
DATE OF ANALYSIS:	04/09/98	Conc. Final Vol.	500 uL
WET WEIGHT EXTRACTED:	60.1 g	Dilution Factor:	1.0
DRY WEIGHT EXTRACTED:	60.1 g	Report Factor:	0.5

SAMPLE RESULTS:

CAS NO.	STORET NO.	Compound	Conc. (ug/Kg)	RL (ug/Kg)	Qualifier or Comment
		Priority Pollutants			
83-32-9	34205	Acenaphthene	ND	110	
208-96-8	34200	Acenaphthylene	ND	110	
120-12-7	34220	Anthracene	ND	110	
309-00-2	39330	Aldrin	ND	110	
56-55-3	34526	Benzo(a)anthracene	ND	110	
205-99-2	34230	Benzo(b)fluoranthene	ND	110	
207-08-9	34242	Benzo(k)fluoranthene	ND	110	
50-32-8	34247	Benzo(a)pyrene	ND	110	
191-24-2	34521	Benzo(ghi)perylene	ND	110	
85-68-7	34292	Butyl Benzyl Phthalate	ND	110	
319-85-7	39338	beta-BHC	ND	110	
319-86-8	34259	delta-BHC	ND	110	
111-44-4	34273	Bis(2-chloroethyl)ether	ND	110	
111-91-1	34278	Bis(2-chloroethoxy)methane	ND	110	
117-81-7	39100	Bis(2-ethylhexyl)phthalate	30	110	L
108-60-1	34283	Bis(2-chloroisopropyl)ether	ND	110	
101-55-3	34636	4-Bromophenylphenyl ether	ND	110	
86-74-8		Carbazole	ND	110	
59-50-7	34452	4-Chloro-3-methylphenol	ND	210	

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
GC/MS EXTRACTABLE ORGANIC ANALYSIS

91-58-7	34581	2-Chloronaphthalene	ND	110	
95-57-8	34586	2-Chlorophenol	ND	210	
7005-72-3	34641	4-Chlorophenylphenyl ether	ND	110	
218-01-9	34320	Chrysene	ND	110	
72-54-8	39310	4,4'-DDD	ND	110	
72-55-9	39320	4,4'-DDE	ND	110	
50-29-3	39300	4,4'-DDT	ND	110	
53-70-3	34556	Dibenzo(a,h)anthracene	ND	110	
84-74-2	39110	Di-n-butylphthalate	54	110	L
541-73-1	34566	1,3-Dichlorobenzene	ND	110	

Note: for samples 07697 & 07698

SAMPLE NO.:BLANK 2
Sample Results Continued:

CAS NO.	STORET NO.	Compound	Conc. (ug/Kg)	RL (ug/Kg)	Qualifier or Comment
95-50-1	34536	1,2-Dichlorobenzene	ND	110	
106-46-7	34571	1,4-Dichlorobenzene	ND	110	
91-94-1	34631	3,3'-Dichlorobenzidine	ND	110	
120-83-2	34601	2,4-Dichlorophenol	ND	210	
60-57-1	39380	Dieldrin	ND	110	
84-66-2	34336	Diethylphthalate	ND	110	
105-67-9	34606	2-4-Dimethylphenol	ND	210	
131-11-3	34341	Dimethylphthalate	ND	110	
51-28-5	34616	2,4-Dinitrophenol	ND	210	
121-14-2	34611	2,4-Dinitrotoluene	ND	110	
606-20-2	34626	2,6-Dinitrotoluene	ND	110	
117-84-0	34596	Di-n-octylphthalate	ND	110	
206-44-0	34376	Fluoranthene	ND	110	
86-73-7	34381	Fluorene	ND	110	
76-44-8	39410	Heptachlor	ND	110	
1024-57-3	39420	Heptachlor epoxide	ND	110	
118-74-1	39700	Hexachlorobenzene	ND	110	
87-68-3	34391	Hexachlorobutadiene	ND	110	
77-47-4	34386	Hexachlorocyclopentadiene	ND	110	
67-72-1	34396	Hexachloroethane	ND	110	
193-39-5	34403	Indeno(1,2,3-cd)pyrene	ND	110	
78-59-1	34408	Isophorone	ND	110	
534-52-1	34657	2-Methyl-4,6-dinitrophenol	ND	210	
91-20-3	34696	Naphthalene	ND	110	
98-95-3	34447	Nitrobenzene	ND	110	
88-75-5	34591	2-Nitrophenol	ND	210	

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
GC/MS EXTRACTABLE ORGANIC ANALYSIS

100-02-7	34646	4-Nitrophenol	ND	210
86-30-3	34433	N-Nitrosodiphenylamine	ND	110
621-64-7	34428	N-Nitrosodi-n-propylamine	ND	110
87-86-5	39032	Pentachlorophenol	ND	210
85-01-8	34461	Phenanthrene	ND	110
108-95-2	34694	Phenol	ND	210
129-00-0	34469	Pyrene	ND	110

SAMPLE NO.:BLANK 2
Sample Results Continued:

CAS NO.	STORET NO.	Compound	Conc. (ug/Kg)	RL (ug/Kg)	Qualifier or Comment
120-82-1	34551	1,2,4-Trichlorobenzene	ND	110	
88-06-2	34621	2,4,6-Trichlorophenol	ND	210	
		Hazardous Substances			
65-53-3	77089	Aniline	ND	110	
65-85-0	77247	Benzoic Acid	ND	210	
100-51-6	77147	Benzyl Alcohol	ND	110	
106-47-8		4-Chloroaniline	ND	110	
132-64-9	81302	Dibenzofuran	ND	110	
91-57-6		2-Methylnaphthalene	ND	110	
95-48-7		2-Methylphenol	ND	110	
106-44-5		4-Methylphenol	ND	110	
88-74-4		2-Nitroaniline	ND	110	
99-09-2		3-Nitroaniline	ND	110	
100-01-6		4-Nitroaniline	ND	110	
95-95-4	34621	2,4,5-Trichlorophenol	ND	110	
		Other Compounds Quantitated			
		Diphenylhydrazine	ND	110	

Tentatively Identified Compounds	Est. Conc. (ug/Kg)	
Unknown	490	J
Unknown	76	J
Unknown	130	J
Unknown	460	J

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
GC/MS EXTRACTABLE ORGANIC ANALYSIS

Decanedioic,bis(2-ethylhexyl)ester	92	J

SAMPLE NO.:BLANK 2
Sample Results Continued:

Sample Recoveries For Surrogate Compounds:	Recoveries (%)	QC Range (%)
2-Fluorophenol	89	25-121
Phenol,d5	87	24-113
Nitrobenzene,d5	76	23-120
Fluorobiphenyl	70	30-115
2,4,6-Tribromophenol	64	19-122
p-Terphenyl,d14	68	18-137
2-Chlorophenol-d4	79	20-130
1,2-Dichlorobenzene-d4	71	20-130

SAMPLE NO.: 07697
DATE OF COLLECTION: 03/24/98
DATE OF EXTRACTION: 04/07/98
DATE OF ANALYSIS: 04/09/98
WET WEIGHT EXTRACTED: 60.7 g
DRY WEIGHT EXTRACTED: 10.2 g

Matrix: Soil
Sample pH: 6.008
Percent Moisture 83
Conc. Final Vol. 1000 uL
Dilution Factor: 2.0
Report Factor: 5.8

SAMPLE RESULTS:

CAS NO.	STORET NO.	Compound	Conc. (ug/Kg)	RL (ug/Kg)	Qualifier or Comment
		Priority Pollutants			
83-32-9	34205	Acenaphthene	ND	1200	
208-96-8	34200	Acenaphthylene	470	1200	L
120-12-7	34220	Anthracene	320	1200	L
309-00-2	39330	Aldrin	ND	1200	
56-55-3	34526	Benzo(a)anthracene	940	1200	L
205-99-2	34230	Benzo(b)fluoranthene	2200	1200	
207-08-9	34242	Benzo(k)fluoranthene	770	1200	L
50-32-8	34247	Benzo(a)pyrene	1300	1200	
191-24-2	34521	Benzo(ghi)perylene	1000	1200	L
85-68-7	34292	Butyl Benzyl Phthalate	300	1200	L
319-85-7	39338	beta-BHC	ND	1200	

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
GC/MS EXTRACTABLE ORGANIC ANALYSIS

319-86-8	34259	delta-BHC	ND	1200	
111-44-4	34273	Bis(2-chloroethyl)ether	ND	1200	
111-91-1	34278	Bis(2-chloroethoxy)methane	ND	1200	
117-81-7	39100	Bis(2-ethylhexyl)phthalate	2600	1200	B
108-60-1	34283	Bis(2-chloroisopropyl)ether	ND	1200	
101-55-3	34636	4-Bromophenylphenyl ether	ND	1200	
86-74-8		Carbazole	ND	1200	
59-50-7	34452	4-Chloro-3-methylphenol	ND	2400	
91-58-7	34581	2-Chloronaphthalene	ND	1200	
95-57-8	34586	2-Chlorophenol	ND	2400	
7005-72-3	34641	4-Chlorophenylphenyl ether	ND	1200	
218-01-9	34320	Chrysene	1600	1200	
72-54-8	39310	4,4'-DDD	ND	1200	
72-55-9	39320	4,4'-DDE	ND	1200	
50-29-3	39300	4,4'-DDT	ND	1200	
53-70-3	34556	Dibenzo(a,h)anthracene	260	1200	L
84-74-2	39110	Di-n-butylphthalate	820	1200	LB
541-73-1	34566	1,3-Dichlorobenzene	ND	1200	

SAMPLE NO.: 07697
Sample Results Continued:

CAS NO.	STORET NO.	Compound	Conc. (ug/Kg)	RL (ug/Kg)	Qualifier or Comment
95-50-1	34536	1,2-Dichlorobenzene	ND	1200	
106-46-7	34571	1,4-Dichlorobenzene	ND	1200	
91-94-1	34631	3,3'-Dichlorobenzidine	ND	1200	
120-83-2	34601	2,4-Dichlorophenol	ND	2400	
60-57-1	39380	Dieldrin	ND	1200	
84-66-2	34336	Diethylphthalate	ND	1200	
105-67-9	34606	2-4-Dimethylphenol	ND	2400	
131-11-3	34341	Dimethylphthalate	ND	1200	
51-28-5	34616	2,4-Dinitrophenol	ND	2400	
121-14-2	34611	2,4-Dinitrotoluene	ND	1200	
606-20-2	34626	2,6-Dinitrotoluene	ND	1200	
117-84-0	34596	Di-n-octylphthalate	ND	1200	
206-44-0	34376	Fluoranthene	2400	1200	
86-73-7	34381	Fluorene	ND	1200	
76-44-8	39410	Heptachlor	ND	1200	
1024-57-3	39420	Heptachlor epoxide	ND	1200	
118-74-1	39700	Hexachlorobenzene	ND	1200	
87-68-3	34391	Hexachlorobutadiene	ND	1200	
77-47-4	34386	Hexachlorocyclopentadiene	ND	1200	

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
GC/MS EXTRACTABLE ORGANIC ANALYSIS

67-72-1	34396	Hexachloroethane	ND	1200	
193-39-5	34403	Indeno(1,2,3-cd)pyrene	1100	1200	L
78-59-1	34408	Isophorone	ND	1200	
534-52-1	34657	2-Methyl-4,6-dinitrophenol	ND	2400	
91-20-3	34696	Naphthalene	ND	1200	
98-95-3	34447	Nitrobenzene	ND	1200	
88-75-5	34591	2-Nitrophenol	ND	2400	
100-02-7	34646	4-Nitrophenol	ND	2400	
86-30-3	34433	N-Nitrosodiphenylamine	ND	1200	
621-64-7	34428	N-Nitrosodi-n-propylamine	ND	1200	
87-86-5	39032	Pentachlorophenol	ND	2400	
85-01-8	34461	Phenanthrene	940	1200	L
108-95-2	34694	Phenol	ND	2400	
129-00-0	34469	Pyrene	2200	1200	

SAMPLE NO.: 07697
Sample Results Continued:

CAS NO.	STORET NO.	Compound	Conc. (ug/Kg)	RL (ug/Kg)	Qualifier or Comment
120-82-1	34551	1,2,4-Trichlorobenzene	ND	1200	
88-06-2	34621	2,4,6-Trichlorophenol	ND	2400	
		Hazardous Substances			
65-53-3	77089	Aniline	ND	1200	
65-85-0	77247	Benzoic Acid	ND	2400	
100-51-6	77147	Benzyl Alcohol	ND	1200	
106-47-8		4-Chloroaniline	ND	1200	
132-64-9	81302	Dibenzofuran	ND	1200	
91-57-6		2-Methylnaphthalene	ND	1200	
95-48-7		2-Methylphenol	ND	1200	
106-44-5		4-Methylphenol	ND	1200	
88-74-4		2-Nitroaniline	ND	1200	
99-09-2		3-Nitroaniline	ND	1200	
100-01-6		4-Nitroaniline	ND	1200	
95-95-4	34621	2,4,5-Trichlorophenol	ND	1200	
		Other Compounds Quantitated			
		Diphenylhydrazine	ND	1200	

SAMPLE NO.: 07697

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
GC/MS EXTRACTABLE ORGANIC ANALYSIS

Sample Results Continued:

Tentatively Identified Compounds	Est. Conc. (ug/Kg)	
Unknown	9600	J,B
Unknown	1800	J,B
Phthalic anhydride	790	J
C16 Hydrocarbon	10000	J
C16 Hydrocarbon	2000	J
Unknown	2500	J
C18 Hydrocarbon	4200	J
C18 Hydrocarbon	1400	J
Unknown	7900	J
C20 Hydrocarbon	1200	J
C22 Hydrocarbon	1800	J
C24 Hydrocarbon	3300	J
C26 Hydrocarbon	860	J
C26 Hydrocarbon	4700	J
Decanedioic acid,bis(2-ethylhexyl) ester	1500	J,B
Unknown	1400	J
C28 Hydrocarbon	5400	J
Unknown	1600	J
Benzo(e)pyrene	1800	J
Unknown	1300	J
C30 Hydrocarbon	4300	J
Unknown	1100	J
C30 Hydrocarbon	3900	J
Unknown	1400	J
Unknown	1800	J
Unknown	1300	J
Unknown	3300	J
Unknown	2100	J
Unknown	1200	J

SAMPLE NO.: 07697
Sample Results Continued:

Sample Recoveries For Surrogate Compounds:	Recoveries (%)	QC Range (%)
2-Fluorophenol	121	25-121
Phenol,d5	118*	24-113
Nitrobenzene,d5	105	23-120
Fluorobiphenyl	92	30-115

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
GC/MS EXTRACTABLE ORGANIC ANALYSIS

2,4,6-Tribromophenol	88	19-122
p-Terphenyl,d14	99	18-137
2-Chlorophenol-d4	109	20-130
1,2-Dichlorobenzene-d4	95	20-130

* Values outside of contact required QC limits

SAMPLE NO.:	07698	Matrix:	Soil
DATE OF COLLECTION:	03/24/98	Sample pH:	6.384
DATE OF EXTRACTION:	04/07/98	Percent Moisture	71
DATE OF ANALYSIS:	04/13/98	Conc. Final Vol.	1000 uL
WET WEIGHT EXTRACTED:	60.7 g	Dilution Factor:	2.0
DRY WEIGHT EXTRACTED:	17.8 g	Report Factor:	3.2

SAMPLE RESULTS:

CAS NO.	STORET NO.	Compound	Conc. (ug/Kg)	RL (ug/Kg)	Qualifier or Comment
		Priority Pollutants			
83-32-9	34205	Acenaphthene	220	670	L
208-96-8	34200	Acenaphthylene	320	670	L
120-12-7	34220	Anthracene	710	670	
309-00-2	39330	Aldrin	ND	670	
56-55-3	34526	Benzo(a)anthracene	4500	670	
205-99-2	34230	Benzo(b)fluoranthene	9400	670	
207-08-9	34242	Benzo(k)fluoranthene	2700	670	
50-32-8	34247	Benzo(a)pyrene	5600	670	
191-24-2	34521	Benzo(ghi)perylene	3100	670	
85-68-7	34292	Butyl Benzyl Phthalate	450	670	L
319-85-7	39338	beta-BHC	ND	670	
319-86-8	34259	delta-BHC	ND	670	
111-44-4	34273	Bis(2-chloroethyl)ether	ND	670	
111-91-1	34278	Bis(2-chloroethoxy)methane	ND	670	
117-81-7	39100	Bis(2-ethylhexyl)phthalate	5300	670	B
108-60-1	34283	Bis(2-chloroisopropyl)ether	ND	670	
101-55-3	34636	4-Bromophenylphenyl ether	ND	670	
86-74-8		Carbazole	660	670	L
59-50-7	34452	4-Chloro-3-methylphenol	ND	1300	
91-58-7	34581	2-Chloronaphthalene	ND	670	
95-57-8	34586	2-Chlorophenol	ND	1300	
7005-72-3	34641	4-Chlorophenylphenyl ether	ND	670	
218-01-9	34320	Chrysene	7000	670	

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
GC/MS EXTRACTABLE ORGANIC ANALYSIS

72-54-8	39310	4,4'-DDD	ND	670	
72-55-9	39320	4,4'-DDE	ND	670	
50-29-3	39300	4,4'-DDT	ND	670	
53-70-3	34556	Dibenzo(a,h)anthracene	780	670	
84-74-2	39110	Di-n-butylphthalate	ND	670	
541-73-1	34566	1,3-Dichlorobenzene	ND	670	

SAMPLE NO.: 07698
Sample Results Continued:

CAS NO.	STORET NO.	Compound	Conc. (ug/Kg)	RL (ug/Kg)	Qualifier or Comment
95-50-1	34536	1,2-Dichlorobenzene	ND	670	
106-46-7	34571	1,4-Dichlorobenzene	ND	670	
91-94-1	34631	3,3'-Dichlorobenzidine	ND	670	
120-83-2	34601	2,4-Dichlorophenol	ND	1300	
60-57-1	39380	Dieldrin	ND	670	
84-66-2	34336	Diethylphthalate	ND	670	
105-67-9	34606	2-4-Dimethylphenol	ND	1300	
131-11-3	34341	Dimethylphthalate	ND	670	
51-28-5	34616	2,4-Dinitrophenol	ND	1300	
121-14-2	34611	2,4-Dinitrotoluene	ND	670	
606-20-2	34626	2,6-Dinitrotoluene	ND	670	
117-84-0	34596	Di-n-octylphthalate	240	670	L
206-44-0	34376	Fluoranthene	11000	670	
86-73-7	34381	Fluorene	330	670	L
76-44-8	39410	Heptachlor	ND	670	
1024-57-3	39420	Heptachlor epoxide	ND	670	
118-74-1	39700	Hexachlorobenzene	ND	670	
87-68-3	34391	Hexachlorobutadiene	ND	670	
77-47-4	34386	Hexachlorocyclopentadiene	ND	670	
67-72-1	34396	Hexachloroethane	ND	670	
193-39-5	34403	Indeno(1,2,3-cd)pyrene	3800	670	
78-59-1	34408	Isophorone	ND	670	
534-52-1	34657	2-Methyl-4,6-dinitrophenol	ND	1300	
91-20-3	34696	Naphthalene	ND	670	
98-95-3	34447	Nitrobenzene	ND	670	
88-75-5	34591	2-Nitrophenol	ND	1300	
100-02-7	34646	4-Nitrophenol	ND	1300	
86-30-3	34433	N-Nitrosodiphenylamine	ND	670	
621-64-7	34428	N-Nitrosodi-n-propylamine	ND	670	
87-86-5	39032	Pentachlorophenol	ND	1300	
85-01-8	34461	Phenanthrene	5000	670	
108-95-2	34694	Phenol	ND	1300	

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
GC/MS EXTRACTABLE ORGANIC ANALYSIS

129-00-0	34469	Pyrene	10000	670	

SAMPLE NO.: 07698
Sample Results Continued:

CAS NO.	STORET NO.	Compound	Conc. (ug/Kg)	RL (ug/Kg)	Qualifier or Comment
120-82-1	34551	1,2,4-Trichlorobenzene	ND	670	
88-06-2	34621	2,4,6-Trichlorophenol	ND	1300	
		Hazardous Substances			
65-53-3	77089	Aniline	ND	670	
65-85-0	77247	Benzoic Acid	ND	1300	
100-51-6	77147	Benzyl Alcohol	ND	670	
106-47-8		4-Chloroaniline	ND	670	
132-64-9	81302	Dibenzofuran	140	670	L
91-57-6		2-Methylnaphthalene	ND	670	
95-48-7		2-Methylphenol	ND	670	
106-44-5		4-Methylphenol	300	670	L
88-74-4		2-Nitroaniline	ND	670	
99-09-2		3-Nitroaniline	ND	670	
100-01-6		4-Nitroaniline	ND	670	
95-95-4	34621	2,4,5-Trichlorophenol	ND	670	
		Other Compounds Quantitated			
		Diphenylhydrazine	ND	670	

SAMPLE NO.: 07698
Sample Results Continued:

Tentatively Identified Compounds	Est. Conc. (ug/Kg)	
Unknown	5800	J,B
C14 Hydrocarbon	1400	J
C16 Hydrocarbon	920	J
C16 Hydrocarbon	890	J
C16 Hydrocarbon	2300	J
C18 Hydrocarbon	1300	J
Unknown	1200	J
methyl-Phenanthrene isomer	4600	J

Unknown	3700	J
Unknown	2700	J
C22 Hydrocarbon	2600	J
Unknown	2900	J
C24 Hydrocarbon	4600	J
Unknown	11000	J
Unknown	4300	J
C28 Hydrocarbon	23000	J
Benzo(e)pyrene	5900	J
C30 Hydrocarbon	11000	J
C30 Hydrocarbon	25000	J
Unknown	25000	J
C32 Hydrocarbon	5400	J
Unknown	3100	J
Unknown	5400	J
Unknown	3700	J
Unknown	9200	J
Unknown	11000	J
Unknown	1300	J
Unknown	8600	J
Unknown	4400	J

SAMPLE NO.: 07698
Sample Results Continued:

Sample Recoveries For Surrogate Compounds:	Recoveries (%)	QC Range (%)
2-Fluorophenol	104	25-121
Phenol,d5	106	24-113
Nitrobenzene,d5	90	23-120
Fluorobiphenyl	86	30-115
2,4,6-Tribromophenol	94	19-122
p-Terphenyl,d14	106	18-137
2-Chlorophenol-d4	102	20-130
1,2-Dichlorobenzene-d4	93	20-130

SAMPLE NO.: 07699		Matrix:	Soil
DATE OF COLLECTION:	03/24/98	Sample pH:	6.341
DATE OF EXTRACTION:	04/02/98	Percent Moisture	69
DATE OF ANALYSIS:	04/11/98	Conc. Final Vol.	1000 uL
WET WEIGHT EXTRACTED:	60.4 g	Dilution Factor:	2.0

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
GC/MS EXTRACTABLE ORGANIC ANALYSIS

DRY WEIGHT EXTRACTED: 18.6 g Report Factor: 3.2

SAMPLE RESULTS:

CAS NO.	STORET NO.	Compound	Conc. (ug/Kg)	RL (ug/Kg)	Qualifier or Comment
		Priority Pollutants			
83-32-9	34205	Acenaphthene	ND	670	
208-96-8	34200	Acenaphthylene	370	670	L
120-12-7	34220	Anthracene	ND	670	
309-00-2	39330	Aldrin	ND	670	
56-55-3	34526	Benzo(a)anthracene	3000	670	
205-99-2	34230	Benzo(b)fluoranthene	5100	670	
207-08-9	34242	Benzo(k)fluoranthene	1000	670	
50-32-8	34247	Benzo(a)pyrene	3100	670	
191-24-2	34521	Benzo(ghi)perylene	1500	670	
85-68-7	34292	Butyl Benzyl Phthalate	360	670	L,B
319-85-7	39338	beta-BHC	ND	670	
319-86-8	34259	delta-BHC	ND	670	
111-44-4	34273	Bis(2-chloroethyl)ether	ND	670	
111-91-1	34278	Bis(2-chloroethoxy)methane	ND	670	
117-81-7	39100	Bis(2-ethylhexyl)phthalate	960	670	L,B
108-60-1	34283	Bis(2-chloroisopropyl)ether	ND	670	
101-55-3	34636	4-Bromophenylphenyl ether	ND	670	
86-74-8		Carbazole	280	670	L
59-50-7	34452	4-Chloro-3-methylphenol	ND	1300	
91-58-7	34581	2-Chloronaphthalene	ND	670	
95-57-8	34586	2-Chlorophenol	ND	1300	
7005-72-3	34641	4-Chlorophenylphenyl ether	ND	670	
218-01-9	34320	Chrysene	3500	670	
72-54-8	39310	4,4'-DDD	ND	670	
72-55-9	39320	4,4'-DDE	ND	670	
50-29-3	39300	4,4'-DDT	ND	670	
53-70-3	34556	Dibenzo(a,h)anthracene	510	670	L
84-74-2	39110	Di-n-butylphthalate	ND	670	
541-73-1	34566	1,3-Dichlorobenzene	ND	670	

SAMPLE NO.: 07699
Sample Results Continued:

CAS NO.	STORET NO.	Compound	Conc. (ug/Kg)	RL (ug/Kg)	Qualifier or Comment
95-50-1	34536	1,2-Dichlorobenzene	ND	670	

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
GC/MS EXTRACTABLE ORGANIC ANALYSIS

106-46-7	34571	1,4-Dichlorobenzene	ND	670	
91-94-1	34631	3,3'-Dichlorobenzidine	ND	670	
120-83-2	34601	2,4-Dichlorophenol	ND	1300	
60-57-1	39380	Dieldrin	ND	670	
84-66-2	34336	Diethylphthalate	ND	670	
105-67-9	34606	2-4-Dimethylphenol	ND	1300	
131-11-3	34341	Dimethylphthalate	ND	670	
51-28-5	34616	2,4-Dinitrophenol	ND	1300	
121-14-2	34611	2,4-Dinitrotoluene	ND	670	
606-20-2	34626	2,6-Dinitrotoluene	ND	670	
117-84-0	34596	Di-n-octylphthalate	ND	670	
206-44-0	34376	Fluoranthene	6700	670	
86-73-7	34381	Fluorene	290	670	L
76-44-8	39410	Heptachlor	ND	670	
1024-57-3	39420	Heptachlor epoxide	ND	670	
118-74-1	39700	Hexachlorobenzene	ND	670	
87-68-3	34391	Hexachlorobutadiene	ND	670	
77-47-4	34386	Hexachlorocyclopentadiene	ND	670	
67-72-1	34396	Hexachloroethane	ND	670	
193-39-5	34403	Indeno(1,2,3-cd)pyrene	2200	670	
78-59-1	34408	Isophorone	ND	670	
534-52-1	34657	2-Methyl-4,6-dinitrophenol	ND	1300	
91-20-3	34696	Naphthalene	ND	670	
98-95-3	34447	Nitrobenzene	ND	670	
88-75-5	34591	2-Nitrophenol	ND	1300	
100-02-7	34646	4-Nitrophenol	ND	1300	
86-30-3	34433	N-Nitrosodiphenylamine	ND	670	
621-64-7	34428	N-Nitrosodi-n-propylamine	ND	670	
87-86-5	39032	Pentachlorophenol	ND	1300	
85-01-8	34461	Phenanthrene	3400	670	
108-95-2	34694	Phenol	ND	1300	
129-00-0	34469	Pyrene	5500	670	

SAMPLE NO.: 07699
Sample Results Continued:

CAS NO.	STORET NO.	Compound	Conc. (ug/Kg)	RL (ug/Kg)	Qualifier or Comment
120-82-1	34551	1,2,4-Trichlorobenzene	ND	670	
88-06-2	34621	2,4,6-Trichlorophenol	ND	1300	

Hazardous Substances

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
GC/MS EXTRACTABLE ORGANIC ANALYSIS

65-53-3	77089	Aniline	ND	670	
65-85-0	77247	Benzoic Acid	920	1300	L
100-51-6	77147	Benzyl Alcohol	ND	670	
106-47-8		4-Chloroaniline	ND	670	
132-64-9	81302	Dibenzofuran	120	670	L
91-57-6		2-Methylnaphthalene	ND	670	
95-48-7		2-Methylphenol	ND	670	
106-44-5		4-Methylphenol	ND	670	
88-74-4		2-Nitroaniline	ND	670	
99-09-2		3-Nitroaniline	ND	670	
100-01-6		4-Nitroaniline	ND	670	
95-95-4	34621	2,4,5-Trichlorophenol	ND	670	
		Other Compounds Quantitated			
		Diphenylhydrazine	ND	670	

SAMPLE NO.: 07699
Sample Results Continued:

Tentatively Identified Compounds	Est. Conc. (ug/Kg)	
Unknown	560	J
Unknown	720	J,B
Unknown	7700	J,B
Unknown	1500	J,B
C16 Hydrocarbon	890	J
Unknown	520	J
Unknown	3700	J
2-Pentadecanone,6,10,14-trimethyl-	630	J
3,7,11,15-Tetramethyl-2-hexadecen-1-01	1100	J
methyl-Phenanthrene isomer	2300	J
Unknown	2000	J
9,10-Anthracenedione	600	J
Unknown	750	J,B
Unknown	490	J
Unknown PAH	650	J
methyl-Pyrene isomer	1600	J
methyl-Pyrene isomer	990	J
Unknown	2500	J
Unknown	1200	J
C24 Hydrocarbon	2600	J

C26 Hydrocarbon	3600	J
Unknown	4900	J
C28 Hydrocarbon	3500	J
Benzo(e)pyrene	3600	J
C30 Hydrocarbon	1100	J
Unknown	4000	J
Unknown	3200	J

SAMPLE NO.: 07699
Sample Results Continued:

Sample Recoveries For Surrogate Compounds:	Recoveries (%)	QC Range (%)
2-Fluorophenol	99	25-121
Phenol,d5	99	24-113
Nitrobenzene,d5	88	23-120
Fluorobiphenyl	86	30-115
2,4,6-Tribromophenol	84	19-122
p-Terphenyl,d14	94	18-137
2-Chlorophenol-d4	97	20-130
1,2-Dichlorobenzene-d4	85	20-130

SAMPLE NO.: 07700 Matrix: Soil
DATE OF COLLECTION: 03/25/98 Sample pH: 6.786
DATE OF EXTRACTION: 04/02/98 Percent Moisture 85
DATE OF ANALYSIS: 04/10/98 Conc. Final Vol. 1000 uL
WET WEIGHT EXTRACTED: 64.9 g Dilution Factor: 2.0
DRY WEIGHT EXTRACTED: 9.6 g Report Factor: 6.2

SAMPLE RESULTS:

CAS NO.	STORET NO.	Compound	Conc. (ug/Kg)	RL (ug/Kg)	Qualifier or Comment
		Priority Pollutants			
83-32-9	34205	Acenaphthene	ND	1300	
208-96-8	34200	Acenaphthylene	320	1300	L
120-12-7	34220	Anthracene	600	1300	L
309-00-2	39330	Aldrin	ND	1300	
56-55-3	34526	Benzo(a)anthracene	2600	1300	
205-99-2	34230	Benzo(b)fluoranthene	4300	1300	
207-08-9	34242	Benzo(k)fluoranthene	1600	1300	

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
GC/MS EXTRACTABLE ORGANIC ANALYSIS

50-32-8	34247	Benzo(a)pyrene	2900	1300	
191-24-2	34521	Benzo(ghi)perylene	1200	1300	L
85-68-7	34292	Butyl Benzyl Phthalate	610	1300	L,B
319-85-7	39338	beta-BHC	ND	1300	
319-86-8	34259	delta-BHC	ND	1300	
111-44-4	34273	Bis(2-chloroethyl)ether	ND	1300	
111-91-1	34278	Bis(2-chloroethoxy)methane	ND	1300	
117-81-7	39100	Bis(2-ethylhexyl)phthalate	5100	1300	B
108-60-1	34283	Bis(2-chloroisopropyl)ether	ND	1300	
101-55-3	34636	4-Bromophenylphenyl ether	ND	1300	
86-74-8		Carbazole	250	1300	L
59-50-7	34452	4-Chloro-3-methylphenol	ND	2600	
91-58-7	34581	2-Chloronaphthalene	ND	1300	
95-57-8	34586	2-Chlorophenol	ND	2600	
7005-72-3	34641	4-Chlorophenylphenyl ether	ND	1300	
218-01-9	34320	Chrysene	3400	1300	
72-54-8	39310	4,4'-DDD	ND	1300	
72-55-9	39320	4,4'-DDE	ND	1300	
50-29-3	39300	4,4'-DDT	ND	1300	
53-70-3	34556	Dibenzo(a,h)anthracene	350	1300	L
84-74-2	39110	Di-n-butylphthalate	700	1300	L,B
541-73-1	34566	1,3-Dichlorobenzene	ND	1300	

SAMPLE NO.: 07700
Sample Results Continued:

CAS NO.	STORET NO.	Compound	Conc. (ug/Kg)	RL (ug/Kg)	Qualifier or Comment
95-50-1	34536	1,2-Dichlorobenzene	ND	1300	
106-46-7	34571	1,4-Dichlorobenzene	ND	1300	
91-94-1	34631	3,3'-Dichlorobenzidine	ND	1300	
120-83-2	34601	2,4-Dichlorophenol	ND	2600	
60-57-1	39380	Dieldrin	ND	1300	
84-66-2	34336	Diethylphthalate	600	1300	L,B
105-67-9	34606	2-4-Dimethylphenol	ND	2600	
131-11-3	34341	Dimethylphthalate	250	1300	L
51-28-5	34616	2,4-Dinitrophenol	ND	2600	
121-14-2	34611	2,4-Dinitrotoluene	ND	1300	
606-20-2	34626	2,6-Dinitrotoluene	ND	1300	
117-84-0	34596	Di-n-octylphthalate	ND	1300	
206-44-0	34376	Fluoranthene	5000	1300	
86-73-7	34381	Fluorene	ND	1300	
76-44-8	39410	Heptachlor	ND	1300	
1024-57-3	39420	Heptachlor epoxide	ND	1300	

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
GC/MS EXTRACTABLE ORGANIC ANALYSIS

118-74-1	39700	Hexachlorobenzene	ND	1300
87-68-3	34391	Hexachlorobutadiene	ND	1300
77-47-4	34386	Hexachlorocyclopentadiene	ND	1300
67-72-1	34396	Hexachloroethane	ND	1300
193-39-5	34403	Indeno(1,2,3-cd)pyrene	1400	1300
78-59-1	34408	Isophorone	ND	1300
534-52-1	34657	2-Methyl-4,6-dinitrophenol	ND	2600
91-20-3	34696	Naphthalene	ND	1300
98-95-3	34447	Nitrobenzene	ND	1300
88-75-5	34591	2-Nitrophenol	ND	2600
100-02-7	34646	4-Nitrophenol	ND	2600
86-30-3	34433	N-Nitrosodiphenylamine	ND	1300
621-64-7	34428	N-Nitrosodi-n-propylamine	ND	1300
87-86-5	39032	Pentachlorophenol	ND	2600
85-01-8	34461	Phenanthrene	1800	1300
108-95-2	34694	Phenol	ND	2600
129-00-0	34469	Pyrene	4900	1300

SAMPLE NO.: 07700
Sample Results Continued:

CAS NO.	STORET NO.	Compound	Conc. (ug/Kg)	RL (ug/Kg)	Qualifier or Comment
120-82-1	34551	1,2,4-Trichlorobenzene	ND	1300	
88-06-2	34621	2,4,6-Trichlorophenol	ND	2600	
		Hazardous Substances			
65-53-3	77089	Aniline	ND	1300	
65-85-0	77247	Benzoic Acid	ND	2600	
100-51-6	77147	Benzyl Alcohol	ND	1300	
106-47-8		4-Chloroaniline	400	1300	L
132-64-9	81302	Dibenzofuran	ND	1300	
91-57-6		2-Methylnaphthalene	ND	1300	
95-48-7		2-Methylphenol	ND	1300	
106-44-5		4-Methylphenol	ND	1300	
88-74-4		2-Nitroaniline	ND	1300	
99-09-2		3-Nitroaniline	ND	1300	
100-01-6		4-Nitroaniline	ND	1300	
95-95-4	34621	2,4,5-Trichlorophenol	ND	1300	
		Other Compounds Quantitated			

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
GC/MS EXTRACTABLE ORGANIC ANALYSIS

Diphenylhydrazine	ND	1300

SAMPLE NO.: 07700
Sample Results Continued:

Tentatively Identified Compounds	Est. Conc. (ug/Kg)	
Unknown	1000	J,B
Unknown	13000	J,B
Unknown	2400	J,B
Unknown	1400	J,B
C12 Hydrocarbon	1200	J
Hexane,2,2,5-trimethyl-	1200	J
C18 Hydrocarbon	1500	J
Unknown	2200	J
Unknown	890	J
Benzene,(1-pentylheptyl)-	930	J
Unknown	1100	J
Unknown	1100	J
Unknown	1400	J
C18 Hydrocarbon	2000	J
Unknown	1900	J
Unknown	1400	J
Unknown	2500	J
Unknown	1800	J
Unknown	1200	J
Unknown	2200	J
Unknown	8700	J
Unknown	2300	J
Unknown	3100	J
Unknown	6100	J
C28 Hydrocarbon	4400	J
Benzo(e)pyrene	2700	J
Unknown	2800	J
Unknown	7100	J

SAMPLE NO.: 07700
Sample Results Continued:

Sample Recoveries For Surrogate Compounds:	Recoveries (%)	QC Range (%)
2-Fluorophenol	88	25-121

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
GC/MS EXTRACTABLE ORGANIC ANALYSIS

Phenol,d5	90	24-113
Nitrobenzene,d5	80	23-120
Fluorobiphenyl	81	30-115
2,4,6-Tribromophenol	82	19-122
p-Terphenyl,d14	95	18-137
2-Chlorophenol-d4	88	20-130
1,2-Dichlorobenzene-d4	92	20-130

SAMPLE NO.:	07701	Matrix:	Soil
DATE OF COLLECTION:	03/25/98	Sample pH:	6.565
DATE OF EXTRACTION:	04/02/98	Percent Moisture	87
DATE OF ANALYSIS:	04/13/98	Conc. Final Vol.	1000 uL
WET WEIGHT EXTRACTED:	65.1 g	Dilution Factor:	2.0
DRY WEIGHT EXTRACTED:	8.4 g	Report Factor:	7.1

SAMPLE RESULTS:

CAS NO.	STORET NO.	Compound	Conc. (ug/Kg)	RL (ug/Kg)	Qualifier or Comment
		Priority Pollutants			
83-32-9	34205	Acenaphthene	ND	1500	
208-96-8	34200	Acenaphthylene	810	1500	L
120-12-7	34220	Anthracene	960	1500	L
309-00-2	39330	Aldrin	ND	1500	
56-55-3	34526	Benzo(a)anthracene	4200	1500	
205-99-2	34230	Benzo(b)fluoranthene	8300	1500	
207-08-9	34242	Benzo(k)fluoranthene	2900	1500	
50-32-8	34247	Benzo(a)pyrene	5200	1500	
191-24-2	34521	Benzo(ghi)perylene	3200	1500	
85-68-7	34292	Butyl Benzyl Phthalate	860	1500	L,B
319-85-7	39338	beta-BHC	ND	1500	
319-86-8	34259	delta-BHC	ND	1500	
111-44-4	34273	Bis(2-chloroethyl)ether	ND	1500	
111-91-1	34278	Bis(2-chloroethoxy)methane	ND	1500	
117-81-7	39100	Bis(2-ethylhexyl)phthalate	14000	1500	B
108-60-1	34283	Bis(2-chloroisopropyl)ether	ND	1500	
101-55-3	34636	4-Bromophenylphenyl ether	ND	1500	
86-74-8		Carbazole	480	1500	L
59-50-7	34452	4-Chloro-3-methylphenol	ND	3000	
91-58-7	34581	2-Chloronaphthalene	ND	1500	
95-57-8	34586	2-Chlorophenol	ND	3000	
7005-72-3	34641	4-Chlorophenylphenyl ether	ND	1500	

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
GC/MS EXTRACTABLE ORGANIC ANALYSIS

218-01-9	34320	Chrysene	5900	1500	
72-54-8	39310	4,4'-DDD	ND	1500	
72-55-9	39320	4,4'-DDE	ND	1500	
50-29-3	39300	4,4'-DDT	ND	1500	
53-70-3	34556	Dibenzo(a,h)anthracene	790	1500	L
84-74-2	39110	Di-n-butylphthalate	930	1500	L,B
541-73-1	34566	1,3-Dichlorobenzene	ND	1500	

SAMPLE NO.: 07701
Sample Results Continued:

CAS NO.	STORET NO.	Compound	Conc. (ug/Kg)	RL (ug/Kg)	Qualifier or Comment
95-50-1	34536	1,2-Dichlorobenzene	ND	1500	
106-46-7	34571	1,4-Dichlorobenzene	ND	1500	
91-94-1	34631	3,3'-Dichlorobenzidine	ND	1500	
120-83-2	34601	2,4-Dichlorophenol	ND	3000	
60-57-1	39380	Dieldrin	ND	1500	
84-66-2	34336	Diethylphthalate	510	1500	L,B
105-67-9	34606	2-4-Dimethylphenol	ND	3000	
131-11-3	34341	Dimethylphthalate	500	1500	L
51-28-5	34616	2,4-Dinitrophenol	ND	3000	
121-14-2	34611	2,4-Dinitrotoluene	ND	1500	
606-20-2	34626	2,6-Dinitrotoluene	ND	1500	
117-84-0	34596	Di-n-octylphthalate	ND	1500	
206-44-0	34376	Fluoranthene	8300	1500	
86-73-7	34381	Fluorene	ND	1500	
76-44-8	39410	Heptachlor	ND	1500	
1024-57-3	39420	Heptachlor epoxide	ND	1500	
118-74-1	39700	Hexachlorobenzene	ND	1500	
87-68-3	34391	Hexachlorobutadiene	ND	1500	
77-47-4	34386	Hexachlorocyclopentadiene	ND	1500	
67-72-1	34396	Hexachloroethane	ND	1500	
193-39-5	34403	Indeno(1,2,3-cd)pyrene	630	1500	L
78-59-1	34408	Isophorone	ND	1500	
534-52-1	34657	2-Methyl-4,6-dinitrophenol	ND	3000	
91-20-3	34696	Naphthalene	ND	1500	
98-95-3	34447	Nitrobenzene	ND	1500	
88-75-5	34591	2-Nitrophenol	ND	3000	
100-02-7	34646	4-Nitrophenol	ND	3000	
86-30-3	34433	N-Nitrosodiphenylamine	ND	1500	
621-64-7	34428	N-Nitrosodi-n-propylamine	ND	1500	
87-86-5	39032	Pentachlorophenol	ND	3000	
85-01-8	34461	Phenanthrene	3200	1500	

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
GC/MS EXTRACTABLE ORGANIC ANALYSIS

108-95-2	34694	Phenol	ND	3000
129-00-0	34469	Pyrene	9100	1500

SAMPLE NO.: 07701
Sample Results Continued:

CAS NO.	STORET NO.	Compound	Conc. (ug/Kg)	RL (ug/Kg)	Qualifier or Comment
120-82-1	34551	1,2,4-Trichlorobenzene	ND	1500	
88-06-2	34621	2,4,6-Trichlorophenol	ND	3000	
		Hazardous Substances			
65-53-3	77089	Aniline	ND	1500	
65-85-0	77247	Benzoic Acid	ND	3000	
100-51-6	77147	Benzyl Alcohol	ND	1500	
106-47-8		4-Chloroaniline	ND	1500	
132-64-9	81302	Dibenzofuran	ND	1500	
91-57-6		2-Methylnaphthalene	ND	1500	
95-48-7		2-Methylphenol	ND	1500	
106-44-5		4-Methylphenol	ND	1500	
88-74-4		2-Nitroaniline	ND	1500	
99-09-2		3-Nitroaniline	ND	1500	
100-01-6		4-Nitroaniline	ND	1500	
95-95-4	34621	2,4,5-Trichlorophenol	ND	1500	
		Other Compounds Quantitated			
		Diphenylhydrazine	ND	1500	

SAMPLE NO.: 07701
Sample Results Continued:

Tentatively Identified Compounds	Est. Conc. (ug/Kg)	
Unknown	10000	J,B
Unknown	2300	J,B
Unknown	1000	J
C12 Hydrocarbon	2800	J
Unknown	3900	J
C12 Hydrocarbon	1600	J
Unknown	1200	J

Unknown	1400	J
Unknown	1100	J
C12 Hydrocarbon	1700	J
Unknown	1200	J
C12 Hydrocarbon	1100	J
C12 Hydrocarbon	1200	J
Unknown	1100	J
C14 Hydrocarbon	2200	J
Unknown	1700	J
Unknown	1200	J
Unknown	1700	J
Unknown	1300	J
C16 Hydrocarbon	1200	J
Unknown	1700	J
C16 Hydrocarbon	4400	J
C16 Hydrocarbon	15000	J
C18 Hydrocarbon	13000	J
Unknown	9900	J
Unknown	8500	J
Unknown	11000	J

SAMPLE NO.: 07701
Sample Results Continued:

Sample Recoveries For Surrogate Compounds:	Recoveries (%)	QC Range (%)
2-Fluorophenol	99	25-121
Phenol,d5	101	24-113
Nitrobenzene,d5	87	23-120
Fluorobiphenyl	86	30-115
2,4,6-Tribromophenol	104	19-122
p-Terphenyl,d14	104	18-137
2-Chlorophenol-d4	101	20-130
1,2-Dichlorobenzene-d4	91	20-130

SAMPLE NO.: 07702
DATE OF COLLECTION: 03/25/98
DATE OF EXTRACTION: 04/02/98
DATE OF ANALYSIS: 04/13/98
WET WEIGHT EXTRACTED: 60.3 g
DRY WEIGHT EXTRACTED: 10.1 g

Matrix: Soil
Sample pH: 6.477
Percent Moisture 83
Conc. Final Vol. 1000 uL
Dilution Factor: 2.0
Report Factor: 6.0

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
GC/MS EXTRACTABLE ORGANIC ANALYSIS

SAMPLE RESULTS:

CAS NO.	STORET NO.	Compound	Conc. (ug/Kg)	RL (ug/Kg)	Qualifier or Comment
		Priority Pollutants			
83-32-9	34205	Acenaphthene	ND	1300	
208-96-8	34200	Acenaphthylene	270	1300	L
120-12-7	34220	Anthracene	250	1300	L
309-00-2	39330	Aldrin	ND	1300	
56-55-3	34526	Benzo(a)anthracene	1000	1300	L
205-99-2	34230	Benzo(b)fluoranthene	2400	1300	
207-08-9	34242	Benzo(k)fluoranthene	780	1300	L
50-32-8	34247	Benzo(a)pyrene	1400	1300	
191-24-2	34521	Benzo(ghi)perylene	1300	1300	
85-68-7	34292	Butyl Benzyl Phthalate	310	1300	L,B
319-85-7	39338	beta-BHC	ND	1300	
319-86-8	34259	delta-BHC	ND	1300	
111-44-4	34273	Bis(2-chloroethyl)ether	ND	1300	
111-91-1	34278	Bis(2-chloroethoxy)methane	ND	1300	
117-81-7	39100	Bis(2-ethylhexyl)phthalate	3200	1300	B
108-60-1	34283	Bis(2-chloroisopropyl)ether	ND	1300	
101-55-3	34636	4-Bromophenylphenyl ether	ND	1300	
86-74-8		Carbazole	ND	1300	
59-50-7	34452	4-Chloro-3-methylphenol	ND	2500	
91-58-7	34581	2-Chloronaphthalene	ND	1300	
95-57-8	34586	2-Chlorophenol	ND	2500	
7005-72-3	34641	4-Chlorophenylphenyl ether	ND	1300	
218-01-9	34320	Chrysene	1500	1300	
72-54-8	39310	4,4'-DDD	ND	1300	
72-55-9	39320	4,4'-DDE	ND	1300	
50-29-3	39300	4,4'-DDT	ND	1300	
53-70-3	34556	Dibenzo(a,h)anthracene	380	1300	L
84-74-2	39110	Di-n-butylphthalate	430	1300	L,B
541-73-1	34566	1,3-Dichlorobenzene	ND	1300	

SAMPLE NO.: 07702
Sample Results Continued:

CAS NO.	STORET NO.	Compound	Conc. (ug/Kg)	RL (ug/Kg)	Qualifier or Comment
95-50-1	34536	1,2-Dichlorobenzene	ND	1300	
106-46-7	34571	1,4-Dichlorobenzene	ND	1300	

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
GC/MS EXTRACTABLE ORGANIC ANALYSIS

91-94-1	34631	3,3'-Dichlorobenzidine	ND	1300	
120-83-2	34601	2,4-Dichlorophenol	ND	2500	
60-57-1	39380	Dieldrin	ND	1300	
84-66-2	34336	Diethylphthalate	250	1300	L,B
105-67-9	34606	2-4-Dimethylphenol	ND	2500	
131-11-3	34341	Dimethylphthalate	ND	1300	
51-28-5	34616	2,4-Dinitrophenol	ND	2500	
121-14-2	34611	2,4-Dinitrotoluene	ND	1300	
606-20-2	34626	2,6-Dinitrotoluene	ND	1300	
117-84-0	34596	Di-n-octylphthalate	ND	1300	
206-44-0	34376	Fluoranthene	2200	1300	
86-73-7	34381	Fluorene	ND	1300	
76-44-8	39410	Heptachlor	ND	1300	
1024-57-3	39420	Heptachlor epoxide	ND	1300	
118-74-1	39700	Hexachlorobenzene	ND	1300	
87-68-3	34391	Hexachlorobutadiene	ND	1300	
77-47-4	34386	Hexachlorocyclopentadiene	ND	1300	
67-72-1	34396	Hexachloroethane	ND	1300	
193-39-5	34403	Indeno(1,2,3-cd)pyrene	1300	1300	
78-59-1	34408	Isophorone	ND	1300	
534-52-1	34657	2-Methyl-4,6-dinitrophenol	ND	2500	
91-20-3	34696	Naphthalene	ND	1300	
98-95-3	34447	Nitrobenzene	ND	1300	
88-75-5	34591	2-Nitrophenol	ND	2500	
100-02-7	34646	4-Nitrophenol	ND	2500	
86-30-3	34433	N-Nitrosodiphenylamine	ND	1300	
621-64-7	34428	N-Nitrosodi-n-propylamine	ND	1300	
87-86-5	39032	Pentachlorophenol	ND	2500	
85-01-8	34461	Phenanthrene	670	1300	L
108-95-2	34694	Phenol	ND	2500	
129-00-0	34469	Pyrene	2300	1300	

SAMPLE NO.: 07702
Sample Results Continued:

CAS NO.	STORET NO.	Compound	Conc. (ug/Kg)	RL (ug/Kg)	Qualifier or Comment
120-82-1	34551	1,2,4-Trichlorobenzene	ND	1300	
88-06-2	34621	2,4,6-Trichlorophenol	ND	2500	
		Hazardous Substances			
65-53-3	77089	Aniline	ND	1300	

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
GC/MS EXTRACTABLE ORGANIC ANALYSIS

65-85-0	77247	Benzoic Acid	ND	2500
100-51-6	77147	Benzyl Alcohol	ND	1300
106-47-8		4-Chloroaniline	ND	1300
132-64-9	81302	Dibenzofuran	ND	1300
91-57-6		2-Methylnaphthalene	ND	1300
95-48-7		2-Methylphenol	ND	1300
106-44-5		4-Methylphenol	ND	1300
88-74-4		2-Nitroaniline	ND	1300
99-09-2		3-Nitroaniline	ND	1300
100-01-6		4-Nitroaniline	ND	1300
95-95-4	34621	2,4,5-Trichlorophenol	ND	1300
		Other Compounds Quantitated		
		Diphenylhydrazine	ND	1300

SAMPLE NO.: 07702
Sample Results Continued:

Tentatively Identified Compounds	Est. Conc. (ug/Kg)	
Unknown	9600	J,B
Unknown	1800	J,B
C12 Hydrocarbon	940	J
C12 Hydrocarbon	1400	J
C14 Hydrocarbon	840	J
4-(tetramethylbutyl)-phenol isomer	1200	J
C16 Hydrocarbon	820	J
C16 Hydrocarbon	2200	J
C16 Hydrocarbon	3500	J
Unknown	1100	J
Unknown	2100	J
C18 Hydrocarbon	2900	J
Unknown	1600	J
Unknown	3800	J
C18 Hydrocarbon	1400	J
Unknown	2500	J
Unknown	6300	J
C28 Hydrocarbon	6900	J
C30 Hydrocarbon	5200	J
Unknown	5000	J
Unknown	5800	J

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
GC/MS EXTRACTABLE ORGANIC ANALYSIS

SAMPLE NO.: 07702
Sample Results Continued:

Sample Recoveries For Surrogate Compounds:	Recoveries (%)	QC Range (%)
2-Fluorophenol	97	25-121
Phenol,d5	91	24-113
Nitrobenzene,d5	83	23-120
Fluorobiphenyl	82	30-115
2,4,6-Tribromophenol	96	19-122
p-Terphenyl,d14	106	18-137
2-Chlorophenol-d4	100	20-130
1,2-Dichlorobenzene-d4	94	20-130

SAMPLE NO.: 07703 Matrix: Soil
DATE OF COLLECTION: 03/25/98 Sample pH: 6.487
DATE OF EXTRACTION: 04/02/98 Percent Moisture 79
DATE OF ANALYSIS: 04/10/98 Conc. Final Vol. 1000 uL
WET WEIGHT EXTRACTED: 60.3 g Dilution Factor: 2.0
DRY WEIGHT EXTRACTED: 12.4 g Report Factor: 4.8

SAMPLE RESULTS:

CAS NO.	STORET NO.	Compound	Conc. (ug/Kg)	RL (ug/Kg)	Qualifier or Comment
		Priority Pollutants			
83-32-9	34205	Acenaphthene	ND	1000	
208-96-8	34200	Acenaphthylene	440	1000	L
120-12-7	34220	Anthracene	330	1000	L
309-00-2	39330	Aldrin	ND	1000	
56-55-3	34526	Benzo(a)anthracene	1200	1000	
205-99-2	34230	Benzo(b)fluoranthene	2500	1000	
207-08-9	34242	Benzo(k)fluoranthene	780	1000	L
50-32-8	34247	Benzo(a)pyrene	1400	1000	
191-24-2	34521	Benzo(ghi)perylene	870	1000	L
85-68-7	34292	Butyl Benzyl Phthalate	ND	1000	
319-85-7	39338	beta-BHC	ND	1000	
319-86-8	34259	delta-BHC	ND	1000	
111-44-4	34273	Bis(2-chloroethyl)ether	ND	1000	
111-91-1	34278	Bis(2-chloroethoxy)methane	ND	1000	
117-81-7	39100	Bis(2-ethylhexyl)phthalate	4000	1000	B

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
GC/MS EXTRACTABLE ORGANIC ANALYSIS

108-60-1	34283	Bis(2-chloroisopropyl)ether	ND	1000	
101-55-3	34636	4-Bromophenylphenyl ether	ND	1000	
86-74-8		Carbazole	ND	1000	
59-50-7	34452	4-Chloro-3-methylphenol	ND	2000	
91-58-7	34581	2-Chloronaphthalene	ND	1000	
95-57-8	34586	2-Chlorophenol	ND	2000	
7005-72-3	34641	4-Chlorophenylphenyl ether	ND	1000	
218-01-9	34320	Chrysene	1700	1000	
72-54-8	39310	4,4'-DDD	ND	1000	
72-55-9	39320	4,4'-DDE	ND	1000	
50-29-3	39300	4,4'-DDT	ND	1000	
53-70-3	34556	Dibenzo(a,h)anthracene	280	1000	L
84-74-2	39110	Di-n-butylphthalate	4500	1000	B
541-73-1	34566	1,3-Dichlorobenzene	ND	1000	

SAMPLE NO.: 07703
Sample Results Continued:

CAS NO.	STORET NO.	Compound	Conc. (ug/Kg)	RL (ug/Kg)	Qualifier or Comment
95-50-1	34536	1,2-Dichlorobenzene	ND	1000	
106-46-7	34571	1,4-Dichlorobenzene	310	1000	L
91-94-1	34631	3,3'-Dichlorobenzidine	ND	1000	
120-83-2	34601	2,4-Dichlorophenol	ND	2000	
60-57-1	39380	Dieldrin	ND	1000	
84-66-2	34336	Diethylphthalate	ND	1000	
105-67-9	34606	2-4-Dimethylphenol	ND	2000	
131-11-3	34341	Dimethylphthalate	ND	1000	
51-28-5	34616	2,4-Dinitrophenol	ND	2000	
121-14-2	34611	2,4-Dinitrotoluene	ND	1000	
606-20-2	34626	2,6-Dinitrotoluene	ND	1000	
117-84-0	34596	Di-n-octylphthalate	ND	1000	
206-44-0	34376	Fluoranthene	2200	1000	
86-73-7	34381	Fluorene	ND	1000	
76-44-8	39410	Heptachlor	ND	1000	
1024-57-3	39420	Heptachlor epoxide	ND	1000	
118-74-1	39700	Hexachlorobenzene	ND	1000	
87-68-3	34391	Hexachlorobutadiene	ND	1000	
77-47-4	34386	Hexachlorocyclopentadiene	ND	1000	
67-72-1	34396	Hexachloroethane	ND	1000	
193-39-5	34403	Indeno(1,2,3-cd)pyrene	960	1000	L
78-59-1	34408	Isophorone	ND	1000	
534-52-1	34657	2-Methyl-4,6-dinitrophenol	ND	2000	

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
GC/MS EXTRACTABLE ORGANIC ANALYSIS

91-20-3	34696	Naphthalene	270	1000	L
98-95-3	34447	Nitrobenzene	ND	1000	
88-75-5	34591	2-Nitrophenol	ND	2000	
100-02-7	34646	4-Nitrophenol	ND	2000	
86-30-3	34433	N-Nitrosodiphenylamine	ND	1000	
621-64-7	34428	N-Nitrosodi-n-propylamine	ND	1000	
87-86-5	39032	Pentachlorophenol	ND	2000	
85-01-8	34461	Phenanthrene	800	1000	L
108-95-2	34694	Phenol	ND	2000	
129-00-0	34469	Pyrene	2600	1000	

SAMPLE NO.: 07703
Sample Results Continued:

CAS NO.	STORET NO.	Compound	Conc. (ug/Kg)	RL (ug/Kg)	Qualifier or Comment
120-82-1	34551	1,2,4-Trichlorobenzene	ND	1000	
88-06-2	34621	2,4,6-Trichlorophenol	ND	2000	
		Hazardous Substances			
65-53-3	77089	Aniline	ND	1000	
65-85-0	77247	Benzoic Acid	ND	2000	
100-51-6	77147	Benzyl Alcohol	ND	1000	
106-47-8		4-Chloroaniline	ND	1000	
132-64-9	81302	Dibenzofuran	ND	1000	
91-57-6		2-Methylnaphthalene	ND	1000	
95-48-7		2-Methylphenol	ND	1000	
106-44-5		4-Methylphenol	ND	1000	
88-74-4		2-Nitroaniline	ND	1000	
99-09-2		3-Nitroaniline	ND	1000	
100-01-6		4-Nitroaniline	ND	1000	
95-95-4	34621	2,4,5-Trichlorophenol	ND	1000	
		Other Compounds Quantitated			
		Diphenylhydrazine	ND	1000	

SAMPLE NO.: 07703
Sample Results Continued:

Tentatively Identified Compounds	Est. Conc. (ug/Kg)

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
GC/MS EXTRACTABLE ORGANIC ANALYSIS

Unknown	8200	J,B
Unknown	1300	J,B
Unknown	1300	J
Biphenyl	1200	J
Diphenyl ether	1000	J
4-(tetramethylbutyl)-Phenol isomer	2800	J
C18 Hydrocarbon	1100	J
C18 Hydrocarbon	1500	J
4-(tetramethylbutyl)-Phenol isomer	860	J
Phenol,nonyl-	900	J
4-Nonylphenol	1400	J
Unknown	760	J
4-(tetramethylbutyl)-Phenol isomer	1000	J
C18 Hydrocarbon	2100	J
Unknown	1300	J
C18 Hydrocarbon	770	J
C18 Hydrocarbon	1400	J
Unknown	2600	J
C20 Hydrocarbon	3300	J
Unknown	1900	J
C24 hydrocarbon	5500	J
Unknown	4100	J
Unknown	6500	J
Decanedioic acid,bis(2-ethylhexyl) ester	5900	J,B
C28 Hydrocarbon	4100	J
C30 Hydrocarbon	2700	J
Unknown	4600	J
Unknown	2100	J
Unknown	7000	J

SAMPLE NO.: 07703
Sample Results Continued:

Sample Recoveries For Surrogate Compounds:	Recoveries (%)	QC Range (%)
2-Fluorophenol	94	25-121
Phenol,d5	96	24-113
Nitrobenzene,d5	82	23-120
Fluorobiphenyl	85	30-115
2,4,6-Tribromophenol	81	19-122

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
GC/MS EXTRACTABLE ORGANIC ANALYSIS

p-Terphenyl,d14	98	18-137
2-Chlorophenol-d4	93	20-130
1,2-Dichlorobenzene-d4	82	20-130

SAMPLE NO.: 07704 Matrix: Soil
DATE OF COLLECTION: 03/24/98 Sample pH: 6.431
DATE OF EXTRACTION: 04/02/98 Percent Moisture 86
DATE OF ANALYSIS: 04/10/98 Conc. Final Vol. 1000 uL
WET WEIGHT EXTRACTED: 63.8 g Dilution Factor: 2.0
DRY WEIGHT EXTRACTED: 8.8 g Report Factor: 6.8

SAMPLE RESULTS:

CAS NO.	STORET NO.	Compound	Conc. (ug/Kg)	RL (ug/Kg)	Qualifier or Comment
		Priority Pollutants			
83-32-9	34205	Acenaphthene	ND	1400	
208-96-8	34200	Acenaphthylene	640	1400	L
120-12-7	34220	Anthracene	340	1400	L
309-00-2	39330	Aldrin	ND	1400	
56-55-3	34526	Benzo(a)anthracene	1100	1400	L
205-99-2	34230	Benzo(b)fluoranthene	2900	1400	
207-08-9	34242	Benzo(k)fluoranthene	990	1400	L
50-32-8	34247	Benzo(a)pyrene	1700	1400	
191-24-2	34521	Benzo(ghi)perylene	1300	1400	L
85-68-7	34292	Butyl Benzyl Phthalate	470	1400	L,B
319-85-7	39338	beta-BHC	ND	1400	
319-86-8	34259	delta-BHC	ND	1400	
111-44-4	34273	Bis(2-chloroethyl)ether	ND	1400	
111-91-1	34278	Bis(2-chloroethoxy)methane	ND	1400	
117-81-7	39100	Bis(2-ethylhexyl)phthalate	3300	1400	B
108-60-1	34283	Bis(2-chloroisopropyl)ether	ND	1400	
101-55-3	34636	4-Bromophenylphenyl ether	ND	1400	
86-74-8		Carbazole	ND	1400	
59-50-7	34452	4-Chloro-3-methylphenol	ND	2900	
91-58-7	34581	2-Chloronaphthalene	ND	1400	
95-57-8	34586	2-Chlorophenol	ND	2900	
7005-72-3	34641	4-Chlorophenylphenyl ether	ND	1400	
218-01-9	34320	Chrysene	2000	1400	
72-54-8	39310	4,4'-DDD	ND	1400	
72-55-9	39320	4,4'-DDE	ND	1400	
50-29-3	39300	4,4'-DDT	ND	1400	
53-70-3	34556	Dibenzo(a,h)anthracene	360	1400	L
84-74-2	39110	Di-n-butylphthalate	1200	1400	L,B

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
GC/MS EXTRACTABLE ORGANIC ANALYSIS

541-73-1	34566	1,3-Dichlorobenzene	ND	1400	

SAMPLE NO.: 07704
Sample Results Continued:

CAS NO.	STORET NO.	Compound	Conc. (ug/Kg)	RL (ug/Kg)	Qualifier or Comment
95-50-1	34536	1,2-Dichlorobenzene	ND	1400	
106-46-7	34571	1,4-Dichlorobenzene	ND	1400	
91-94-1	34631	3,3'-Dichlorobenzidine	ND	1400	
120-83-2	34601	2,4-Dichlorophenol	ND	2900	
60-57-1	39380	Dieldrin	ND	1400	
84-66-2	34336	Diethylphthalate	290	1400	L,B
105-67-9	34606	2-4-Dimethylphenol	ND	2900	
131-11-3	34341	Dimethylphthalate	330	1400	L
51-28-5	34616	2,4-Dinitrophenol	ND	2900	
121-14-2	34611	2,4-Dinitrotoluene	ND	1400	
606-20-2	34626	2,6-Dinitrotoluene	ND	1400	
117-84-0	34596	Di-n-octylphthalate	ND	1400	
206-44-0	34376	Fluoranthene	2800	1400	
86-73-7	34381	Fluorene	ND	1400	
76-44-8	39410	Heptachlor	ND	1400	
1024-57-3	39420	Heptachlor epoxide	ND	1400	
118-74-1	39700	Hexachlorobenzene	ND	1400	
87-68-3	34391	Hexachlorobutadiene	ND	1400	
77-47-4	34386	Hexachlorocyclopentadiene	ND	1400	
67-72-1	34396	Hexachloroethane	ND	1400	
193-39-5	34403	Indeno(1,2,3-cd)pyrene	1300	1400	L
78-59-1	34408	Isophorone	ND	1400	
534-52-1	34657	2-Methyl-4,6-dinitrophenol	ND	2900	
91-20-3	34696	Naphthalene	ND	1400	
98-95-3	34447	Nitrobenzene	ND	1400	
88-75-5	34591	2-Nitrophenol	ND	2900	
100-02-7	34646	4-Nitrophenol	ND	2900	
86-30-3	34433	N-Nitrosodiphenylamine	ND	1400	
621-64-7	34428	N-Nitrosodi-n-propylamine	ND	1400	
87-86-5	39032	Pentachlorophenol	ND	2900	
85-01-8	34461	Phenanthrene	970	1400	L
108-95-2	34694	Phenol	ND	2900	
129-00-0	34469	Pyrene	2600	1400	

SAMPLE NO.: 07704
Sample Results Continued:

CAS	STORET	Compound	Conc.	RL	Qualifier

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
GC/MS EXTRACTABLE ORGANIC ANALYSIS

NO.	NO.		(ug/Kg)	(ug/Kg) or Comment
120-82-1	34551	1,2,4-Trichlorobenzene	ND	1400
88-06-2	34621	2,4,6-Trichlorophenol	ND	2900
		Hazardous Substances		
65-53-3	77089	Aniline	ND	1400
65-85-0	77247	Benzoic Acid	ND	2900
100-51-6	77147	Benzyl Alcohol	ND	1400
106-47-8		4-Chloroaniline	ND	1400
132-64-9	81302	Dibenzofuran	ND	1400
91-57-6		2-Methylnaphthalene	ND	1400
95-48-7		2-Methylphenol	ND	1400
106-44-5		4-Methylphenol	ND	1400
88-74-4		2-Nitroaniline	ND	1400
99-09-2		3-Nitroaniline	ND	1400
100-01-6		4-Nitroaniline	ND	1400
95-95-4	34621	2,4,5-Trichlorophenol	ND	1400
		Other Compounds Quantitated		
		Diphenylhydrazine	ND	1400

SAMPLE NO.: 07704
Sample Results Continued:

Tentatively Identified Compounds	Est. Conc. (ug/Kg)	
Unknown	930	J,B
Unknown	12000	J,B
Unknown	2100	J,B
Phthalic Anhydride	1500	J
C16 Hydrocarbon	4800	J
C16 Hydrocarbon	1200	J
Unknown	930	J
Unknown	1900	J
C18 Hydrocarbon	1100	J
Unknown	970	J
Unknown	2000	J
Unknown	10000	J
C22 Hydrocarbon	1600	J
C24 Hydrocarbon	4000	J
Unknown	7700	J

Unknown	1400	J,B
Unknown	2100	J
C28 Hydrocarbon	4400	J,B
Benzo(e)pyrene	1700	J
Unknown	1700	J
C30 Hydrocarbon	2700	J
Unknown	1400	J
Unknown	5000	J
Unknown	1900	J
Unknown	1900	J
Unknown	2300	J
Unknown	4300	J
Unknown	2800	J
Unknown	2800	J

SAMPLE NO.: 07704
Sample Results Continued:

Sample Recoveries For Surrogate Compounds:	Recoveries (%)	QC Range (%)
2-Fluorophenol	104	25-121
Phenol,d5	106	24-113
Nitrobenzene,d5	86	23-120
Fluorobiphenyl	94	30-115
2,4,6-Tribromophenol	89	19-122
p-Terphenyl,d14	96	18-137
2-Chlorophenol-d4	104	20-130
1,2-Dichlorobenzene-d4	94	20-130

Chlorinated Pesticides and PCBs

DATE: May 15, 1998

SUBJ: Analysis of Chlorinated Pesticides and Polychlorinated Biphenyls (PCBs) in Soil Samples - TEN MILE RIVER

FROM: Peter Philbrook, Chemistry Section

THRU: Dr. William J. Andrade, Advanced Analytical Chemistry Specialist

TO: Greg Hellyer

PROJECT NUMBER: 98177

ANALYTICAL PROCEDURE:

All samples were received and logged in by the laboratory according to the SOP for Sample Log-In (EIA-ADMLOGN1.SOP, 7/97).

Sample preparation was done by the EPA Multi-Media Consensus Organics Protocol - Revised 8/87. A macro-Florisil column elution and GPC was used for the sample cleanup. The analysis was carried out using high resolution capillary column chromatography. The 30-m dual capillary system consists of J&W DB-1701 and J&W DB-5, both with a 0.25mm ID and a 0.25 micron film thickness. Results are reported out in dry weight.

Date Samples Received by the Laboratory: 03/26/98

Date Analysis Started: 03/31/98

File: J:\CHEMSTRY\REPORTS\PCB-PEST\98177SO.PES
QUALITY CONTROL:

1. One method blank was included in the analysis.

2. Each sample was spiked with the surrogate compounds, tetrachloroxylene and decachlorobiphenyl, at approximately 17 ug/Kg. The results for the surrogate recoveries are reported out with each sample.

3. One sample, 07699, was spiked as a matrix spike and a matrix spike duplicate at the following concentrations: Aldrin, gamma-BHC (Lindane), and Heptachlor at ~3 ug/Kg. DDT, Dieldrin, and Endrin at ~13 ug/Kg. The recoveries are listed below.

Pesticide	Matrix Recovery (%)	Matrix Dup Recovery (%)	QC Limits (%)	RPD (%)
gamma-BHC	56	44	46-127	24
Heptachlor	64	65	35-130	2
Aldrin	123	103	34-132	18
Dieldrin	80	60	31-134	29
Endrin	99	125	42-139	23
pp-DDT	148	100	23-134	39

Other targeted Compounds Quantitated:

Compound	MS Conc. ug/Kg	MSD Conc. ug/Kg	RPD %
alpha-Chlordane	9.1	10	9
endrin ketone	12	10	18

DDD	16	16	0
DDE	18	15	18

4. One sample, 07698, was analyzed in duplicate. The results are listed below.

Compound	07698 ug/Kg	07698 Dup. ug/Kg	RPD %
alpha-BHC	15	14	7
alpha Chlordane	34	33	3
gamma-Chlordane	28	26	7
DDD	84	78	7
DDE	65	60	8
DDT	65	57	13
Aroclor 1254	140 P*	290	70 *
Aroclor 1260	90	130	36

* = The reported value (140 ug/Kg) for sample 07698 was qualified as a 'P'. The value determined on the primary GC column exceeded 35% difference compared to that of the confirmatory column. The values had less than a 100% difference so the lower value was reported. The value for 07698 DUP (290 ug/Kg) had no such limitations and the average of the 2 columns was used. This would explain the high (70%) relative percent differences when comparing the two values.

SAMPLES ANALYZED: BLANK, 07697, 07698, 07698 DUP, 07699, 07699 MS, 07699 MSD, 07700, 07701, 07702, 07703, 07704

Chemist who reviewed data: Paul Carroll

Holding times meet (Y/N): Yes
Extraction (Water - 7 days, Soils - 14 days)
Analytical (40 days after extraction)

Method modifications:
Samples were air dried prior to extraction.

Limitations of data: None

Laboratory blank problems: None

Instrument performance problems: None

Surrogate and spike recovery problems:

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
CHLORINATED PESTICIDES AND POLYCHLORINATED BIPHENYLS

Decachlorobiphenyl (DCB) surrogate recoveries for samples 07702, 07703 were high due to the compound DCB in the samples. Aroclor 1268 was found in each of these samples. Aroclor 1268 contains the compound decachlorobiphenyl.

Additional comments: Clean-ups for sample extracts included a macro-florisil column elution followed by a Gel Permeation Chromatography clean-up. The extracts were split one aliquot was used for the pesticides analysis, and one portion was further cleaned with a sulfuric acid clean-up for the PCB analysis.

SAMPLE NO.:	BLANK	Matrix:	Sand
DATE OF COLLECTION:	NOT APPLICABLE	Sample pH:	N/A
DATE OF EXTRACTION:	04/06/98	Final Volume:	5.0 mL
DATE OF ANALYSIS:	04/22/98	Percent Moisture	0.0
WET WEIGHT EXTRACTED:	30.15 g	Extract Dilution	1
DRY WEIGHT EXTRACTED:	30.15 g	Report Factor:	1.0

SAMPLE RESULTS:

CAS NO.	STORET NO.	Compound	Conc. (ug/Kg)	RL (ug/Kg)	Qualifier or Comment
309-00-2	39330	Aldrin	ND	8E-01	
319-84-6	39337	alpha-BHC	ND	8E-01	
319-85-7	39338	beta-BHC	ND	8E-01	
319-86-8	34259	delta-BHC	ND	8E-01	
58-89-9	39340	gamma-BHC	ND	8E-01	
5103-71-9	---	Alpha Chlordane	ND	8E-01	
5103-74-2	---	gamma Chlordane	ND	8E-01	
57-74-9	39350	Chlordane (technical)	ND	2E+01	
72-54-8	39310	4,4'-DDD	ND	8E-01	
72-55-9	39320	4,4'-DDE	ND	8E-01	
50-29-3	39300	4,4'-DDT	ND	8E-01	
60-57-1	39380	Dieldrin	ND	8E-01	
959-98-8	34361	Endosulfan I	ND	8E-01	
33212-65-9	34356	Endosulfan II	ND	8E-01	
1031-078	34351	Endosulfan sulfate	ND	8E-01	
72-20-8	39390	Endrin	ND	8E-01	
7421-93-4	34366	Endrin aldehyde	ND	8E-01	
53494-70-5	---	Endrin ketone	ND	8E-01	
76-44-8	39410	Heptachlor	ND	8E-01	
1024-57-3	39420	Heptachlor epoxide	ND	8E-01	
72-43-5	---	Methoxychlor	ND	8E-01	
8001-35-2	39400	Toxaphene	ND	2E+01	
12674-11-2	34671	Aroclor-1016	ND	2E+01	
11104-28-2	39488	Aroclor-1221	ND	2E+01	

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
CHLORINATED PESTICIDES AND POLYCHLORINATED BIPHENYLS

11141-16-5	39492	Aroclor-1232	ND	2E+01
53469-21-9	39496	Aroclor-1242	ND	2E+01
12672-29-6	39500	Aroclor-1248	ND	2E+01
11097-69-1	39504	Aroclor-1254	ND	2E+01
11096-82-5	39508	Aroclor-1260	ND	2E+01
11100-14-4	81649	Aroclor-1262	ND	2E+01
37324-23-5	81650	Aroclor-1268	ND	2E+01

SAMPLE NO.: BLANK
ANALYTICAL RESULTS CONT.

Sample Recovery for Surrogate Compound:	Observed Recoveries (%)	QC Range
Decachlorobiphenyl	108	60-150
2,4,5,6-Tetrachloro-m-xylene	97	60-150

Notes:

RL = Reporting limit
(6E+00 = 6, 1E+01 = 10, 4E-01 = 0.4)
ND = None detected
~ = Approximate
< = Less than
> = Greater than
NA = Not available due to dilution or interference
E = Estimated value exceeds the calibration range
L = Estimated value is below the calibration range
B = Analyte is associated with the lab blank or trip blank contamination. Values are qualified when the observed concentration of the contaminant in the sample extract is less than ten times the concentration in the blank.
P = The confirmation value exceeded 35% difference and is less than 100 %. The lower value is reported.
D = Detected but too low to quantitate.
C = The identification has been confirmed by GC/MS.

SAMPLE NO.:	07697	Matrix:	Sediment
DATE OF COLLECTION:	03/24/98	Sample pH:	6.0
DATE OF EXTRACTION:	03/31/98	Final Volume:	5.0 mL
DATE OF ANALYSIS:	04/24/98	Percent Moisture	83.1
WET WEIGHT EXTRACTED:	30.04 g	Extract Dilution	1
DRY WEIGHT EXTRACTED:	27.25g	Dilution Factor:	1.15

SAMPLE RESULTS:

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
CHLORINATED PESTICIDES AND POLYCHLORINATED BIPHENYLS

CAS NO.	STORET NO.	Compound	Conc. (ug/Kg)	RL (ug/Kg)	Qualifier or Comment
309-00-2	39330	Aldrin	ND	9E-01	
319-84-6	39337	alpha-BHC	ND	9E-01	
319-85-7	39338	beta-BHC	ND	9E-01	
319-86-8	34259	delta-BHC	ND	9E-01	
58-89-9	39340	gamma-BHC	ND	9E-01	
5103-71-9	---	Alpha Chlordane	5.2	9E-01	
5103-74-2	---	gamma Chlordane	ND	9E-01	
57-74-9	39350	Chlordane (technical)	ND	2E+01	
72-54-8	39310	4,4'-DDD	19	9E-01	
72-55-9	39320	4,4'-DDE	18	9E-01	
50-29-3	39300	4,4'-DDT	10	9E-01	P
60-57-1	39380	Dieldrin	4.4	9E-01	P
959-98-8	34361	Endosulfan I	ND	9E-01	
33212-65-9	34356	Endosulfan II	ND	9E-01	
1031-078	34351	Endosulfan sulfate	ND	9E-01	
72-20-8	39390	Endrin	ND	9E-01	
7421-93-4	34366	Endrin aldehyde	ND	9E-01	
53494-70-5	---	Endrin ketone	8.4	9E-01	
76-44-8	39410	Heptachlor	ND	9E-01	
1024-57-3	39420	Heptachlor epoxide	ND	9E-01	
72-43-5	---	Methoxychlor	ND	9E-01	
8001-35-2	39400	Toxaphene	ND	2E+01	
12674-11-2	34671	Aroclor-1016	ND	2E+01	
11104-28-2	39488	Aroclor-1221	ND	2E+01	
11141-16-5	39492	Aroclor-1232	ND	2E+01	
53469-21-9	39496	Aroclor-1242	ND	2E+01	
12672-29-6	39500	Aroclor-1248	ND	2E+01	
11097-69-1	39504	Aroclor-1254	110	2E+01	
11096-82-5	39508	Aroclor-1260	45	2E+01	
11100-14-4	81649	Aroclor-1262	ND	2E+01	
37324-23-5	81650	Aroclor-1268	ND	2E+01	

SAMPLE NO.: 07697
ANALYTICAL RESULTS CONT.

Sample Recovery for Surrogate Compound:	Observed Recoveries (%)	QC Range
Decachlorobiphenyl	85	60-150
2,4,5,6-Tetrachloro-m-xylene	52	60-150

SAMPLE NO.: 07698 Matrix: Sediment

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
CHLORINATED PESTICIDES AND POLYCHLORINATED BIPHENYLS

DATE OF COLLECTION:	03/24/98	Sample pH:	6.4
DATE OF EXTRACTION:	03/31/98	Final Volume:	5.0 mL
DATE OF ANALYSIS:	05/01/98	Percent Moisture	70.6
WET WEIGHT EXTRACTED:	29.84 g	Extract Dilution	10
DRY WEIGHT EXTRACTED:	16.31	Dilution Factor:	19.16

SAMPLE RESULTS:

CAS NO.	STORET NO.	Compound	Conc. (ug/Kg)	RL (ug/Kg)	Qualifier or Comment
309-00-2	39330	Aldrin	ND	2E+01	
319-84-6	39337	alpha-BHC	15	2E+01	
319-85-7	39338	beta-BHC	ND	2E+01	
319-86-8	34259	delta-BHC	ND	2E+01	
58-89-9	39340	gamma-BHC	ND	2E+01	
5103-71-9	---	Alpha Chlordane	34	2E+01	
5103-74-2	---	gamma Chlordane	28	2E+01	
57-74-9	39350	Chlordane (technical)	ND	3E+01	
72-54-8	39310	4,4'-DDD	84	2E+01	
72-55-9	39320	4,4'-DDE	65	2E+01	
50-29-3	39300	4,4'-DDT	65	2E+01	
60-57-1	39380	Dieldrin	ND	2E+01	
959-98-8	34361	Endosulfan I	ND	2E+01	
33212-65-9	34356	Endosulfan II	ND	2E+01	
1031-078	34351	Endosulfan sulfate	ND	2E+01	
72-20-8	39390	Endrin	ND	2E+01	
7421-93-4	34366	Endrin aldehyde	ND	2E+01	
53494-70-5	---	Endrin ketone	ND	2E+01	
76-44-8	39410	Heptachlor	ND	2E+01	
1024-57-3	39420	Heptachlor epoxide	ND	2E+01	
72-43-5	---	Methoxychlor	ND	2E+01	
8001-35-2	39400	Toxaphene	ND	3E+01	
12674-11-2	34671	Aroclor-1016	ND	3E+01	
11104-28-2	39488	Aroclor-1221	ND	3E+01	
11141-16-5	39492	Aroclor-1232	ND	3E+01	
53469-21-9	39496	Aroclor-1242	ND	3E+01	
12672-29-6	39500	Aroclor-1248	ND	3E+01	
11097-69-1	39504	Aroclor-1254	140	3E+01	P
11096-82-5	39508	Aroclor-1260	90	3E+01	P
11100-14-4	81649	Aroclor-1262	ND	3E+01	
37324-23-5	81650	Aroclor-1268	ND	3E+01	

SAMPLE NO.: 07698
ANALYTICAL RESULTS CONT.

Sample Recovery for Surrogate Compound:	Observed Recoveries (%)	QC Range

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
CHLORINATED PESTICIDES AND POLYCHLORINATED BIPHENYLS

Decachlorobiphenyl	70	60-150
2,4,5,6-Tetrachloro-m-xylene	59	60-150

SAMPLE NO.:	07699	Matrix:	Sediment
DATE OF COLLECTION:	03/24/98	Sample pH:	6.4
DATE OF EXTRACTION:	03/31/98	Final Volume:	5.0 mL
DATE OF ANALYSIS:	04/24/98	Percent Moisture	69.3
WET WEIGHT EXTRACTED:	30.05 g	Extract Dilution	1
DRY WEIGHT EXTRACTED:	24.73g	Dilution Factor:	1.26

SAMPLE RESULTS:

CAS NO.	STORET NO.	Compound	Conc. (ug/Kg)	RL (ug/Kg)	Qualifier or Comment
309-00-2	39330	Aldrin	ND	1E+00	
319-84-6	39337	alpha-BHC	ND	1E+00	
319-85-7	39338	beta-BHC	ND	1E+00	
319-86-8	34259	delta-BHC	ND	1E+00	
58-89-9	39340	gamma-BHC	ND	1E+00	
5103-71-9	---	Alpha Chlordane	10	1E+00	
5103-74-2	---	gamma Chlordane	ND	1E+00	
57-74-9	39350	Chlordane (technical)	ND	2E+01	
72-54-8	39310	4,4'-DDD	12	1E+00	
72-55-9	39320	4,4'-DDE	16	1E+00	
50-29-3	39300	4,4'-DDT	12	1E+00	
60-57-1	39380	Dieldrin	7.4	1E+00	
959-98-8	34361	Endosulfan I	ND	1E+00	
33212-65-9	34356	Endosulfan II	ND	1E+00	
1031-078	34351	Endosulfan sulfate	ND	1E+00	
72-20-8	39390	Endrin	ND	1E+00	
7421-93-4	34366	Endrin aldehyde	ND	1E+00	
53494-70-5	---	Endrin ketone	13	1E+00	
76-44-8	39410	Heptachlor	1.1	1E+00	P
1024-57-3	39420	Heptachlor epoxide	ND	1E+00	
72-43-5	---	Methoxychlor	ND	1E+00	
8001-35-2	39400	Toxaphene	ND	2E+01	
12674-11-2	34671	Aroclor-1016	ND	2E+01	
11104-28-2	39488	Aroclor-1221	ND	2E+01	
11141-16-5	39492	Aroclor-1232	ND	2E+01	
53469-21-9	39496	Aroclor-1242	ND	2E+01	
12672-29-6	39500	Aroclor-1248	ND	2E+01	
11097-69-1	39504	Aroclor-1254	95	2E+01	
11096-82-5	39508	Aroclor-1260	48	2E+01	
11100-14-4	81649	Aroclor-1262	ND	2E+01	

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
CHLORINATED PESTICIDES AND POLYCHLORINATED BIPHENYLS

37324-23-5	81650	Aroclor-1268	ND	2E+01

SAMPLE NO.: 07699
ANALYTICAL RESULTS CONT.

Sample Recovery for Surrogate Compound:	Observed Recoveries (%)	QC Range
Decachlorobiphenyl	64	60-150
2,4,5,6-Tetrachloro-m-xylene	75	60-150

SAMPLE NO.: 07700 Matrix: Sediment
DATE OF COLLECTION: 03/25/98 Sample pH: 6.8
DATE OF EXTRACTION: 03/31/98 Final Volume: 5.0 mL
DATE OF ANALYSIS: 05/01/98 Percent Moisture 85.3
WET WEIGHT EXTRACTED: 30.16 g Extract Dilution 10
DRY WEIGHT EXTRACTED: 13.4 g Dilution Factor: 23.32

SAMPLE RESULTS:

CAS NO.	STORET NO.	Compound	Conc. (ug/Kg)	RL (ug/Kg)	Qualifier or Comment
309-00-2	39330	Aldrin	ND	2E+01	
319-84-6	39337	alpha-BHC	ND	2E+01	
319-85-7	39338	beta-BHC	ND	2E+01	
319-86-8	34259	delta-BHC	ND	2E+01	
58-89-9	39340	gamma-BHC	ND	2E+01	
5103-71-9	---	Alpha Chlordane	28	2E+01	
5103-74-2	---	gamma Chlordane	ND	2E+01	
57-74-9	39350	Chlordane (technical)	ND	4E+02	
72-54-8	39310	4,4'-DDD	34	2E+01	
72-55-9	39320	4,4'-DDE	64	2E+01	
50-29-3	39300	4,4'-DDT	34	2E+01	P
60-57-1	39380	Dieldrin	18	2E+01	
959-98-8	34361	Endosulfan I	ND	2E+01	
33212-65-9	34356	Endosulfan II	ND	2E+01	
1031-078	34351	Endosulfan sulfate	ND	2E+01	
72-20-8	39390	Endrin	ND	2E+01	
7421-93-4	34366	Endrin aldehyde	ND	2E+01	
53494-70-5	---	Endrin ketone	ND	2E+01	
76-44-8	39410	Heptachlor	ND	2E+01	
1024-57-3	39420	Heptachlor epoxide	ND	2E+01	
72-43-5	---	Methoxychlor	ND	2E+01	
8001-35-2	39400	Toxaphene	ND	4E+02	
12674-11-2	34671	Aroclor-1016	ND	4E+02	

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
CHLORINATED PESTICIDES AND POLYCHLORINATED BIPHENYLS

11104-28-2	39488	Aroclor-1221	ND	4E+02
11141-16-5	39492	Aroclor-1232	ND	4E+02
53469-21-9	39496	Aroclor-1242	ND	4E+02
12672-29-6	39500	Aroclor-1248	ND	4E+02
11097-69-1	39504	Aroclor-1254	280	4E+02
11096-82-5	39508	Aroclor-1260	280	4E+02
11100-14-4	81649	Aroclor-1262	ND	4E+02
37324-23-5	81650	Aroclor-1268	ND	4E+02

SAMPLE NO.: 07700
ANALYTICAL RESULTS CONT.

Sample Recovery for Surrogate Compound:	Observed Recoveries (%)	QC Range
Decachlorobiphenyl	85	60-150
2,4,5,6-Tetrachloro-m-xylene	68	60-150

SAMPLE NO.: 07701 Matrix: Sediment
DATE OF COLLECTION: 03/25/98 Sample pH: 6.6
DATE OF EXTRACTION: 03/31/98 Final Volume: 5.0 mL
DATE OF ANALYSIS: 05/01/98 Percent Moisture 87.0
WET WEIGHT EXTRACTED: 30.16 g Extract Dilution 10
DRY WEIGHT EXTRACTED: 21.54 g Dilution Factor: 14.51

SAMPLE RESULTS:

CAS NO.	STORET NO.	Compound	Conc. (ug/Kg)	RL (ug/Kg)	Qualifier or Comment
309-00-2	39330	Aldrin	ND	1E+01	
319-84-6	39337	alpha-BHC	11	1E+01	P
319-85-7	39338	beta-BHC	ND	1E+01	
319-86-8	34259	delta-BHC	ND	1E+01	
58-89-9	39340	gamma-BHC	ND	1E+01	
5103-71-9	---	Alpha Chlordane	38	1E+01	
5103-74-2	---	gamma Chlordane	22	1E+01	
57-74-9	39350	Chlordane (technical)	ND	2E+02	
72-54-8	39310	4,4'-DDD	41	1E+01	
72-55-9	39320	4,4'-DDE	68	1E+01	
50-29-3	39300	4,4'-DDT	44	1E+01	
60-57-1	39380	Dieldrin	ND	1E+01	
959-98-8	34361	Endosulfan I	ND	1E+01	
33212-65-9	34356	Endosulfan II	ND	1E+01	
1031-078	34351	Endosulfan sulfate	ND	1E+01	
72-20-8	39390	Endrin	ND	1E+01	

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
CHLORINATED PESTICIDES AND POLYCHLORINATED BIPHENYLS

7421-93-4	34366	Endrin aldehyde	ND	1E+01
53494-70-5	---	Endrin ketone	ND	1E+01
76-44-8	39410	Heptachlor	ND	1E+01
1024-57-3	39420	Heptachlor epoxide	ND	1E+01
72-43-5	---	Methoxychlor	ND	1E+01
8001-35-2	39400	Toxaphene	ND	2E+02
12674-11-2	34671	Aroclor-1016	ND	2E+02
11104-28-2	39488	Aroclor-1221	ND	2E+02
11141-16-5	39492	Aroclor-1232	ND	2E+02
53469-21-9	39496	Aroclor-1242	ND	2E+02
12672-29-6	39500	Aroclor-1248	ND	2E+02
11097-69-1	39504	Aroclor-1254	510	2E+02
11096-82-5	39508	Aroclor-1260	400	2E+02
11100-14-4	81649	Aroclor-1262	ND	2E+02
37324-23-5	81650	Aroclor-1268	ND	2E+02

SAMPLE NO.: 07701
ANALYTICAL RESULTS CONT.

Sample Recovery for Surrogate Compound:	Observed Recoveries (%)	QC Range
Decachlorobiphenyl	154	60-150
2,4,5,6-Tetrachloro-m-xylene	59	60-150

SAMPLE NO.: 07702 Matrix: Sediment
DATE OF COLLECTION: 03/25/98 Sample pH: 6.5
DATE OF EXTRACTION: 03/31/98 Final Volume: 5.0 mL
DATE OF ANALYSIS: 04/24/98 Percent Moisture 83.3
WET WEIGHT EXTRACTED: 30.58 g Extract Dilution 1
DRY WEIGHT EXTRACTED: 14.08 g Dilution Factor: 2.22

SAMPLE RESULTS:

CAS NO.	STORET NO.	Compound	Conc. (ug/Kg)	RL (ug/Kg)	Qualifier or Comment
309-00-2	39330	Aldrin	ND	2E+00	
319-84-6	39337	alpha-BHC	3.6	2E+00	
319-85-7	39338	beta-BHC	ND	2E+00	
319-86-8	34259	delta-BHC	ND	2E+00	
58-89-9	39340	gamma-BHC	ND	2E+00	
5103-71-9	---	Alpha Chlordane	16	2E+00	
5103-74-2	---	gamma Chlordane	ND	2E+00	
57-74-9	39350	Chlordane (technical)	ND	2E+01	
72-54-8	39310	4,4'-DDD	18	2E+00	P

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
CHLORINATED PESTICIDES AND POLYCHLORINATED BIPHENYLS

72-55-9	39320	4,4'-DDE	37	2E+00	
50-29-3	39300	4,4'-DDT	41	2E+00	P
60-57-1	39380	Dieldrin	11	2E+00	P
959-98-8	34361	Endosulfan I	ND	2E+00	
33212-65-9	34356	Endosulfan II	ND	2E+00	
1031-078	34351	Endosulfan sulfate	ND	2E+00	
72-20-8	39390	Endrin	ND	2E+00	
7421-93-4	34366	Endrin aldehyde	ND	2E+00	
53494-70-5	---	Endrin ketone	ND	2E+00	
76-44-8	39410	Heptachlor	ND	2E+00	
1024-57-3	39420	Heptachlor epoxide	ND	2E+00	
72-43-5	---	Methoxychlor	ND	2E+00	
8001-35-2	39400	Toxaphene	ND	2E+01	
12674-11-2	34671	Aroclor-1016	ND	2E+01	
11104-28-2	39488	Aroclor-1221	ND	2E+01	
11141-16-5	39492	Aroclor-1232	ND	2E+01	
53469-21-9	39496	Aroclor-1242	ND	2E+01	
12672-29-6	39500	Aroclor-1248	ND	2E+01	
11097-69-1	39504	Aroclor-1254	260	2E+01	
11096-82-5	39508	Aroclor-1260	200	2E+01	
11100-14-4	81649	Aroclor-1262	ND	2E+01	
37324-23-5	81650	Aroclor-1268	140	2E+01	

SAMPLE NO.: 07702
ANALYTICAL RESULTS CONT.

Sample Recovery for Surrogate Compound:	Observed Recoveries (%)	QC Range
Decachlorobiphenyl	179	60-150
2,4,5,6-Tetrachloro-m-xylene	66	60-150

SAMPLE NO.: 07703 Matrix: Sediment
DATE OF COLLECTION: 03/25/98 Sample pH: 6.5
DATE OF EXTRACTION: 03/31/98 Final Volume: 5.0 mL
DATE OF ANALYSIS: 04/24/98 Percent Moisture 79.5
WET WEIGHT EXTRACTED: 30 g Extract Dilution 1
DRY WEIGHT EXTRACTED: 13.51 g Dilution Factor: 2.31

SAMPLE RESULTS:

CAS NO.	STORET NO.	Compound	Conc. (ug/Kg)	RL (ug/Kg)	Qualifier or Comment
309-00-2	39330	Aldrin	ND	2E+00	
319-84-6	39337	alpha-BHC	3.8	2E+00	P

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
CHLORINATED PESTICIDES AND POLYCHLORINATED BIPHENYLS

319-85-7	39338	beta-BHC	ND	2E+00	
319-86-8	34259	delta-BHC	ND	2E+00	
58-89-9	39340	gamma-BHC	ND	2E+00	
5103-71-9	---	Alpha Chlordane	ND	2E+00	
5103-74-2	---	gamma Chlordane	ND	2E+00	
57-74-9	39350	Chlordane (technical)	ND	4E+01	
72-54-8	39310	4,4'-DDD	9.5	2E+00	
72-55-9	39320	4,4'-DDE	32	2E+00	
50-29-3	39300	4,4'-DDT	40	2E+00	
60-57-1	39380	Dieldrin	9.8	2E+00	P
959-98-8	34361	Endosulfan I	14	2E+00	
33212-65-9	34356	Endosulfan II	ND	2E+00	
1031-078	34351	Endosulfan sulfate	ND	2E+00	
72-20-8	39390	Endrin	ND	2E+00	
7421-93-4	34366	Endrin aldehyde	ND	2E+00	
53494-70-5	---	Endrin ketone	ND	2E+00	
76-44-8	39410	Heptachlor	ND	2E+00	
1024-57-3	39420	Heptachlor epoxide	ND	2E+00	
72-43-5	---	Methoxychlor	ND	2E+00	
8001-35-2	39400	Toxaphene	ND	4E+01	
12674-11-2	34671	Aroclor-1016	ND	4E+01	
11104-28-2	39488	Aroclor-1221	ND	4E+01	
11141-16-5	39492	Aroclor-1232	ND	4E+01	
53469-21-9	39496	Aroclor-1242	ND	4E+01	
12672-29-6	39500	Aroclor-1248	ND	4E+01	
11097-69-1	39504	Aroclor-1254	230	4E+01	
11096-82-5	39508	Aroclor-1260	200	4E+01	
11100-14-4	81649	Aroclor-1262	ND	4E+01	
37324-23-5	81650	Aroclor-1268	690	4E+01	

SAMPLE NO.: 07703
ANALYTICAL RESULTS CONT.

Sample Recovery for Surrogate Compound:	Observed Recoveries (%)	QC Range
Decachlorobiphenyl	650 (NA)	60-150
2,4,5,6-Tetrachloro-m-xylene	76	60-150

SAMPLE NO.: 07704 Matrix: Sediment
DATE OF COLLECTION: 03/24/98 Sample pH: 6.4
DATE OF EXTRACTION: 03/31/98 Final Volume: 5.0 mL
DATE OF ANALYSIS: 04/24/98 Percent Moisture 86.2
WET WEIGHT EXTRACTED: 36.63 G Extract Dilution 1
DRY WEIGHT EXTRACTED: 11.85 g Dilution Factor: 2.64

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
CHLORINATED PESTICIDES AND POLYCHLORINATED BIPHENYLS

SAMPLE RESULTS:

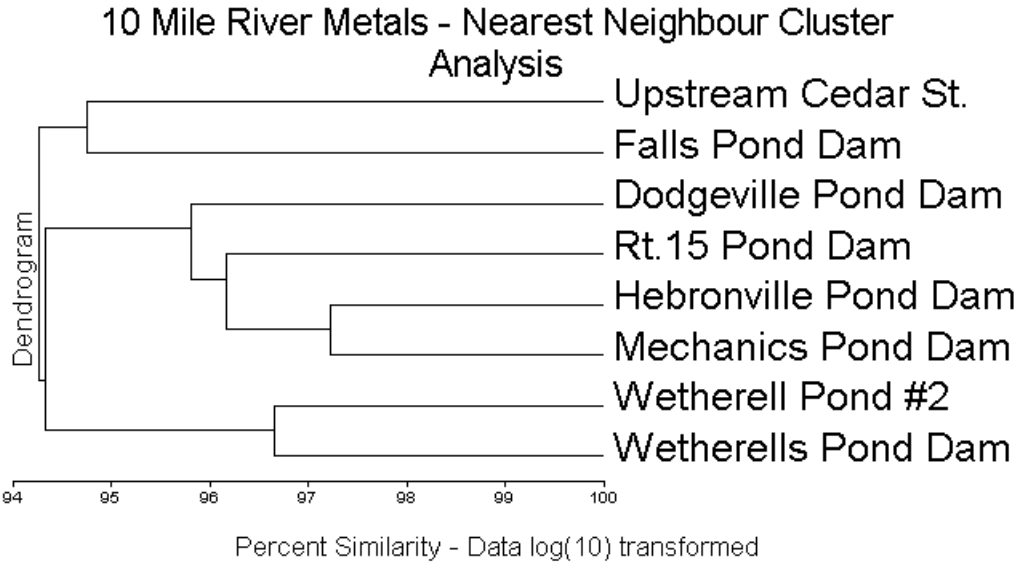
CAS NO.	STORET NO.	Compound	Conc. (ug/Kg)	RL (ug/Kg)	Qualifier or Comment
309-00-2	39330	Aldrin	ND	2E+00	
319-84-6	39337	alpha-BHC	ND	2E+00	
319-85-7	39338	beta-BHC	ND	2E+00	
319-86-8	34259	delta-BHC	ND	2E+00	
58-89-9	39340	gamma-BHC	ND	2E+00	
5103-71-9	---	Alpha Chlordane	12	2E+00	
5103-74-2	---	gamma Chlordane	ND	2E+00	
57-74-9	39350	Chlordane (technical)	ND	4E+01	
72-54-8	39310	4,4'-DDD	40	2E+00	
72-55-9	39320	4,4'-DDE	41	2E+00	
50-29-3	39300	4,4'-DDT	24	2E+00	P
60-57-1	39380	Dieldrin	9.5	2E+00	P
959-98-8	34361	Endosulfan I	ND	2E+00	
33212-65-9	34356	Endosulfan II	ND	2E+00	
1031-078	34351	Endosulfan sulfate	ND	2E+00	
72-20-8	39390	Endrin	ND	2E+00	
7421-93-4	34366	Endrin aldehyde	ND	2E+00	
53494-70-5	---	Endrin ketone	12	2E+00	P
76-44-8	39410	Heptachlor	ND	2E+00	
1024-57-3	39420	Heptachlor epoxide	ND	2E+00	
72-43-5	---	Methoxychlor	ND	2E+00	
8001-35-2	39400	Toxaphene	ND	4E+01	
12674-11-2	34671	Aroclor-1016	ND	4E+01	
11104-28-2	39488	Aroclor-1221	ND	4E+01	
11141-16-5	39492	Aroclor-1232	ND	4E+01	
53469-21-9	39496	Aroclor-1242	ND	4E+01	
12672-29-6	39500	Aroclor-1248	ND	4E+01	
11097-69-1	39504	Aroclor-1254	250	4E+01	
11096-82-5	39508	Aroclor-1260	100	4E+01	
11100-14-4	81649	Aroclor-1262	ND	4E+01	
37324-23-5	81650	Aroclor-1268	ND	4E+01	

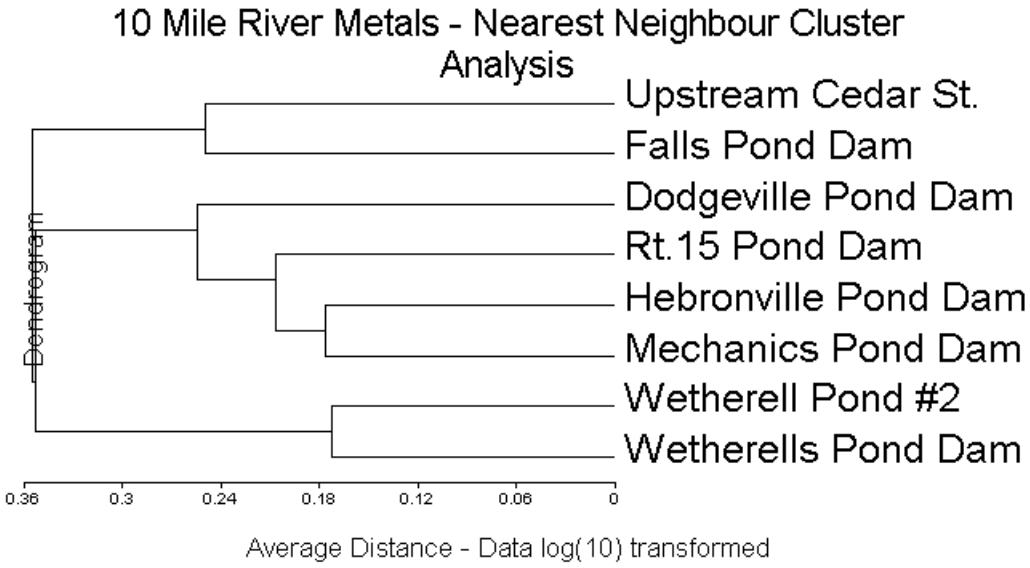
SAMPLE NO.: 07704
ANALYTICAL RESULTS CONT.

Sample Recovery for Surrogate Compound:	Observed Recoveries (%)	QC Range
Decachlorobiphenyl	109	60-150
2,4,5,6-Tetrachloro-m-xylene	71	60-150

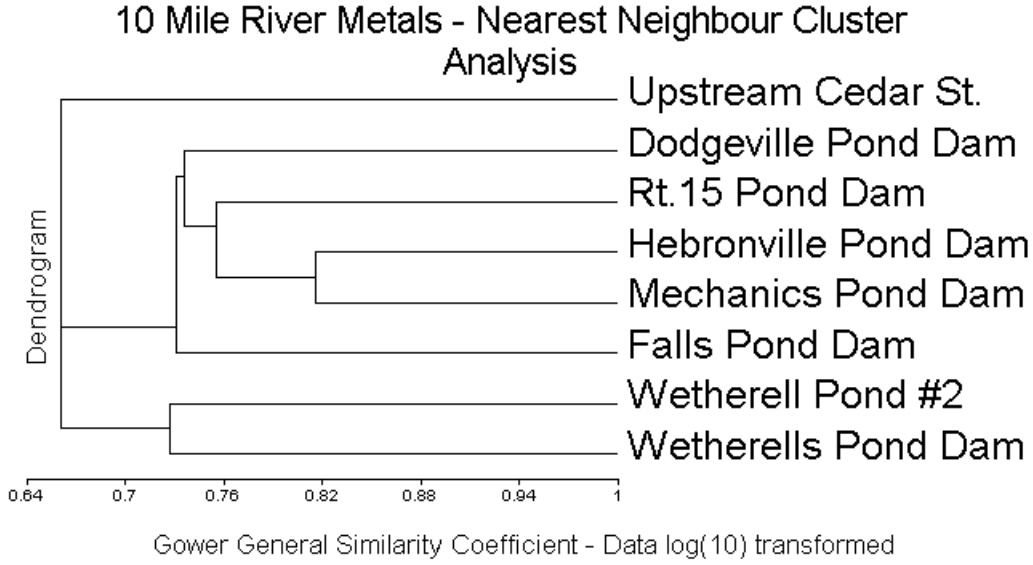
Appendix B: Multivariate Graphical and Numerical Chemistry Data Analysis

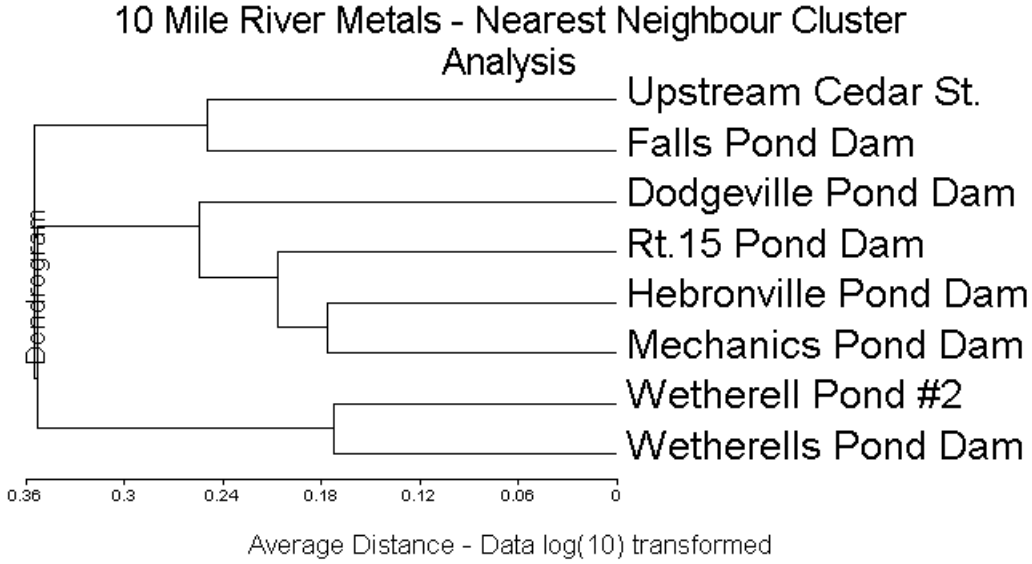
Graphical Analysis -- Inorganic Chemicals (Metals)



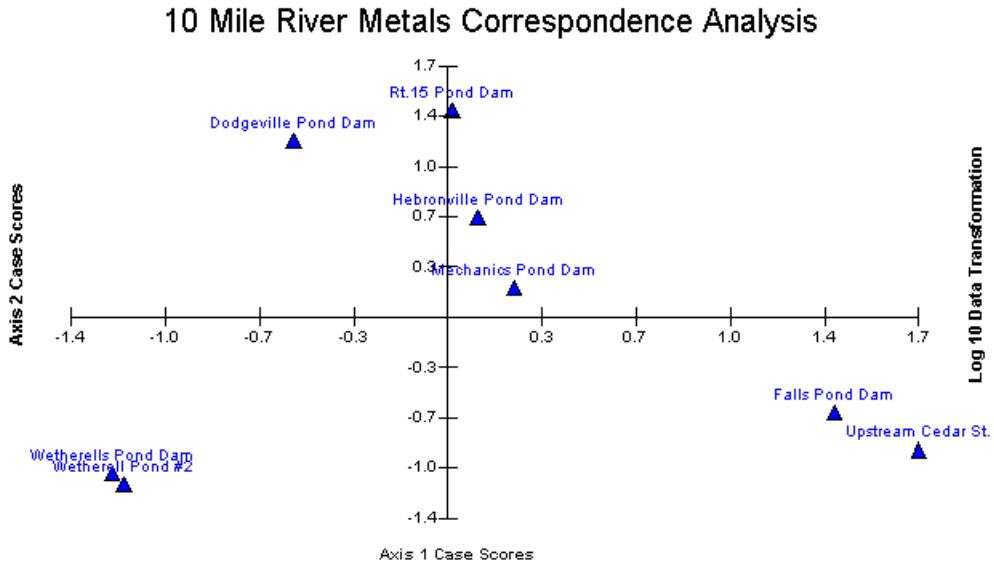


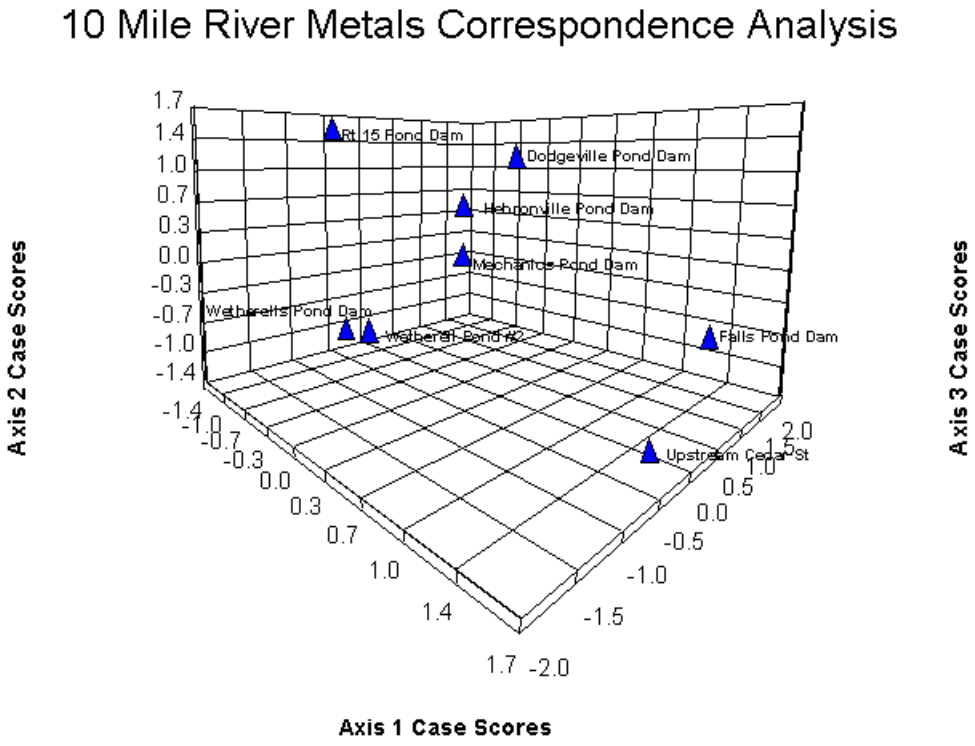
Graphical Analysis -- Inorganic Chemicals (Metals)



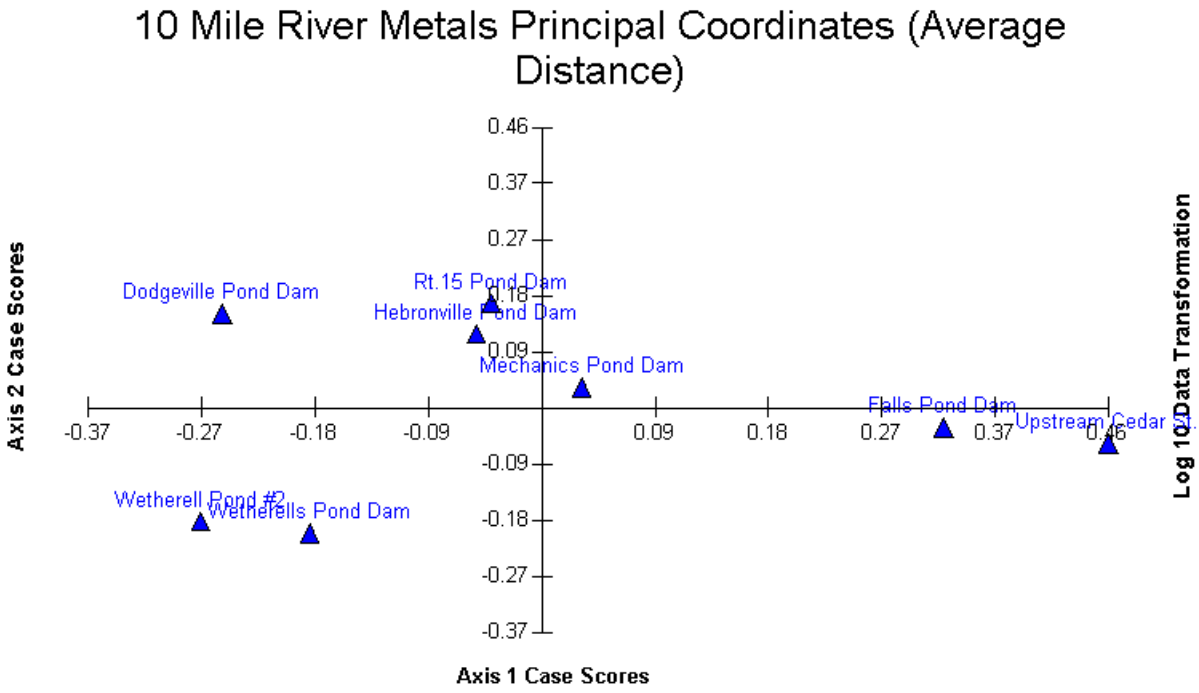


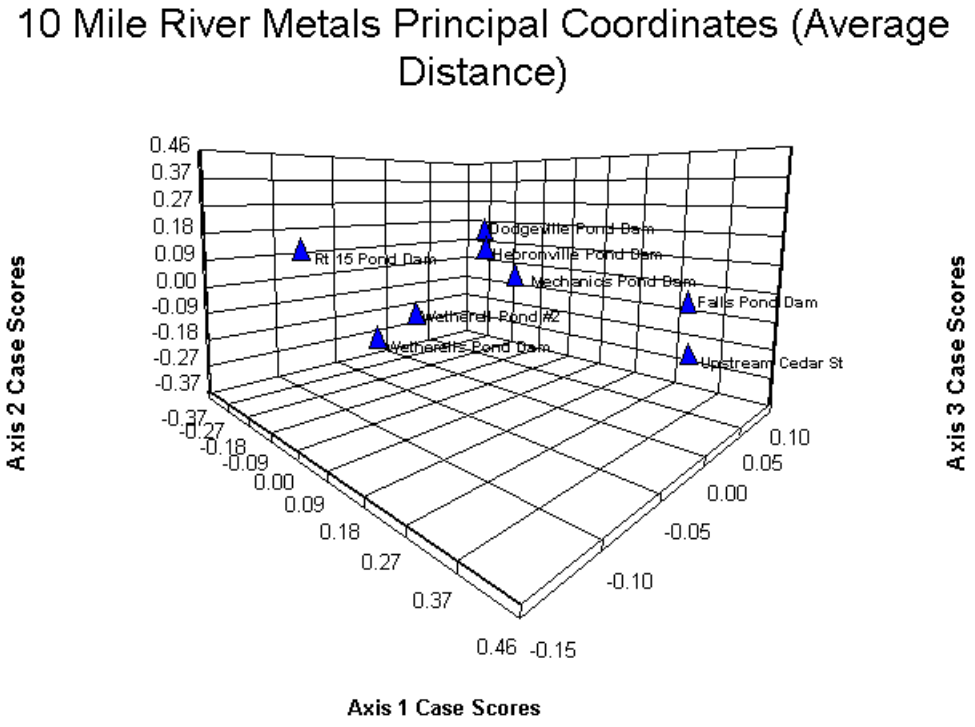
Graphical Analysis -- Inorganic Chemicals (Metals)



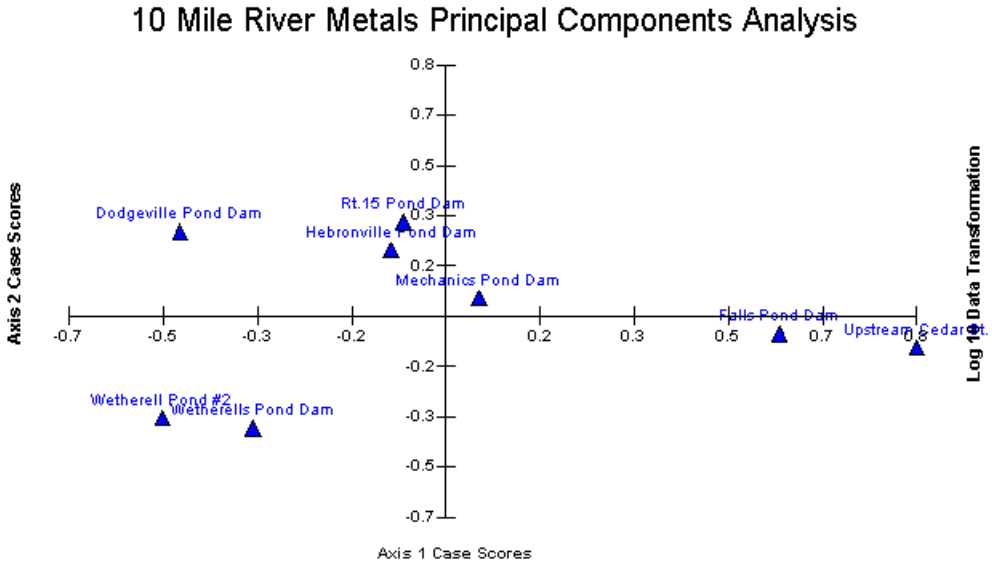


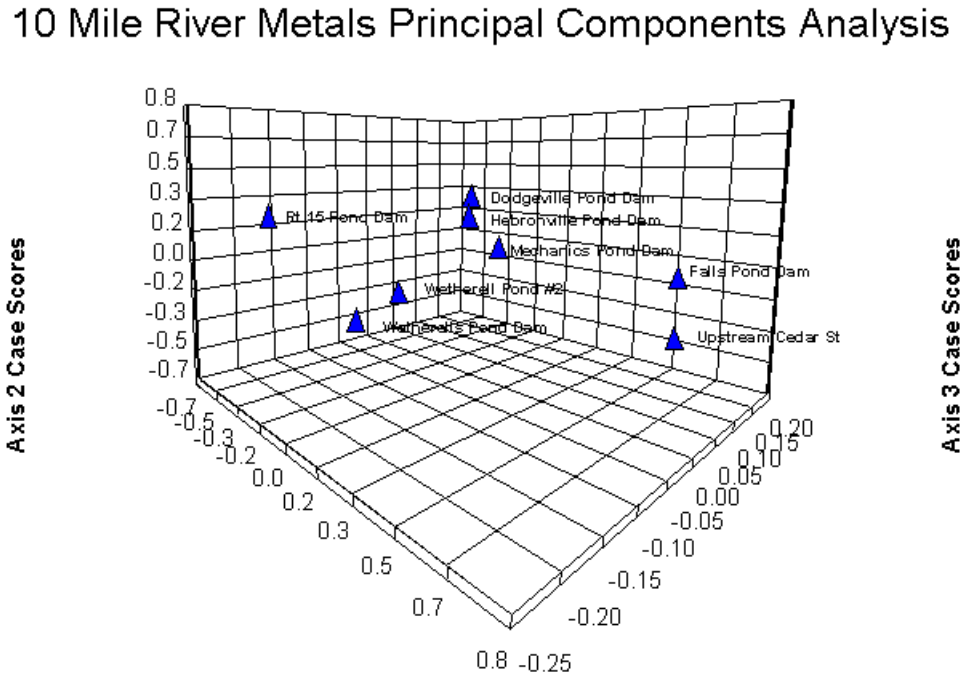
Graphical Analysis -- Inorganic Chemicals (Metals)





Graphical Analysis -- Inorganic Chemicals (Metals)

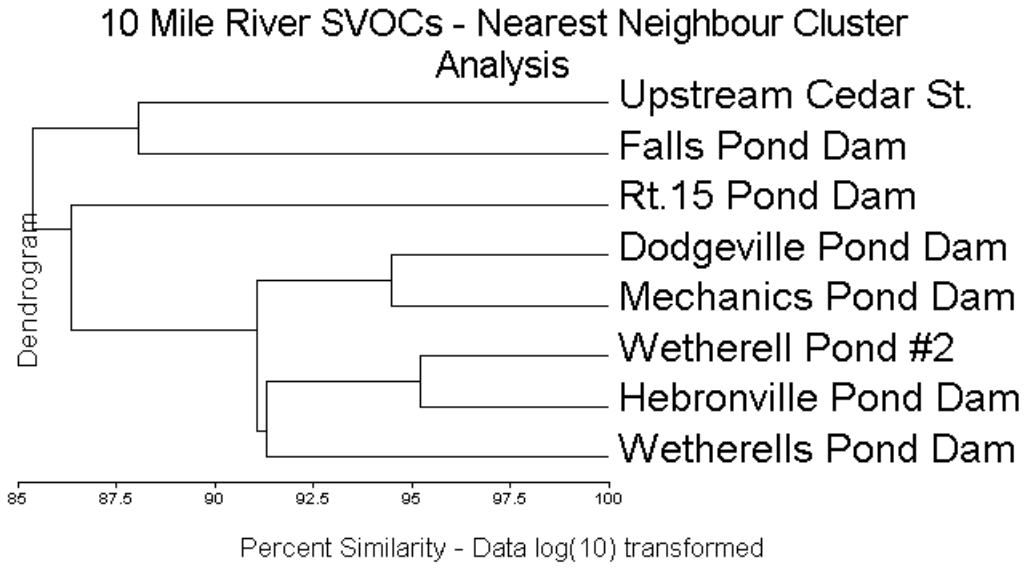


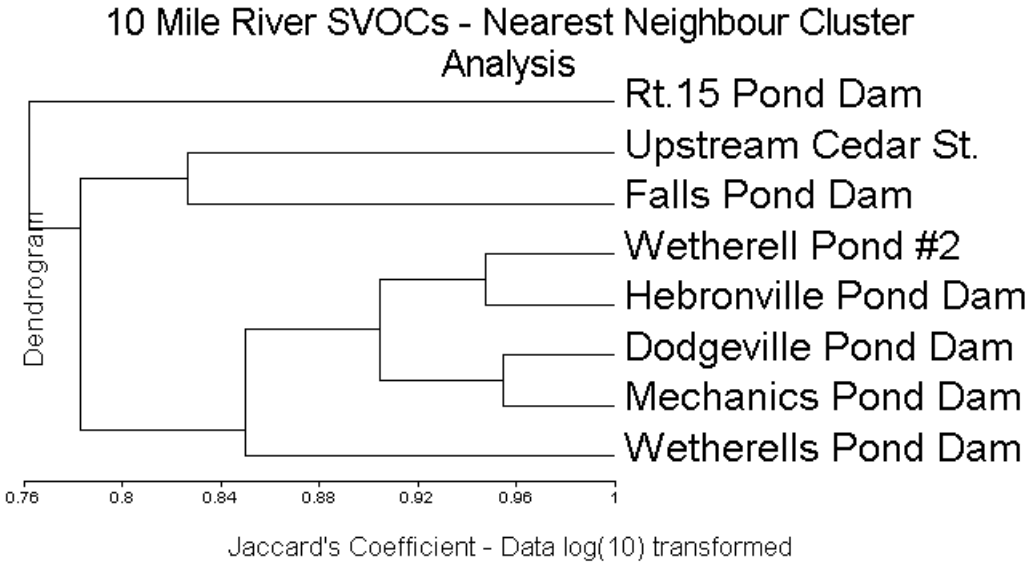


Graphical Analysis -- Inorganic Chemicals (Metals)

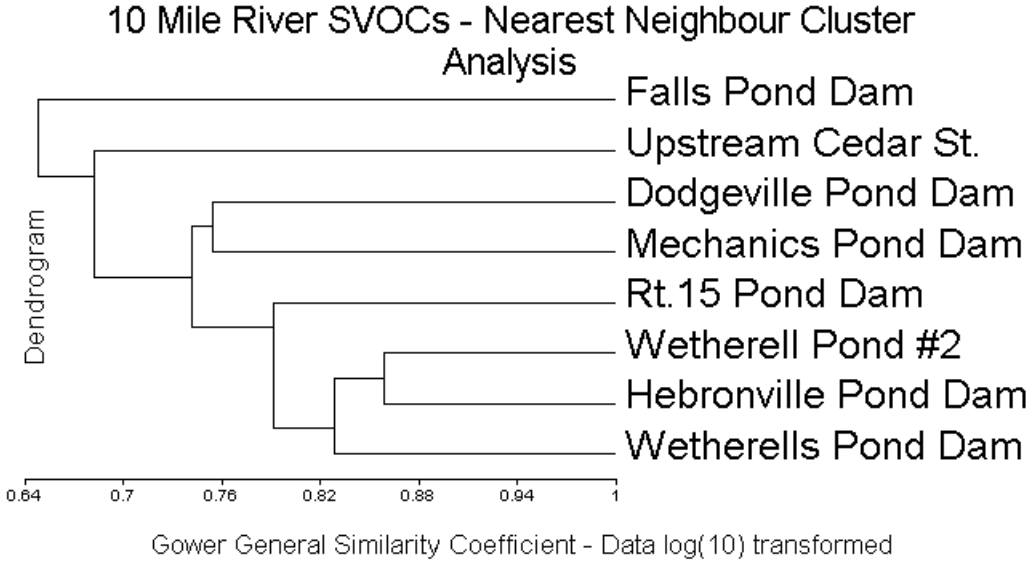
The Principal Components and Principal Coordinates metals analyses yielded identical ordinations with the only difference being the particular values along the axes case scores. The Falls Pond and Upstream Cedar St. sites formed a discrete highly associated cluster. The Wetherell Pond sites were even more strongly associated under the metals analysis. The Route 15 Pond Dam site was strongly associated in all three ordinations with the Dodgeville Pond Dam, Hebronville Pond Dam, and Mechanics Pond Dam sites.

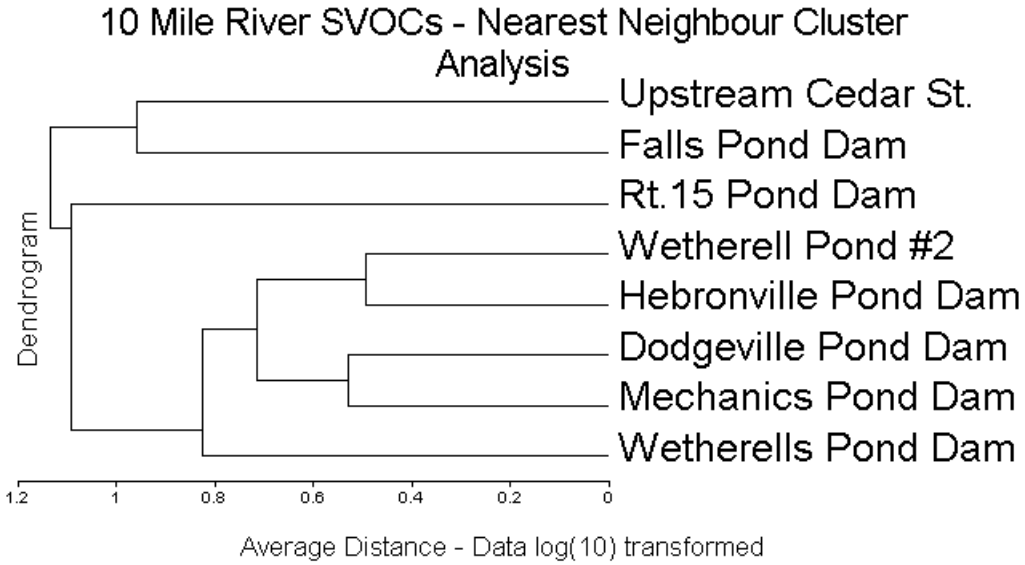
Graphical Analysis -- Volatile and Semi-Volatile Organic Compounds Data



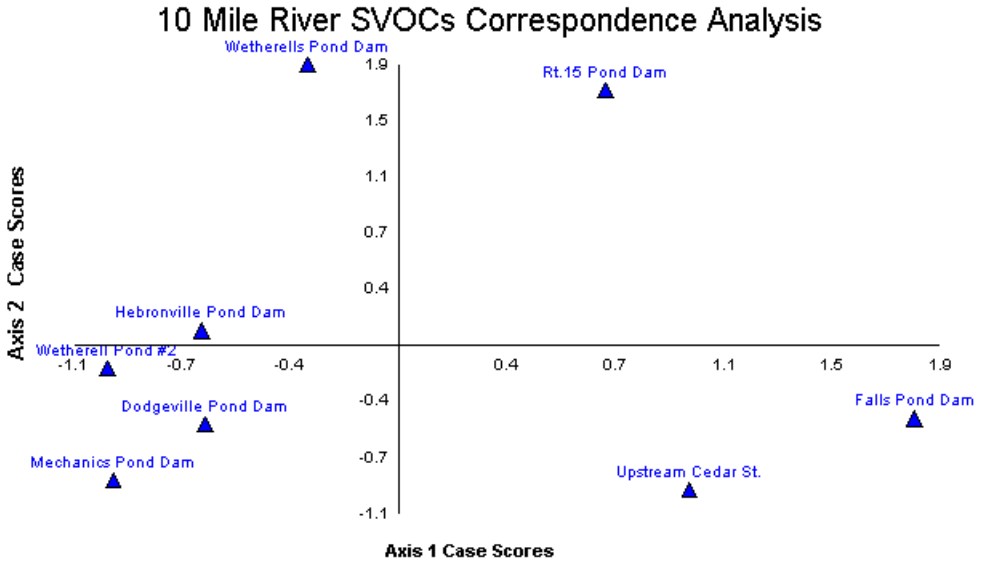


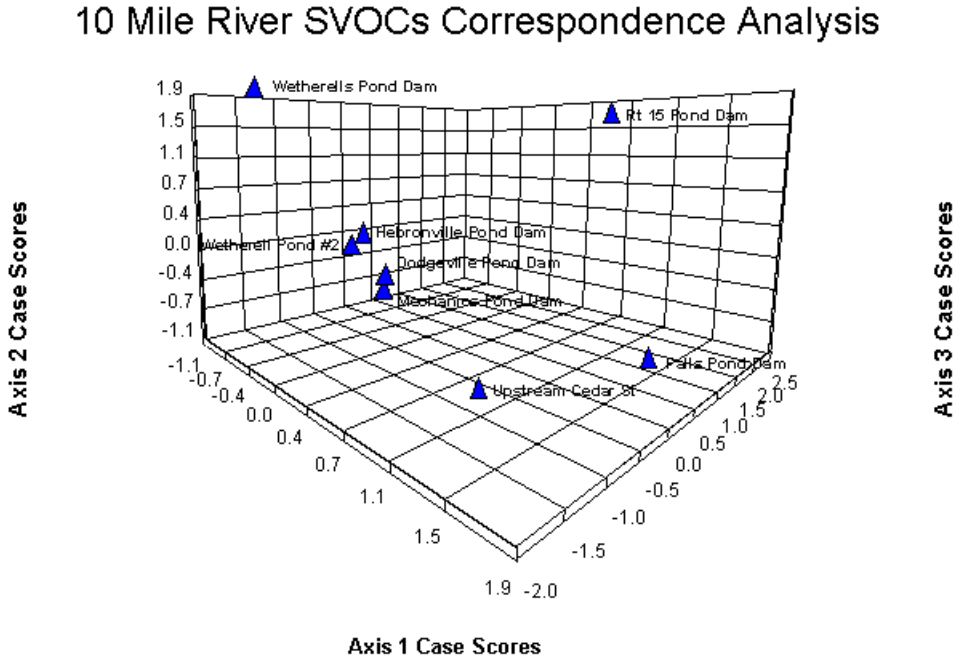
Graphical Analysis -- Volatile and Semi-Volatile Organic Compounds



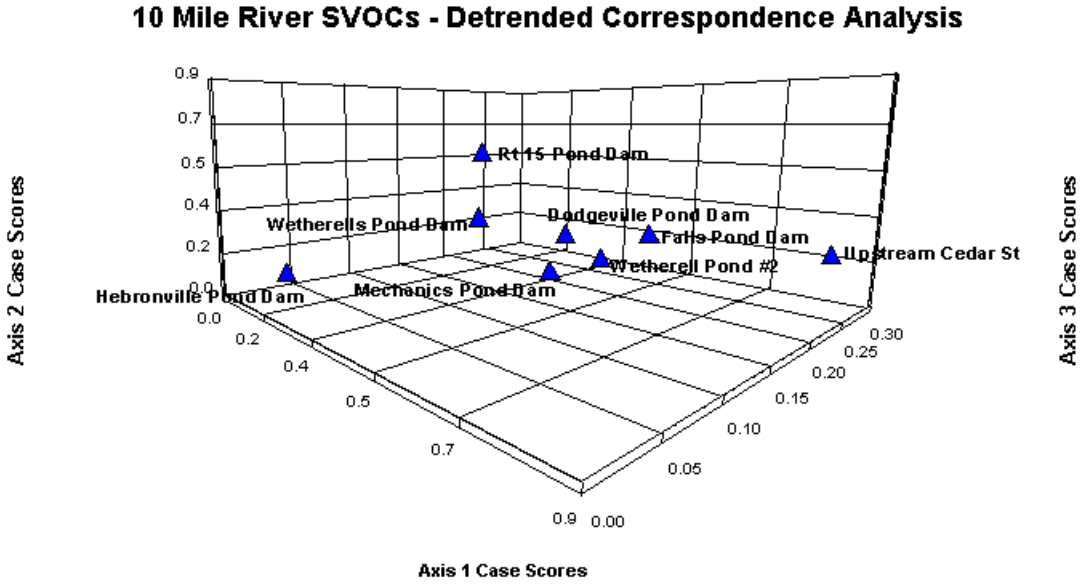


Graphical Analysis -- Volatile and Semi-Volatile Organic Compounds

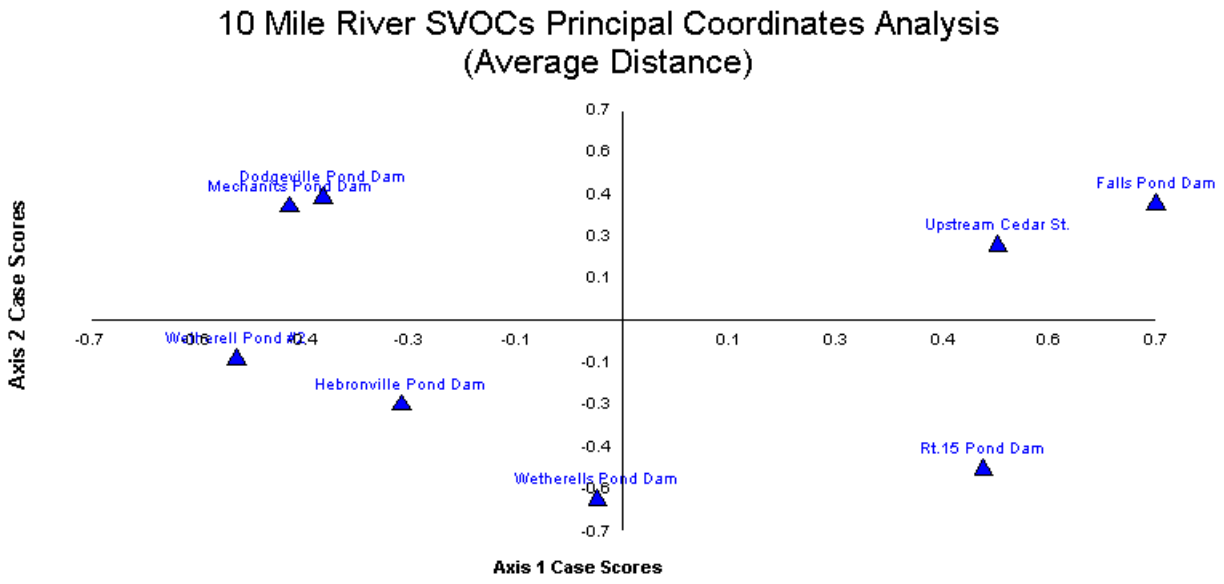


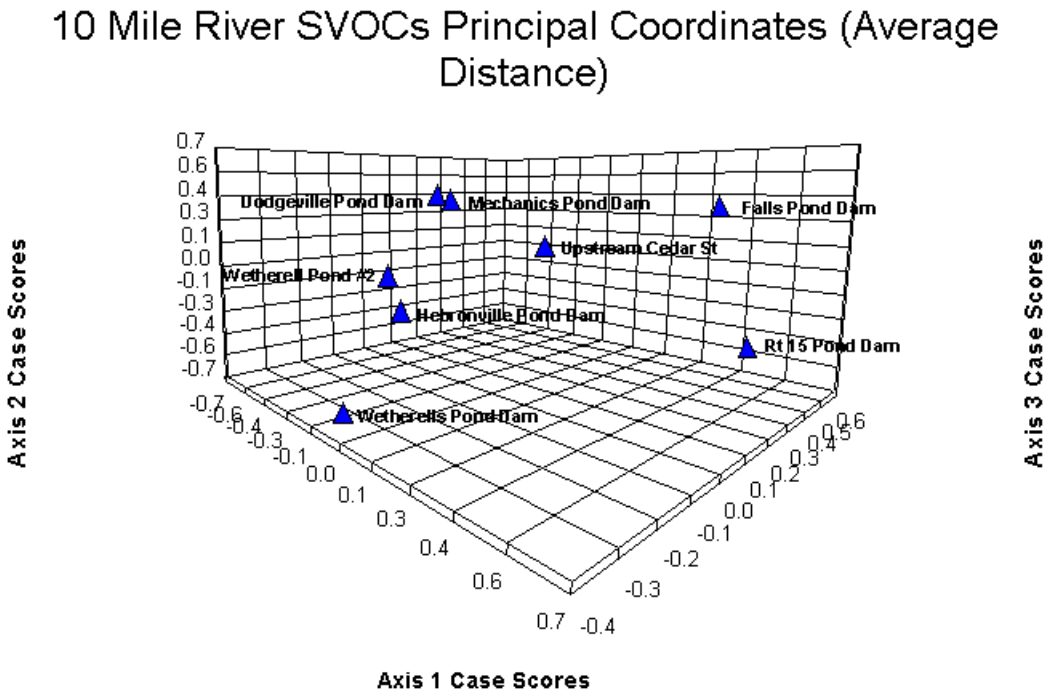


Graphical Analysis -- Volatile and Semi-Volatile Organic Compounds

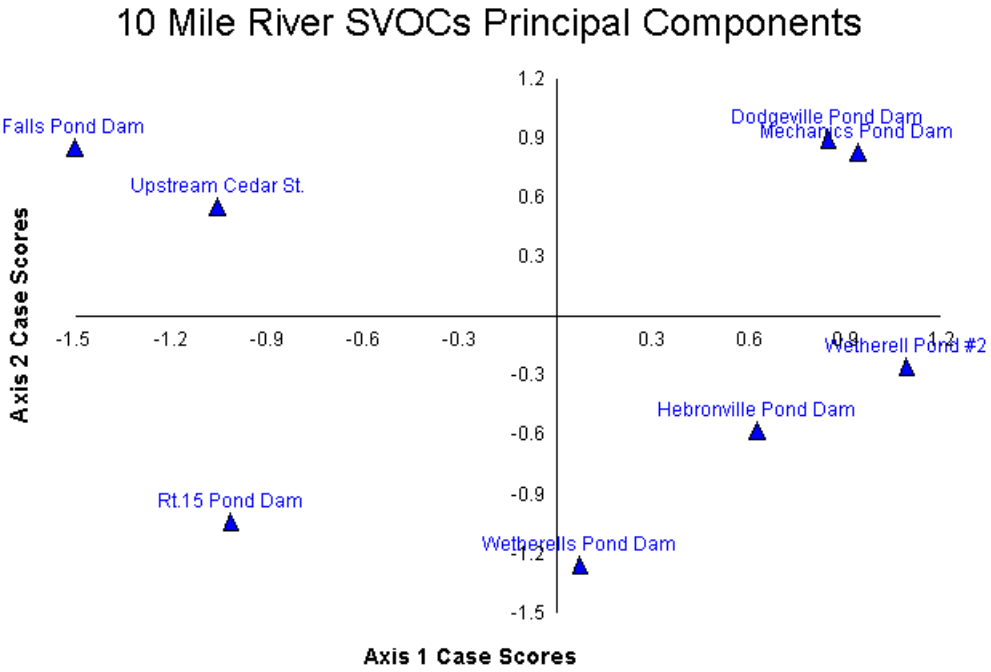


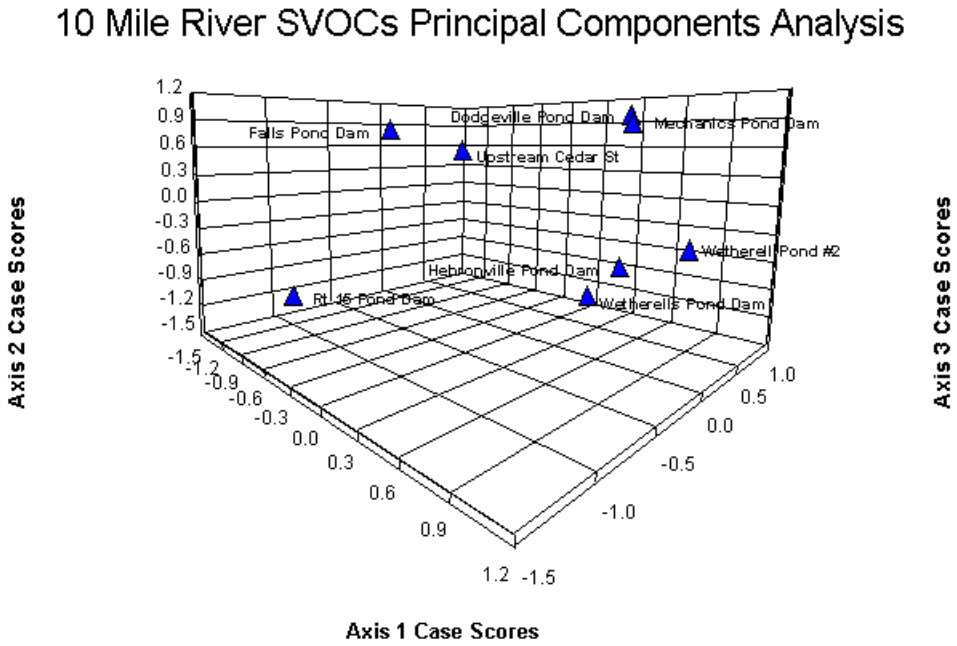
Graphical Analysis -- Volatile and Semi-Volatile Organic Compounds





Graphical Analysis -- Volatile and Semi-Volatile Organic Compounds

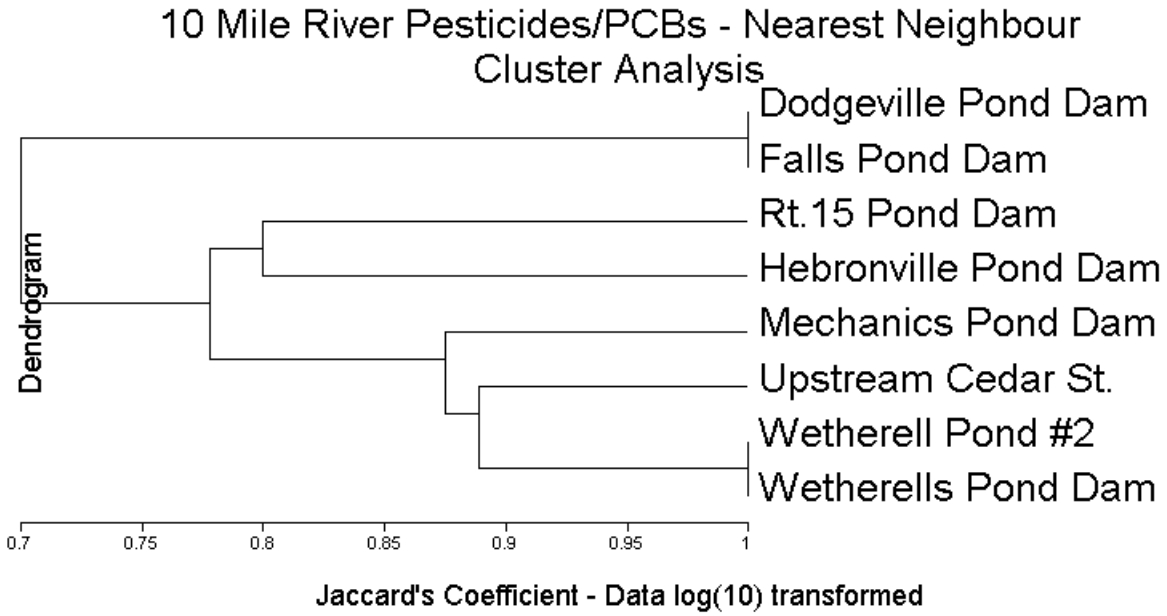


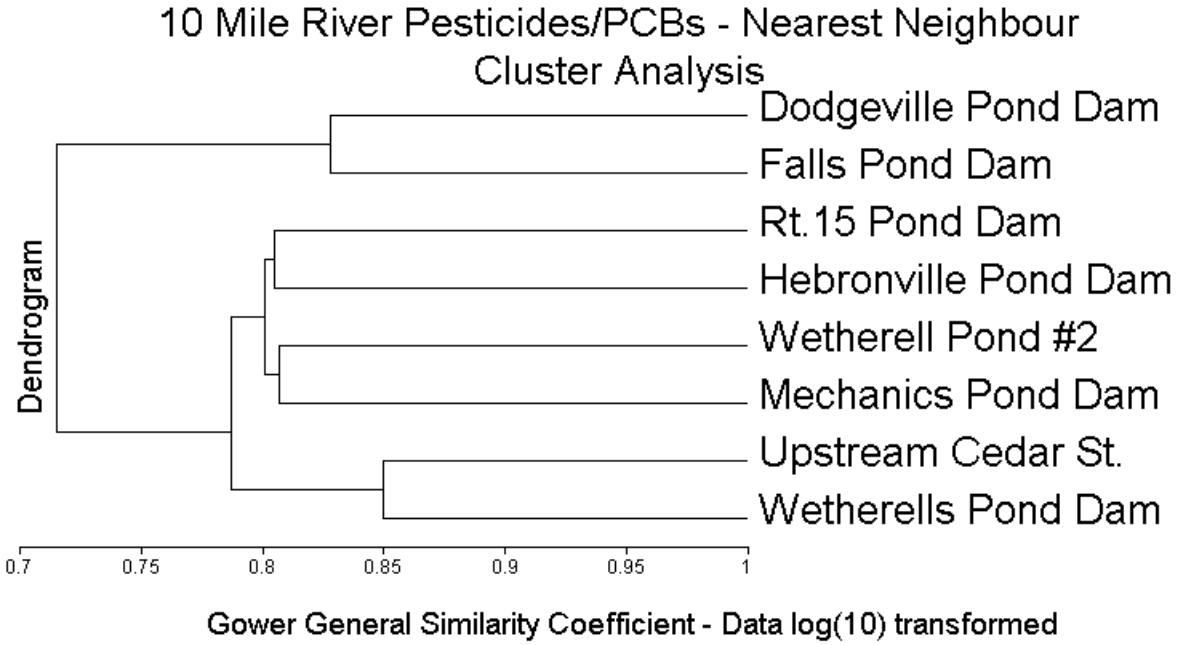


Graphical Analysis -- Volatile and Semi-Volatile Organic Compounds

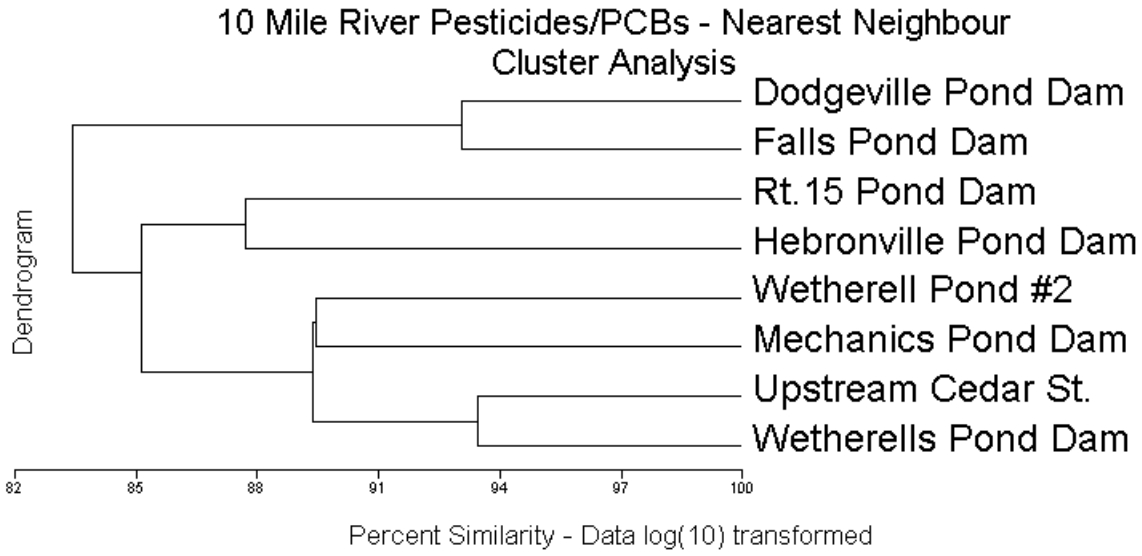
All of the ordinations and cluster analyses for SVOCs reveal an aggregation of Mechanic Pond Dam and Dodgeville Pond Dam sites. Hebronville Pond Dam is also strongly associated with the two Wetherell Pond sites. However, in the Correspondence Analysis the Wetherells Pond Dam site is quite divergent from the other sites, including Wetherell Pond #2. Upstream Cedar Street and Fall Pond Dam also form a distinct association. The Route 15 Pond Dam site appears somewhat anomalous being the most dissimilar from other sites.

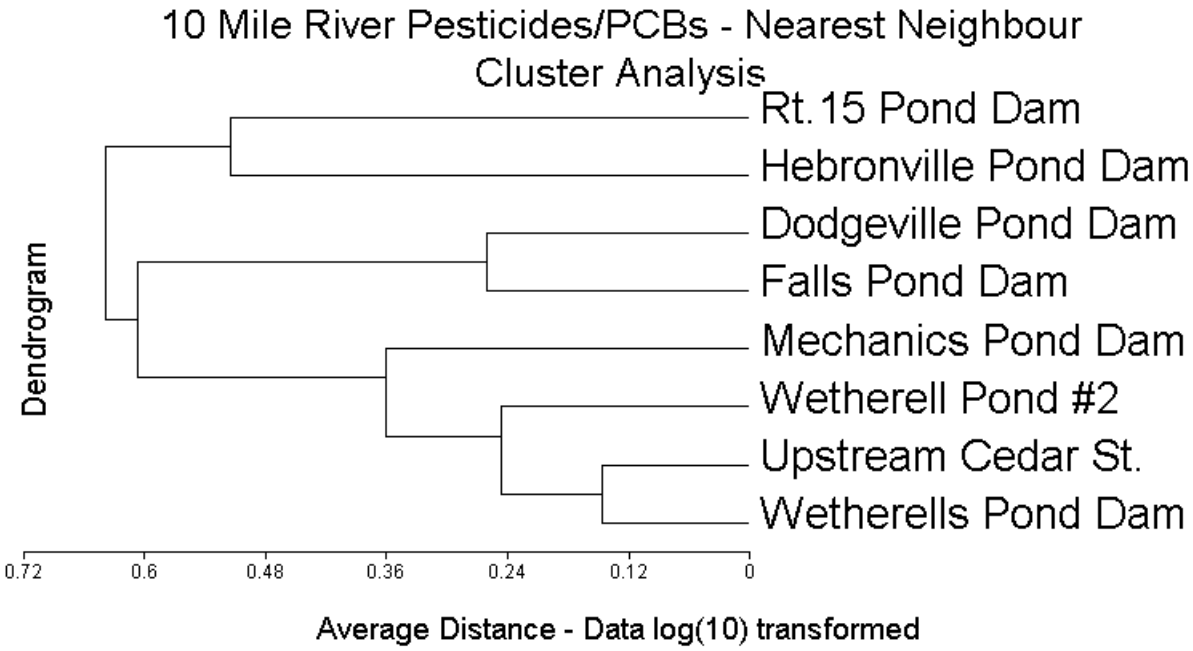
Graphical Analysis -- Chlorinated Pesticides and PCBs



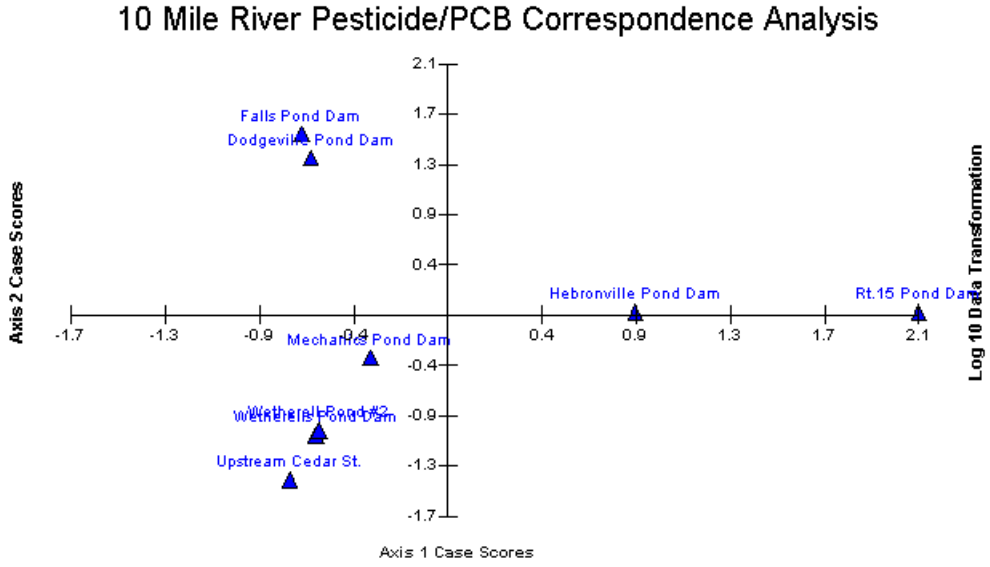


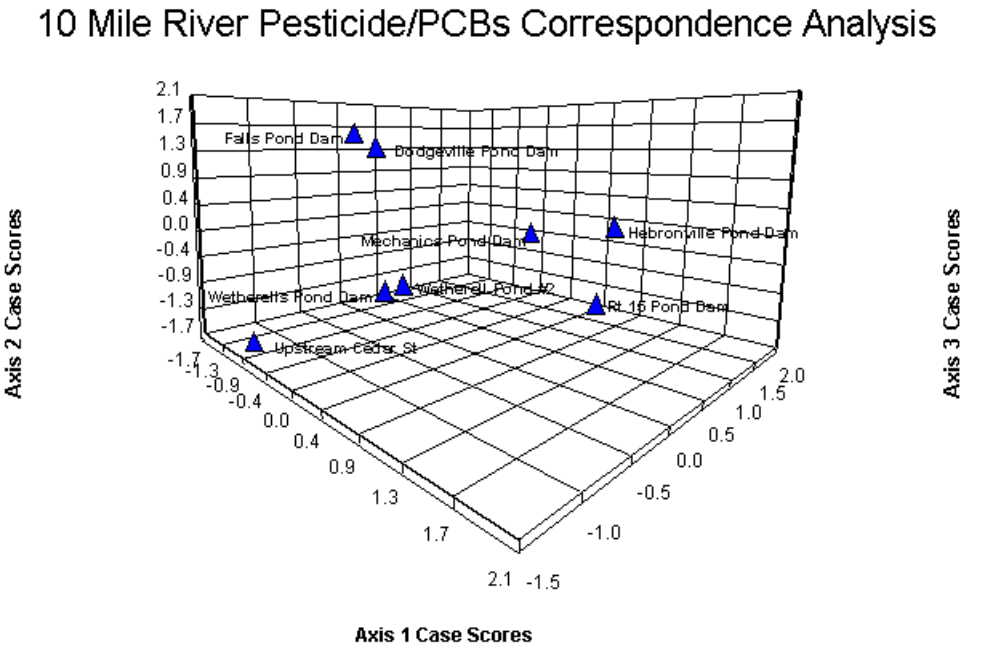
Graphical Analysis -- Chlorinated Pesticides and PCBs



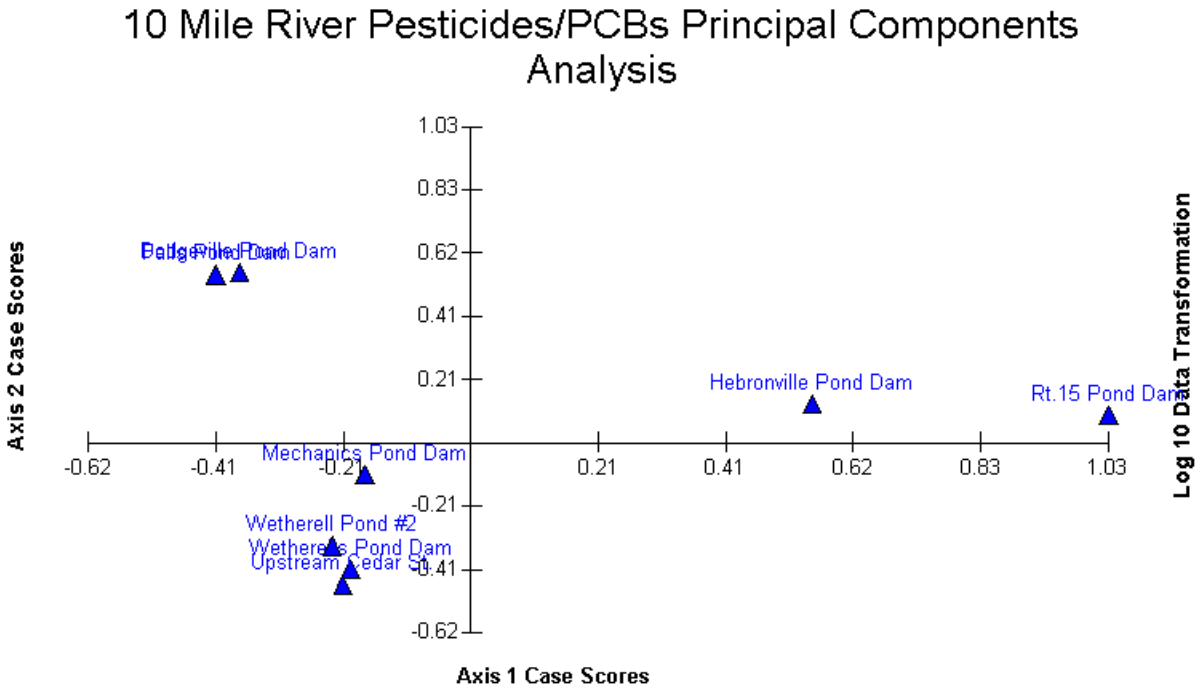


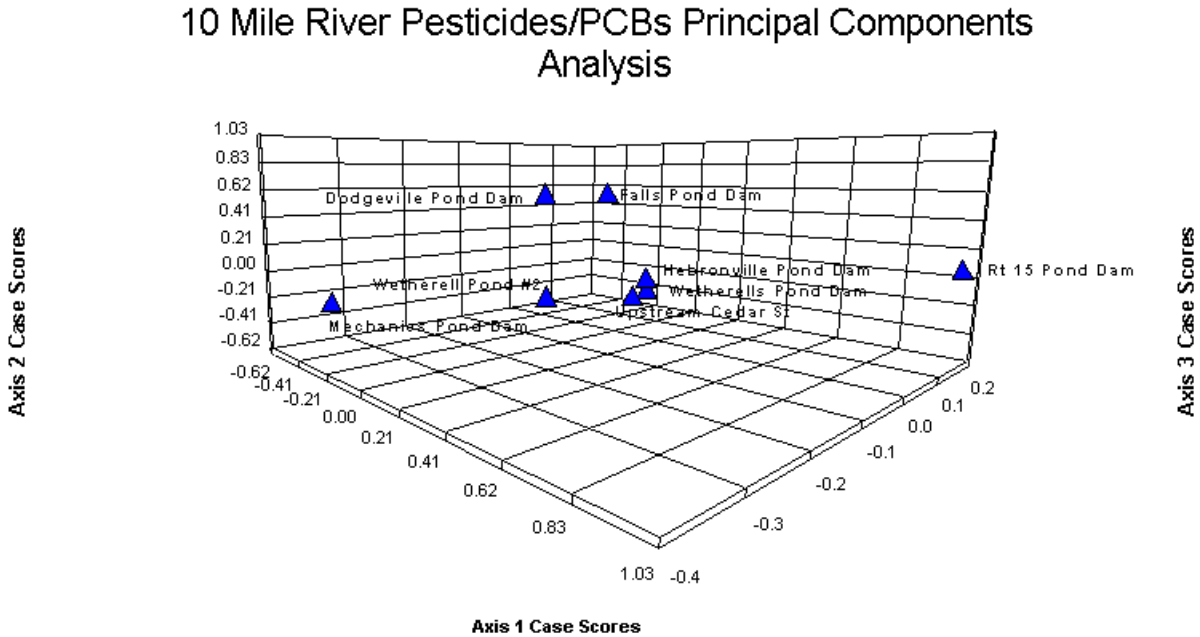
Graphical Analysis -- Chlorinated Pesticides and PCBs



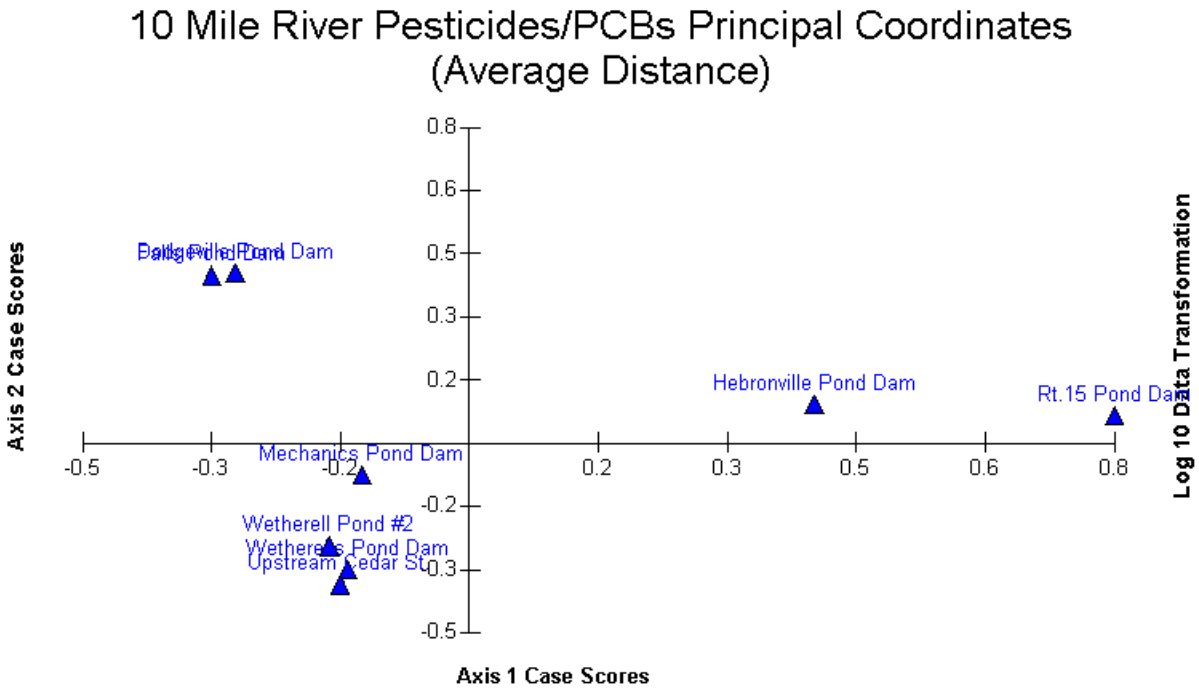


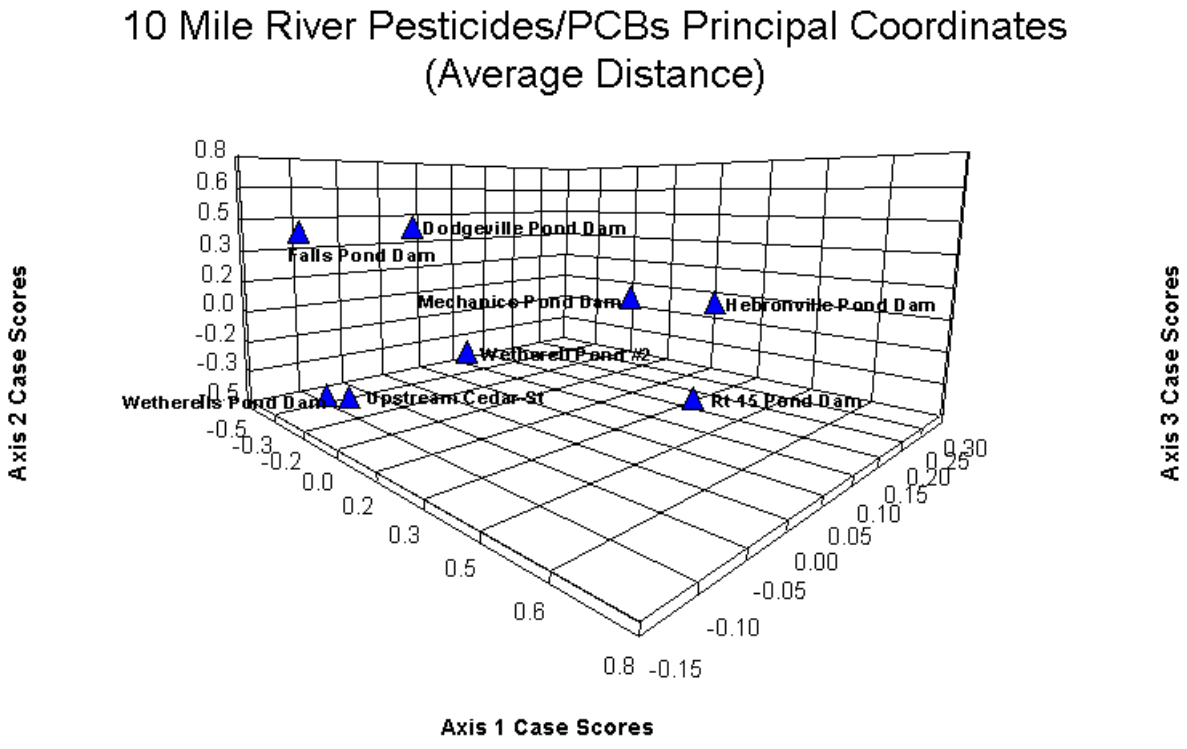
Graphical Analysis -- Chlorinated Pesticides and PCBs





Graphical Analysis -- Chlorinated Pesticides and PCBs



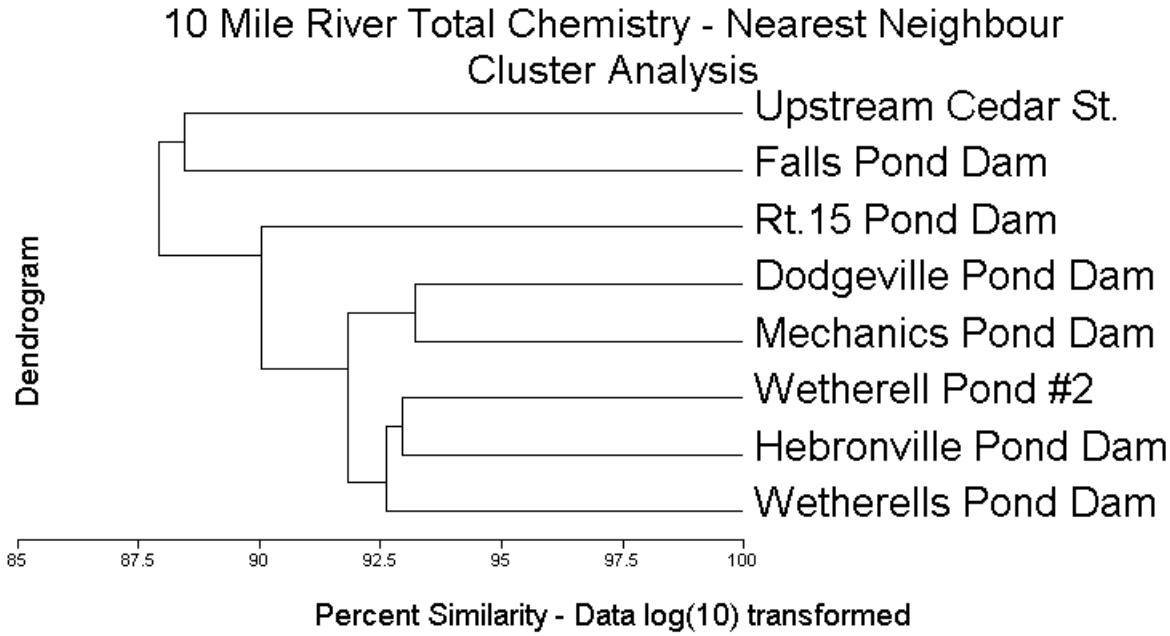


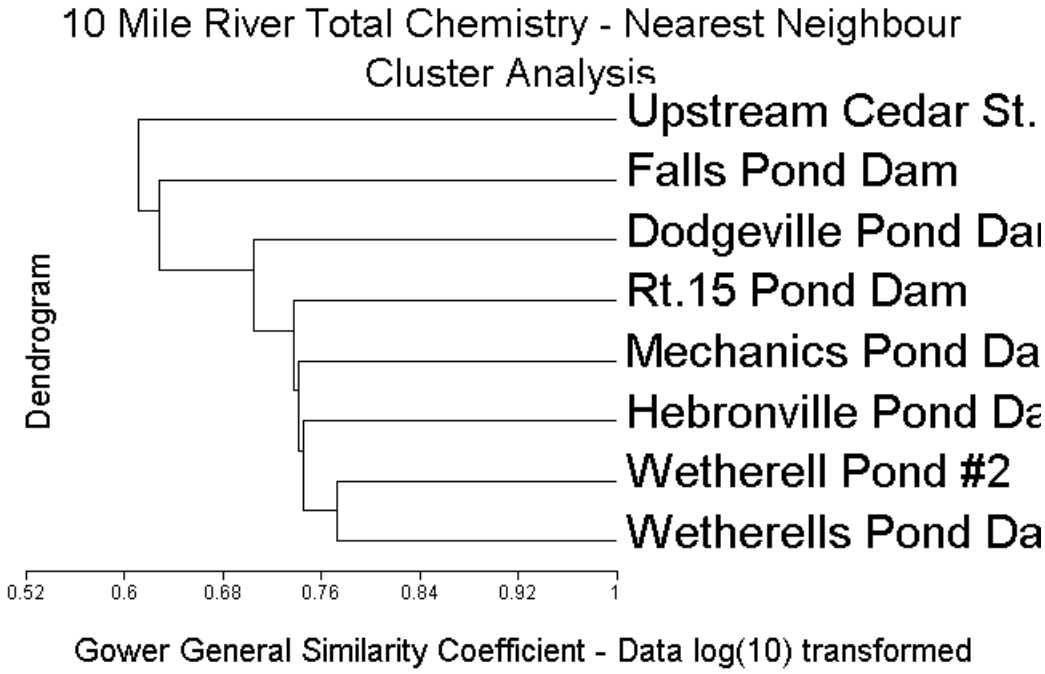
Ten M

Graphical Analysis -- Chlorinated Pesticides and PCBs

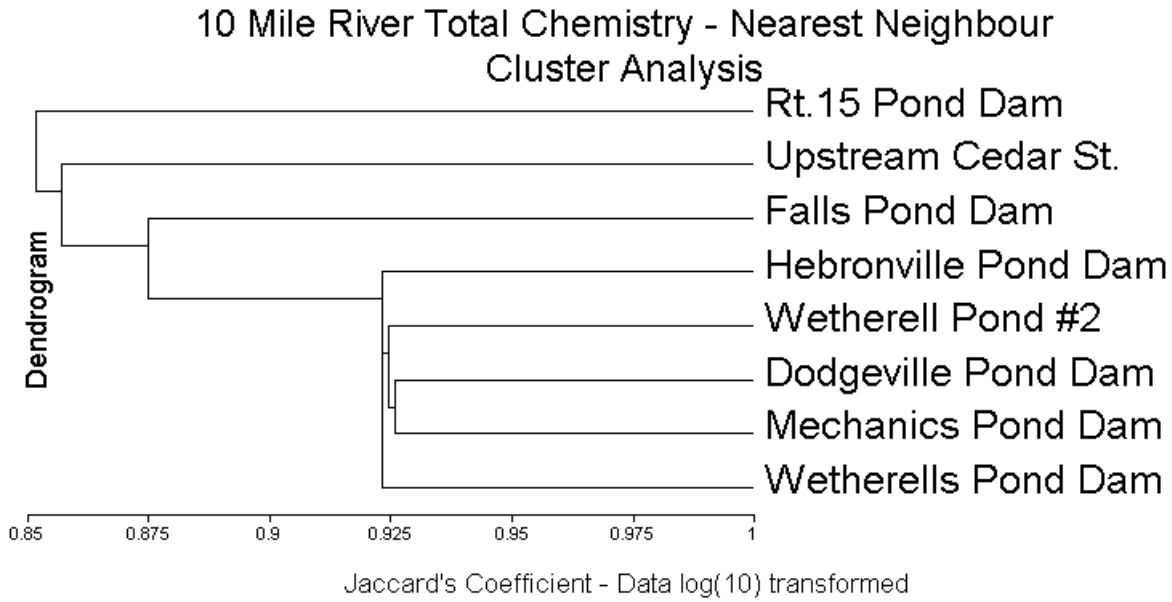
Results of the ordinations for Pesticides/PCBs are somewhat more anomalous than those for metals and SVOCs. All three ordinations yielded highly similar results for Pesticides/PCBs. The Dodgeville Pond Dam and Falls Pond Dam sites are highly associated in all three ordinations for these contaminants. The Route 15 Pond Dam site is somewhat of an outlier and the Hebronville Pond Dam is also to a lesser degree. A strong cluster is formed by Mechanics Pond Dam, Upstream Cedar St., and the two Wetherell Pond Dam sites.

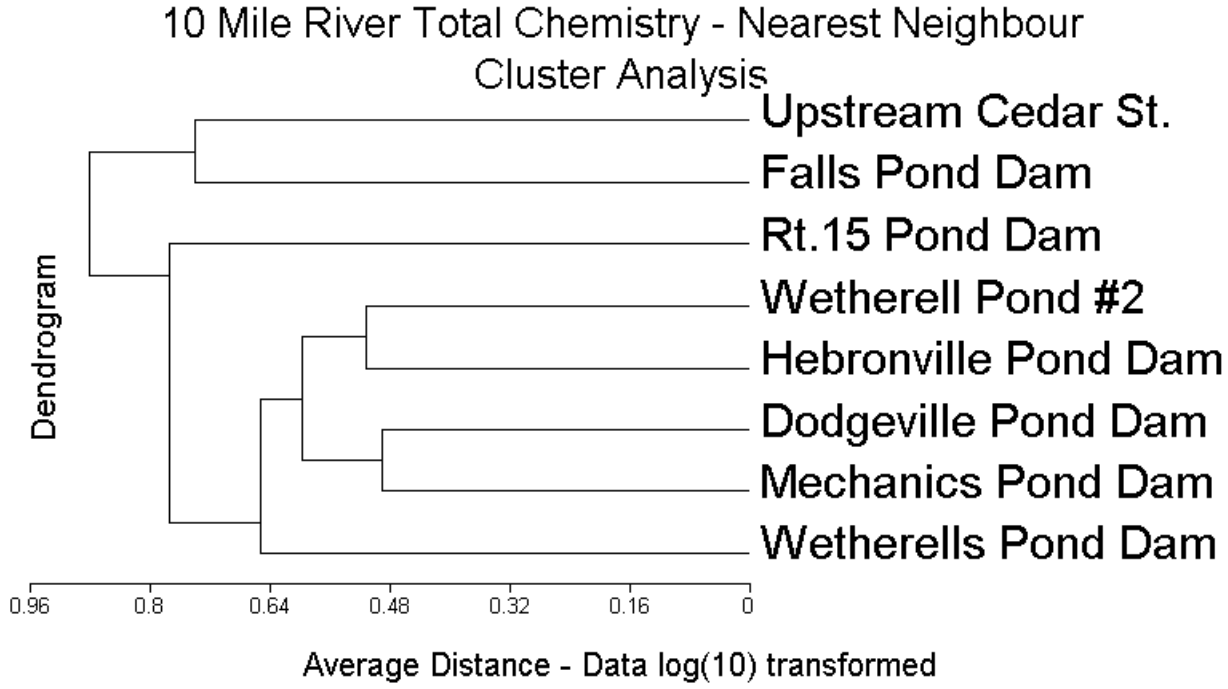
Graphical Analysis Total Chemistry



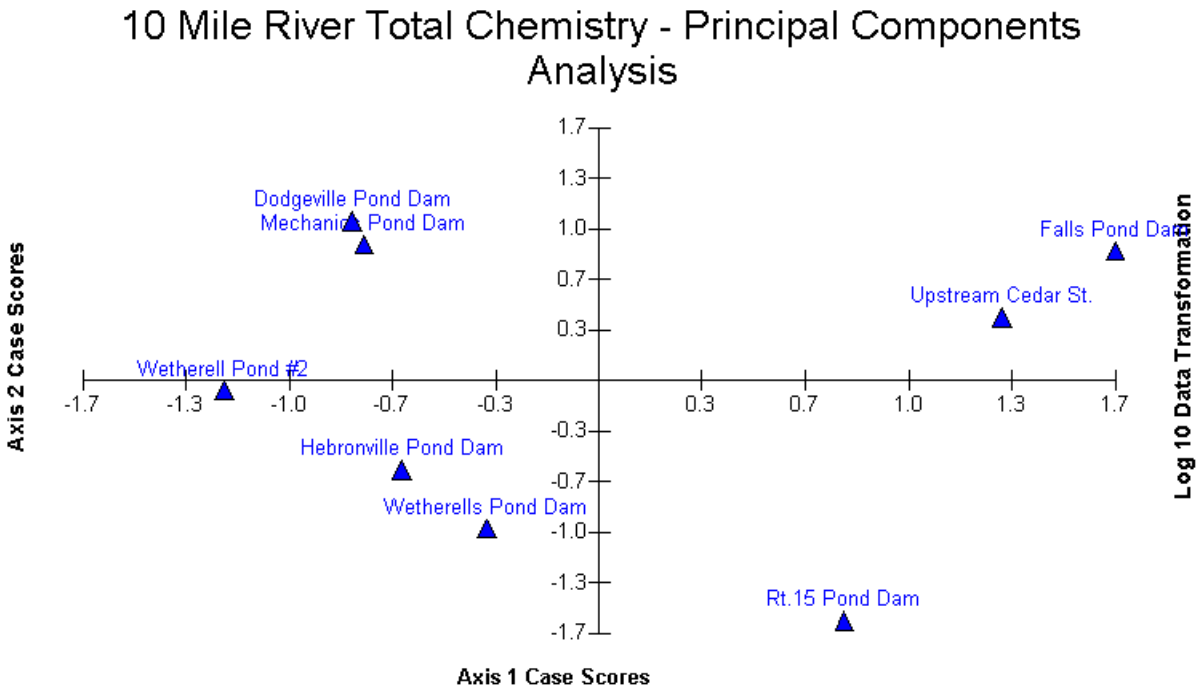


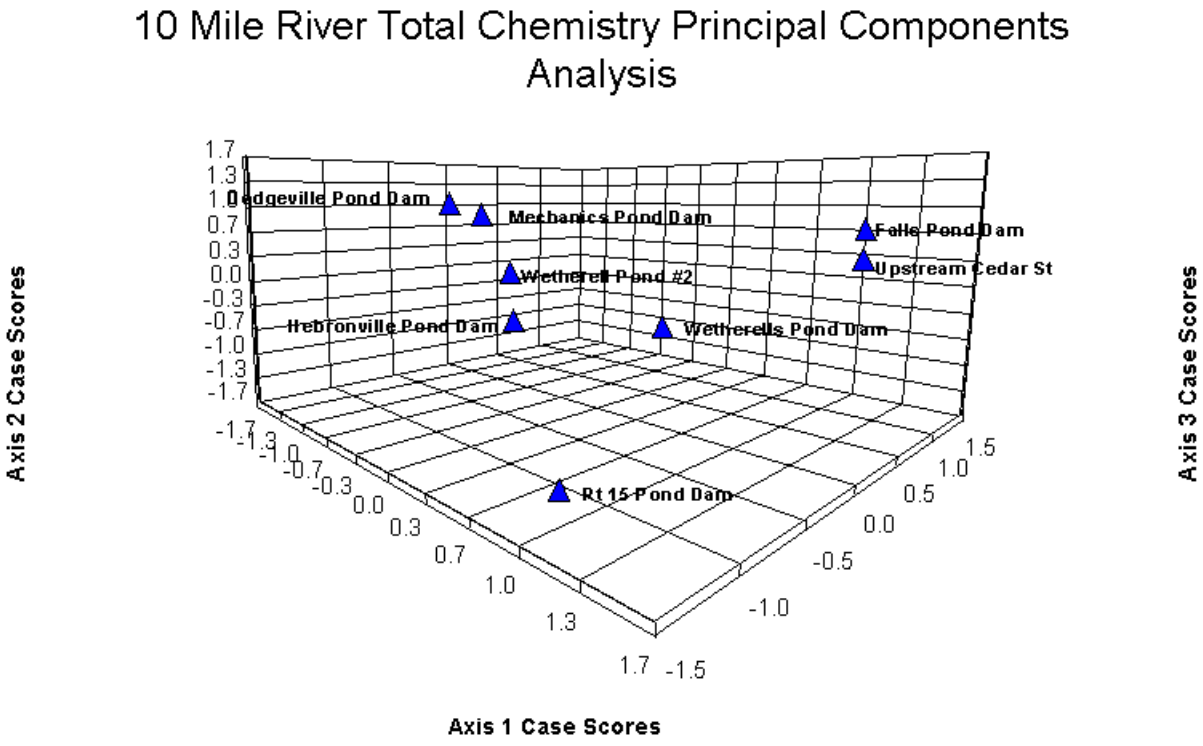
Graphical Analysis Total Chemistry





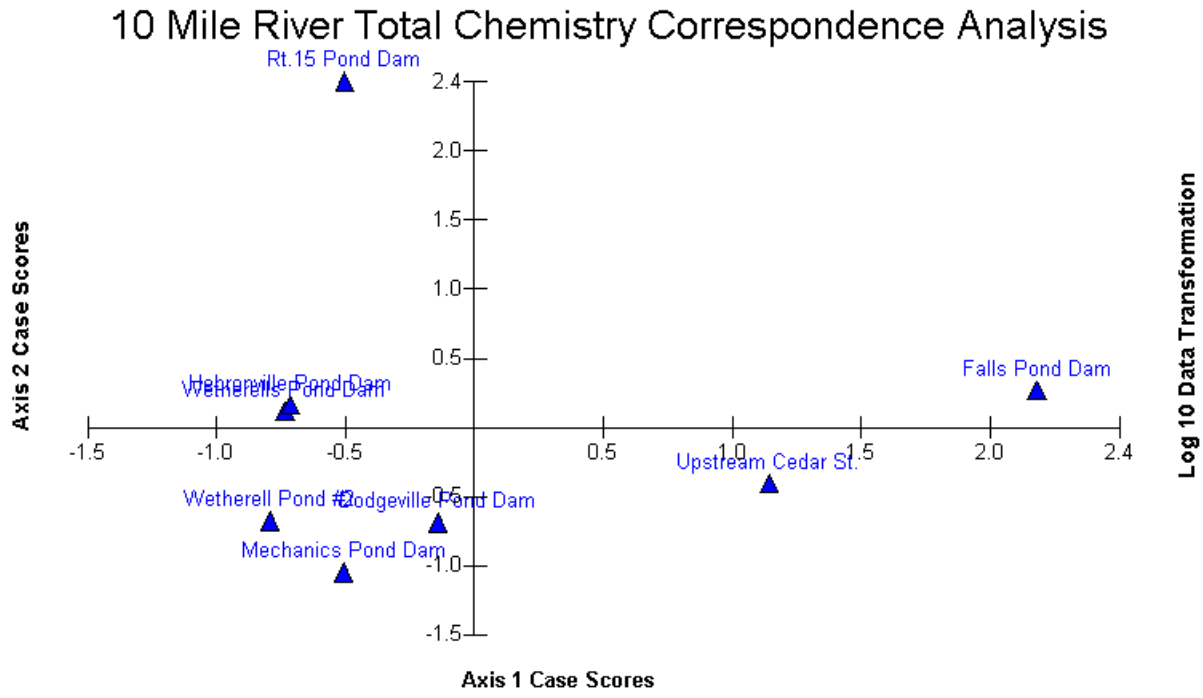
Graphical Analysis Total Chemistry

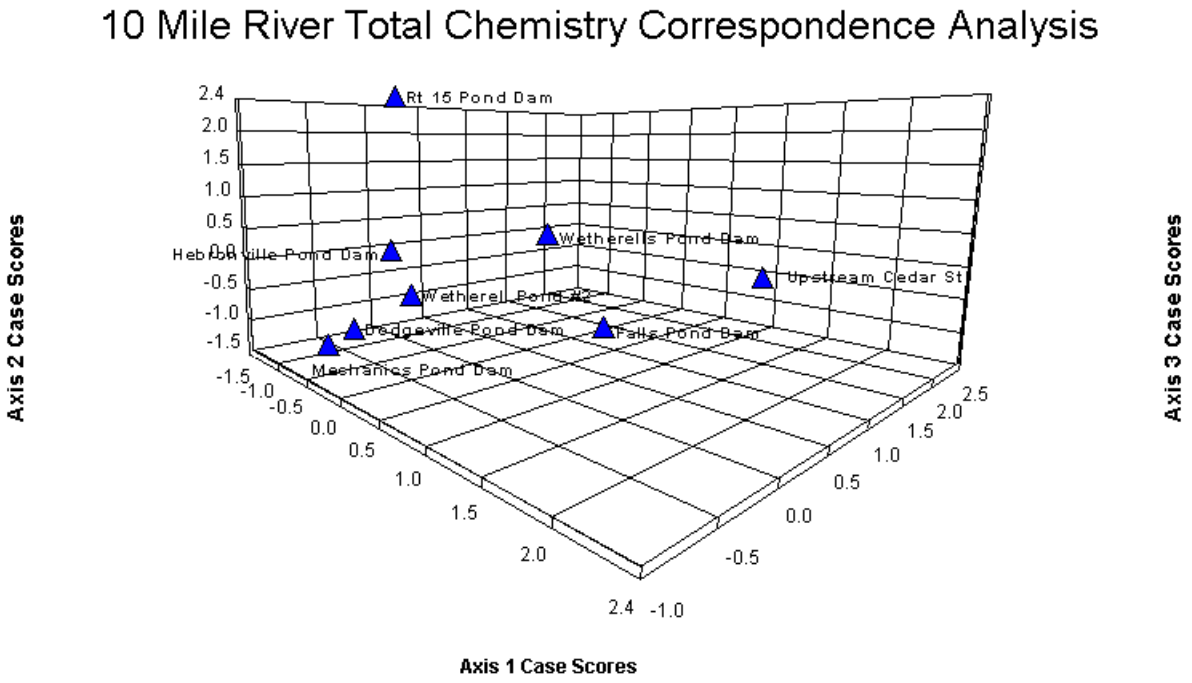




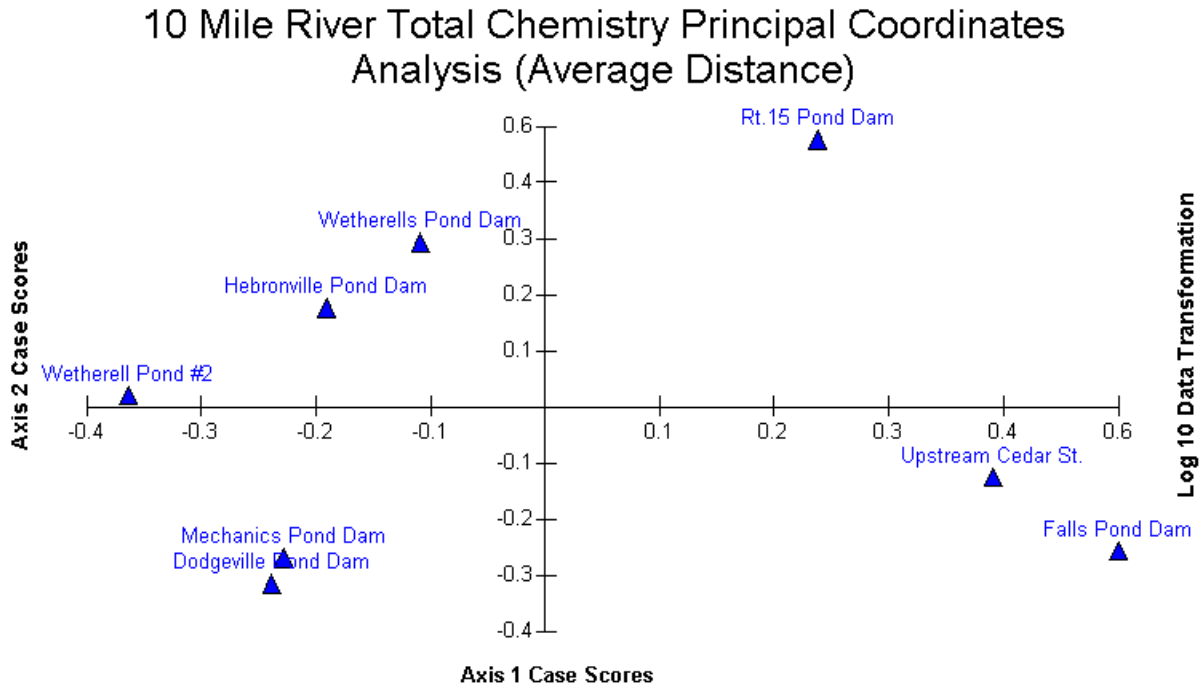
Ten

Graphical Analysis Total Chemistry

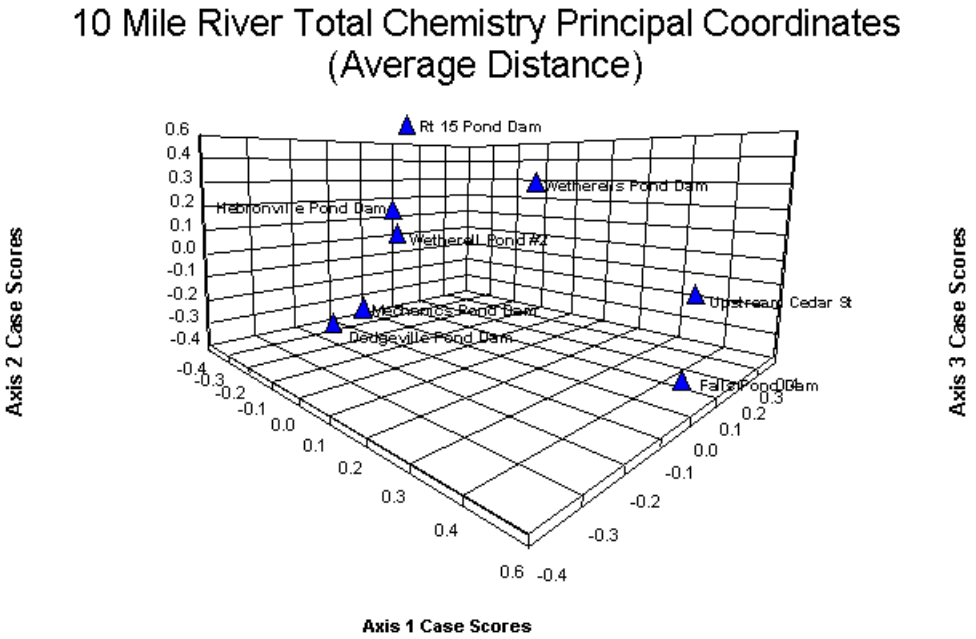




Graphical Analysis Total Chemistry



Note: Results of this analysis are identical, except for scaling, when calculated using Euclidean Distance which methodologically equals Principal Components Analysis (Palmer, 1998).



Graphical Analysis Total Chemistry

The ordination results for total chemistry are, of course, highly similar to those observed for each separate class of contaminant. The Falls Pond Dam and Upstream Cedar St. sites are highly associated in all three ordinations. The Route 15 Pond Dam site is an outlier without any close affinity to any other sites. The Dodgeville Pond Dam and Mechnics Pond Dam sites are more highly associated than the two Wetherell Pond Dam sites. The two Wetherell Pond Dam sites are highly associated with the Hebronville Pond Dam site.

Numerical Ordination Results of Ten Mile Metals Analyses

PRINCIPAL COMPONENTS ANALYSIS
Data file - C:\Data\GHELLYER\SEDTOX\10MILE\10mile Metals.mvs

Analysing 23 variables x 8 cases
Data log(10) transformed
Tolerance of eigenanalysis set at 1E-7
Eigenvalues

	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7
Eigenvalues	1.627	0.486	0.116	0.083	0.044	0.034	0.012
Percentage	67.723	20.23	44.849	3.470	1.816	1.399	0.510
Cum. Percentage	67.723	87.957	92.806	96.275	98.09	199.490	100.000

PCA variable loadings

	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7
Aluminum (Al)	-0.061	0.067	0.200	-0.011	0.000	-0.041	-0.019
Antimony (Sb)	-0.079	-0.058	0.180	-0.079	0.150	0.171	0.030
Arsenic (As), Total	-0.011	0.249	-0.039	-0.098	-0.180	-0.286	0.614
Barium (Ba)	-0.180	0.040	0.261	0.219	0.034	-0.108	-0.189
Beryllium (Be)	-0.065	-0.051	0.150	-0.046	0.121	0.148	0.004
Calcium (Ca)	-0.081	0.071	0.145	0.018	0.154	-0.191	0.123
Cadmium (Cd)	-0.247	0.629	-0.061	0.046	-0.186	-0.162	-0.021
Chromium (Cr), Total	-0.443	-0.104	-0.069	0.210	0.317	-0.588	-0.150
Cobalt (Co)	-0.092	0.253	-0.040	0.081	0.275	0.309	0.194
Copper (Cu)	-0.368	-0.038	-0.126	-0.034	-0.084	0.085	-0.168
Cyanide (Cn), Total	-0.073	0.117	0.433	-0.031	-0.264	0.175	-0.036
Gold (Au)	-0.081	-0.062	0.193	-0.062	0.151	0.173	0.020
Iron (Fe)	-0.021	0.129	0.043	-0.021	0.209	-0.048	-0.186
Lead (Pb)	-0.129	-0.003	0.303	-0.240	0.031	-0.036	-0.191
Manganese (Mn)	0.164	0.169	0.209	0.766	0.124	0.136	-0.042
Magnesium (Mg)	-0.010	0.090	0.303	-0.074	0.114	-0.073	0.084
Mercury (Hg), Total	-0.359	-0.347	-0.121	0.348	-0.296	0.076	0.397
Nickel (Ni)	-0.329	0.328	-0.347	0.014	0.128	0.456	-0.050
Selenium (Se)	-0.049	-0.124	0.037	-0.053	0.412	0.058	0.293
Silver (Ag)	-0.457	-0.239	0.245	-0.064	-0.240	0.180	0.009
Thallium (Tl)	-0.049	-0.124	0.037	-0.053	0.412	0.058	0.293
Vanadium (V)	0.010	0.196	0.365	-0.032	-0.063	-0.035	0.261
Zinc (Zn)	-0.196	0.154	-0.051	-0.304	0.131	-0.028	-0.014

PCA case scores

	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7
Wetherells Pond Dam	-0.338	-0.369	-0.089	-0.012	-0.106	-0.018	0.048
Falls Pond Dam	0.587	-0.059	0.136	-0.192	0.024	-0.018	0.020
Upstream Cedar St.	0.828	-0.104	-0.048	0.118	-0.043	0.064	-0.031
Mechanics Pond Dam	0.058	0.061	0.030	0.107	0.023	-0.153	-0.014
Dodgeville Pond Dam	-0.466	0.278	0.161	-0.006	-0.103	0.035	-0.031
Hebronville Pond Dam	-0.096	0.219	0.030	0.099	0.080	0.054	0.071

Numerical Ordination Results of Ten Mile Metals Analyses

Rt.15 Pond Dam	-0.074	0.309	-0.244	-0.105	0.015	-0.002	-0.018
Wetherell Pond #2	-0.498	-0.333	0.023	-0.008	0.110	0.037	-0.045

PRINCIPAL COORDINATES ANALYSIS
Data file - C:\Data\GHELLYER\SEDTOX\10MILE\10mile Metals.mvs
Analysing 23 variables x 8 cases
Data log(10) transformed
Tolerance of eigenanalysis set at 1E-7

Average Distance

Eigenvalues

	Axis 1	Axis 2	Axis 3
Eigenvalues	0.495	0.148	0.035
Percentage	67.723	20.234	4.849
Cum. Percentage	67.723	87.957	92.806

PCO case scores

	Axis 1	Axis 2	Axis 3
Wetherells Pond Dam	-0.187	-0.204	-0.049
Falls Pond Dam	0.324	-0.033	0.075
Upstream Cedar St.	0.457	-0.058	-0.026
Mechanics Pond Dam	0.032	0.033	0.017
Dodgeville Pond Dam	-0.257	0.154	0.089
Hebronville Pond Dam	-0.053	0.121	0.017
Rt.15 Pond Dam	-0.041	0.170	-0.135
Wetherell Pond #2	-0.275	-0.184	0.013

CORRESPONDENCE ANALYSIS
Data file - C:\Data\GHELLYER\SEDTOX\10MILE\10mile Metals.mvs

Analysing 23 variables x 8 cases
Tolerance of eigenanalysis set at 1E-7
Scores scaled by chemical 'species'

Eigenvalues

	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7
Eigenvalues	0.054	0.014	0.008	0.004	0.001	0.001	0.000
Percentage	66.455	16.575	9.328	4.980	1.515	0.914	0.233
Cum. Percentage	66.455	83.031	92.359	97.339	98.854	99.767	100.000

CA variable scores

	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7
Aluminum (Al)	-0.021	0.026	0.082	0.051	0.004	-0.002	-0.007
Antimony (Sb)	-0.189	0.125	0.046	-0.062	-0.088	-0.028	0.090

Numerical Ordination Results of Ten Mile Metals Analyses

Arsenic (As), Total	0.166	-0.209	-0.011	0.052	0.004	0.156	-0.021
Barium (Ba)	-0.258	0.061	0.067	0.108	0.171	-0.074	-0.025
Beryllium (Be)	-0.195	0.134	0.045	-0.058	-0.081	-0.028	0.091
Calcium (Ca)	-0.040	0.007	0.052	-0.026	0.070	0.042	0.010
Cadmium (Cd)	-0.035	-0.586	-0.096	0.554	0.219	-0.146	-0.120
Chromium (Cr), Total	-0.754	0.231	-0.112	-0.225	0.074	-0.071	0.003
Cobalt (Co)	0.061	-0.208	-0.149	0.123	0.134	0.027	0.207
Copper (Cu)	-0.660	0.069	-0.089	0.069	-0.046	0.020	-0.004
Cyanide (Cn), Total	-0.072	-0.048	0.265	0.380	0.050	-0.171	-0.026
Gold (Au)	-0.185	0.133	0.044	-0.060	-0.082	-0.029	0.087
Iron (Fe)	0.106	-0.042	-0.040	-0.035	-0.011	0.000	-0.003
Lead (Pb)	-0.234	0.018	0.139	0.031	-0.056	-0.101	-0.011
Manganese (Mn)	0.706	0.601	-0.262	0.145	0.016	-0.010	0.010
Magnesium (Mg)	0.115	0.017	0.173	-0.014	-0.043	-0.030	0.033
Mercury (Hg), Total	-1.012	0.457	-0.016	-0.022	-0.260	0.581	0.014
Nickel (Ni)	-0.187	-0.469	-0.309	0.244	0.060	-0.032	0.057
Selenium (Se)	-0.166	0.179	-0.009	-0.210	-0.114	0.042	0.136
Silver (Ag)	-0.949	0.301	0.003	0.048	-0.113	-0.012	0.025
Thallium (Tl)	-0.166	0.179	-0.009	-0.210	-0.114	0.042	0.136
Vanadium (V)	0.196	-0.040	0.218	0.121	0.006	-0.042	0.043
Zinc (Zn)	-0.205	-0.247	-0.112	0.077	-0.016	-0.007	-0.012

CA case scores

	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7
Wetherells Pond Dam	-1.490	0.775	0.268	0.418	-0.890	2.313	-0.225
Falls Pond Dam	0.922	-0.437	1.897	-0.967	-1.600	-0.317	0.363
Upstream Cedar St.	1.779	2.117	-1.301	0.734	-0.922	-0.367	-0.356
Mechanics Pond Dam	0.539	0.254	0.456	-1.047	1.619	0.446	-1.465
Dodgeville Pond Dam	-0.424	-0.412	0.662	1.716	0.302	-0.887	-0.502
Hebronville Pond Dam	0.536	-0.128	-0.071	0.234	1.101	0.545	2.051
Rt.15 Pond Dam	0.243	-1.844	-1.565	-0.235	-0.604	0.290	-0.446
Wetherell Pond #2	-1.503	0.664	-0.559	-1.132	-0.041	-1.327	0.431

Numerical Ordination Results of Ten Mile Volatile and Semi-Volatile Analyses

CORRESPONDENCE ANALYSIS
Data file - C:\Data\GHELLYER\SEDTOX\10MILE\10 Miles VOAs.mvs
Analysing 29 variables x 8 cases
Tolerance of eigenanalysis set at 1E-7

Scores will be detrended

Eigenvalues

	Axis 1	Axis 2	Axis 3
Eigenvalues	0.090	0.022	0.002
Percentage	40.485	10.104	0.845
Cum. Percentage	40.485	50.590	51.435

CA variable scores

	Axis 1	Axis 2	Axis 3
Acenaphthene	3.035	1.018	0.562
Acenaphthylene	-0.839	0.876	1.820
Anthracene	-0.620	0.719	0.449
Benzoic Acid	7.432	0.254	0.442
Benzo(a)anthracene	1.159	0.445	-0.156
Benzo(b)fluoranthene	0.610	0.222	0.334
Benzo(k)fluoranthene	-0.093	0.543	0.332
Benzo(a)pyrene	0.714	-0.018	0.093
Benzo(e)pyrene	-3.502	0.254	0.442
Benzo(ghi)perylene	-0.408	0.529	-1.622
Bis(2-ethylhexyl)phthalate	-0.629	0.684	-0.225
Butyl benzyl phthalate	-0.676	-2.857	0.582
Carbazole	3.582	-1.731	0.864
Chloroaniline, 4-	1.472	-0.670	-5.160
Chrysene	0.630	0.101	0.538
Dibenzo(a,h)anthracene	-0.072	0.430	-2.042
Dibenzofuran	6.072	0.254	0.442
Dichlorobenzene, 1,4	-0.893	8.420	0.287
Diethyl phthalate	-0.203	-3.682	-2.906
Dimethyl phthalate	-0.392	-5.572	6.509
Di-n-butyl phthalate	-1.199	-4.050	2.882
Di-n-octyl phthalate	4.905	0.254	0.442
Fluoranthene	1.093	0.479	0.388
Fluorene	0.985	0.925	0.945
Indeno(1,2,3-cd)pyrene	-0.145	0.659	-1.735
Methylphenol, 4-	4.905	0.254	0.442
Naphthalene	-0.801	5.940	0.348
Phenanthrene	1.480	-0.076	0.736
Pyrene	0.906	0.399	0.945

CA case scores

Numerical Ordination Results of Ten Mile Volatile and Semi-Volatile Analyses

	Axis 1	Axis 2	Axis 3
Wetherells Pond Dam	0.000	0.187	0.243
Falls Pond Dam	0.656	0.324	0.168
Upstream Cedar St.	0.894	0.285	0.218
Mechanics Pond Dam	0.466	0.129	0.157
Dodgeville Pond Dam	0.384	0.223	0.207
Hebronville Pond Dam	0.277	0.204	0.000
Rt.15 Pond Dam	0.373	0.608	0.124
Wetherell Pond #2	0.292	0.000	0.297

PRINCIPAL COMPONENTS ANALYSIS
Data file - C:\Data\GHELLYER\SEDTOX\10MILE\10 Miles VOAs.mvs

Analysing 29 variables x 8 cases
Tolerance of eigenanalysis set at 1E-7

	Axis 1	Axis 2	Axis 3	Axis 4
Eigenvalues	15716450.0	12428392.9	10575535.7	7756964.3
	Axis 5	Axis 6	Axis 7	Axis 8
Eigenvalues	4374107.1	3010714.3	2485850.0	2173878.6
	Axis 1	Axis 2	Axis 3	Axis 4
Percentage	25.008	19.776	16.828	12.343
	Axis 5	Axis 6	Axis 7	Axis 8
	6.960	4.791	3.956	3.459
	Axis 1	Axis 2	Axis 3	Axis 4
Cum. Percentage	25.008	44.785	61.613	73.956
	Axis 5	Axis 6	Axis 7	Axis 8
	80.916	85.707	89.663	93.122

PCA variable loadings

	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7	Axis 8
Acenaphthene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Acenaphthylene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Anthracene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Benzoic Acid	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Benzo(a)anthracene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000
Benzo(b)fluoranthene	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000
Benzo(k)fluoranthene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Benzo(a)pyrene	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000
Benzo(e)pyrene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Benzo(ghi)perylene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Bis(2-ethylhexyl) phthalate	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Butyl benzyl phthalate	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Carbazole	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Chloroaniline, 4-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Numerical Ordination Results of Ten Mile Volatile and Semi-Volatile Analyses

Chrysene	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000
Dibenzo(a,h)anthracene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Dibenzofuran	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Dichlorobenzene, 1,4-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diethyl phthalate	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Dimethyl phthalate	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Di-n-butyl phthalate	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Di-n-octyl phthalate	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fluoranthene	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000
Fluorene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Indeno(1,2,3-cd)pyrene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Methylphenol, 4-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Naphthalene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Phenanthrene	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000
Pyrene	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000

PCA case scores

	Axis 1	Axis 2	Axis 3	Axis 4
Wetherells Pond Dam	-834.357	-1081.923	-977.983	-930.738
	Axis 5	Axis 6	Axis 7	Axis 8
Wetherells Pond Dam	-656.713	-576.396	-445.053	-520.646
	Axis 1	Axis 2	Axis 3	Axis 4
Falls Pond Dam	186.148	2546.536	1970.140	1790.607
	Axis 5	Axis 6	Axis 7	Axis 8
Falls Pond Dam	1384.295	1048.851	1089.483	824.907
	Axis 1	Axis 2	Axis 3	Axis 4
Upstream Cedar St.	-1454.218	543.324	269.300	165.359
	Axis 5	Axis 6	Axis 7	Axis 8
Upstream Cedar St.	61.419	103.940	484.739	257.961
	Axis 1	Axis 2	Axis 3	Axis 4
Mechanics Pond Dam	110.555	-99.216	42.521	-137.012
	Axis 5	Axis 6	Axis 7	Axis 8
Mechanics Pond Dam	23.623	28.347	-120.004	106.775
	Axis 1	Axis 2	Axis 3	Axis 4
Dodgeville Pond Dam	3474.438	1148.067	1629.972	1374.846
	Axis 5	Axis 6	Axis 7	Axis 8
Dodgeville Pond Dam	968.534	897.666	409.147	711.518
	Axis 1	Axis 2	Axis 3	Axis 4
Hebronville Pond Dam	-607.578	-1157.516	-1280.355	-855.145
	Axis 5	Axis 6	Axis 7	Axis 8
Hebronville Pond Dam	-694.510	-538.599	-547.104	-497.968
	Axis 1	Axis 2	Axis 3	Axis 4
Rt.15 Pond Dam	-305.206	-1006.330	-826.797	-817.348
	Axis 5	Axis 6	Axis 7	Axis 8
Hebronville Pond Dam	-618.917	-538.599	-486.629	-422.375
	Axis 1	Axis 2	Axis 3	Axis 4
Wetherell Pond #2	-569.781	-892.941	-826.797	-590.569

Numerical Ordination Results of Ten Mile Volatile and Semi-Volatile Analyses

	Axis 5	Axis 6	Axis 7	Axis 8
Wetherell Pond #2	-467.731	-425.210	-384.579	-460.172

PRINCIPAL COORDINATES ANALYSIS
Data file - C:\Data\GHELLYER\SEDTOX\10MILE\10 Miles VOAs.mvs

Analysing 29 variables x 8 cases
Data log(10) transformed
Tolerance of eigenanalysis set at 1E-7

Average Distance

Eigenvalues

	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5
Eigenvalues	1.731	1.276	0.533 0	.459	0.264
Percentage	38.728	28.553	11.937	10.278	5.902
Cum. Percentage	38.728	67.281	79.218	89.496	95.398

PCO case scores

	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5
Wetherells Pond Dam	-0.035	-0.601	-0.369	-0.238	0.234
Falls Pond Dam	0.717	0.407	-0.062	-0.380	-0.169
Upstream Cedar St.	0.505	0.264	-0.269	0.482	0.079
Mechanics Pond Dam	-0.449	0.397	0.173	-0.031	0.227
Dodgeville Pond Dam	-0.404	0.428	0.096	-0.069	0.054
Hebronville Pond Dam	-0.299	-0.278	-0.087	0.109	-0.275
Rt.15 Pond Dam	0.485	-0.496	0.524	0.077	0.052
Wetherell Pond #2	-0.521	-0.121	-0.007	0.049	-0.203

CORRESPONDENCE ANALYSIS
Data file - C:\Data\GHELLYER\SEDTOX\10MILE\10 Miles VOAs.mvs

Analysing 29 variables x 8 cases
Data log(10) transformed
Tolerance of eigenanalysis set at 1E-7

Scores scaled by species

Eigenvalues

	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7
Eigenvalues	0.12	0.092	0.064	0.061	0.031	0.011	0.004
Percentage	31.12	23.99	16.72	15.96	8.21	2.86	1.10
Cum. Percentage	31.16	55.16	71.87	87.84	96.04	98.89	100.0

Numerical Ordination Results of Ten Mile Volatile and Semi-Volatile Analyses

CA variable scores

	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7
Acenaphthene	0.359	-0.280	0.368	0.009	0.313	-0.235	-0.160
Acenaphthylene	-0.038	0.086	0.007	0.050	-0.048	0.002	0.022
Anthracene	-0.019	0.049	0.021	0.003	-0.018	0.007	-0.006
Benzoic Acid	0.993	-0.953	-0.789	2.098	0.166	0.040	0.184
Benzo(a)anthracene	0.013	0.020	0.010	0.035	-0.017	0.017	-0.008
Benzo(b)fluoranthene	0.005	0.034	0.007	0.030	-0.033	0.022	0.000
Benzo(k)fluoranthene	0.004	0.039	0.014	0.003	-0.028	0.016	-0.004
Benzo(a)pyrene	0.005	0.027	0.006	0.028	-0.027	0.020	-0.004
Benzo(e)pyrene	-0.313	1.853	-1.850	-0.239	0.795	-0.277	-0.010
Benzo(ghi)perylene	0.001	0.044	0.001	0.018	-0.041	0.031	-0.004
Bis(2-ethylhexyl)phthalate	-0.043	0.073	0.041	-0.006	-0.039	0.015	-0.019
Butyl benzyl phthalate	-0.138	-0.178	-0.262	-0.063	-0.053	0.031	-0.003
Carbazole	0.317	-0.699	-0.029	-0.055	0.308	-0.291	-0.213
Chloroaniline, 4-	-0.977	-0.890	0.579	-0.377	1.888	0.635	0.174
Chrysene	0.007	0.030	0.006	0.026	-0.026	0.018	0.001
Dibenzo(a,h)anthracene	0.005	0.025	0.003	0.022	-0.042	0.031	-0.008
Dibenzofuran	1.385	-0.715	-0.453	0.231	-0.004	0.071	0.154
Dichlorobenzene, 1,4	-0.706	1.683	2.089	0.723	0.151	-0.072	0.068
Diethyl phthalate	-0.829	-0.388	0.195	-0.163	-0.237	0.112	-0.085
Dimethyl phthalate	-0.872	-0.515	0.276	-0.212	0.000	-0.520	0.321
Di-n-butyl phthalate	-0.727	0.077	-0.227	-0.175	-0.086	0.019	-0.015
Di-n-octyl phthalate	1.764	-0.485	-0.126	-1.579	-0.167	0.100	0.125
Fluoranthene	0.015	0.030	0.003	0.032	-0.024	0.021	0.001
Fluorene	0.046	0.014	0.013	0.047	0.002	-0.012	0.020
Indeno(1,2,3-cd)pyrene	0.011	0.039	-0.007	0.031	-0.041	0.036	0.000
Methylphenol, 4-	1.764	-0.485	-0.126	-1.579	-0.167	0.100	0.125
Naphthalene	0.744	1.057	0.271	-0.270	0.236	-0.077	0.063
Phenanthrene	0.028	0.014	-0.008	0.036	-0.019	0.009	0.005
Pyrene	0.013	0.031	0.009	0.031	-0.015	0.005	0.004

CA case scores

	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7
Wetherells Pond Dam	-0.31	1.85	-1.85	-0.24	0.80	-0.28	-0.01
Falls Pond Dam	1.76	-0.48	-0.13	-1.58	-0.17	0.10	0.12
Upstream Cedar St.	0.99	-0.95	-0.79	2.1	0.17	0.04	0.18
Mechanics Pond Dam	-0.98	-0.89	0.58	-0.38	1.89	0.64	0.17
Dodgeville Pond Dam	-0.67	-0.52	0.22	-0.13	-0.48	-1.84	-1.28
Hebronville Pond Dam	-0.67	0.1	-0.13	0.02	-1.35	2.04	-1.36
Rt.15 Pond Dam	0.706	1.683	2.089	0.723	0.151	-0.07	0.068
Wetherell Pond #2	-1.0	-0.15	0.04	-0.14	-1.29	-0.21	2.17

Numerical Ordination Results of Ten Mile Pesticide/PCB Analyses

PRINCIPAL COMPONENTS ANALYSIS
Data file - C:\Data\GHELLYER\SEDTOX\10MILE\Ten Mile Pesticide PCB.mvs

Analysing 13 variables x 8 cases
Data log(10) transformed
Tolerance of eigenanalysis set at 1E-7

Eigenvalues

	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7
Eigenvalues	1.840	1.141	0.29	0.10	0.05	0.04	0.02
Percentage	52.93	32.83	8.26	3.0	1.42	1.12	0.45
Cum. Percentage	52.93	85.76	94.01	97.01	98.4	99.55	100.0

PCA variable loadings

	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7
BHC, alpha-	0.035	0.465	0.228	-0.187	0.050	0.045	0.105
Chlordane, alpha(cis)-	-0.292	0.180	-0.422	-0.476	0.069	-0.050	0.288
Chlordane, gamma(trans)-	-0.229	0.515	0.312	0.050	0.047	-0.018	0.197
DDD, p, p'- (4,4')	-0.155	0.149	-0.096	0.025	-0.257	0.627	-0.203
DDE, p,p'- (4,4')	-0.037	0.171	-0.216	0.182	-0.060	0.310	0.051
DDT, p,p'- (4,4')	0.037	0.226	-0.132	0.037	-0.180	0.355	0.330
Dieldrin	0.181	-0.325	-0.446	0.041	-0.228	0.117	0.345
Endosulfan I (alpha)	0.249	0.035	0.233	0.610	-0.133	0.032	0.346
Endrin ketone	-0.139	-0.433	0.362	-0.150	0.512	0.499	0.267
Heptachlor	-0.014	-0.049	0.060	-0.083	0.031	-0.236	0.617
PCB (Aroclor-1254)	0.022	0.122	-0.246	0.222	0.572	0.141	-0.140
PCB (Aroclor-1260)	0.066	0.203	-0.387	0.324	0.463	-0.146	0.059
PCB (Aroclor-1268)	0.846	0.175	0.032	-0.378	0.114	0.140	-0.024

PCA case scores

	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7
Wetherells Pond Dam	-0.195	-0.413	0.173	-0.003	-0.020	-0.038	-0.093
Falls Pond Dam	-0.412	0.548	0.160	-0.053	-0.129	0.048	0.012
Upstream Cedar St.	-0.207	-0.463	0.140	-0.071	0.013	-0.076	0.078
Mechanics Pond Dam	-0.172	-0.106	-0.390	0.116	-0.083	-0.044	0.003
Dodgeville Pond Dam	-0.374	0.554	0.002	0.067	0.143	-0.053	-0.007
Hebronville Pond Dam	0.552	0.126	-0.187	-0.238	0.027	0.003	-0.016
Rt.15 Pond Dam	1.032	0.091	0.150	0.143	-0.015	0.003	0.012
Wetherell Pond #2	-0.224	-0.337	-0.048	0.039	0.065	0.157	0.010

Numerical Ordination Results of Ten Mile Pesticide/PCB Analyses

PRINCIPAL COORDINATES ANALYSIS
Data file - C:\Data\GHELLYER\SEDTOX\10MILE\Ten Mile Pesticide PCB.mvs

Analysing 13 variables x 8 cases
Data log(10) transformed
Tolerance of eigenanalysis set at 1E-7

Average Distance

Eigenvalues

	Axis 1	Axis 2	Axis 3
Eigenvalues	0.991	0.614	0.154
Percentage	52.927	32.828	8.254
Cum. Percentage	52.927	85.755	94.009

PCO case scores

	Axis 1	Axis 2	Axis 3
Wetherells Pond Dam	-0.143	-0.303	-0.127
Falls Pond Dam	-0.302	0.402	-0.118
Upstream Cedar St.	-0.152	-0.339	-0.103
Mechanics Pond Dam	-0.126	-0.077	0.286
Dodgeville Pond Dam	-0.275	0.407	-0.001
Hebronville Pond Dam	0.405	0.092	0.137
Rt.15 Pond Dam	0.757	0.067	-0.110
Wetherell Pond #2	-0.165	-0.247	0.035

CORRESPONDENCE ANALYSIS
Data file - C:\Data\GHELLYER\SEDTOX\10MILE\Ten Mile Pesticide PCB.mvs

Analysing 13 variables x 8 cases
Data log(10) transformed
Tolerance of eigenanalysis set at 1E-7
Scores scaled by Chemical 'species'

Eigenvalues

	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7
Eigenvalues	0.218	0.154	0.04	0.02	0.01	0.00	0.00
Percentage	48.94	34.49	8.25	4.86	3.057	0.38	0.01
Cum. Percentage	48.94	83.43	91.69	96.54	99.60	99.99	100.0

Numerical Ordination Results of Ten Mile Pesticide/PCB Analyses

CA variable scores

	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7
BHC, alpha-	0.150	0.915	-0.158	0.175	-0.109	-0.022	0.001
Chlordane, alpha(cis)-	-0.381	0.073	0.154	0.089	0.046	-0.008	-0.015
Chlordane, gamma(trans)-	-0.642	1.437	-0.384	0.018	-0.025	-0.003	-0.008
DDD, p, p'- (4,4')	-0.182	0.015	0.019	-0.060	-0.032	-0.060	0.014
DDE, p,p'- (4,4')	-0.078	0.005	0.036	-0.049	0.018	-0.012	0.002
DDT, p,p'- (4,4')	-0.016	0.045	0.021	-0.013	0.014	-0.040	-0.004
Dieldrin	0.161	-0.567	0.205	-0.026	0.111	-0.054	-0.008
Endosulfan I (alpha)	2.128	0.023	-0.926	-0.727	0.350	-0.023	-0.012
Endrin ketone	-0.633	-1.137	-0.564	0.026	-0.375	0.001	-0.009
Heptachlor	-0.713	-1.397	-1.432	1.650	1.209	-0.016	0.027
PCB (Aroclor-1254)	-0.049	-0.057	0.016	-0.030	-0.002	0.046	0.005
PCB (Aroclor-1260)	-0.016	-0.018	0.047	-0.031	0.039	0.057	0.000
PCB (Aroclor-1268)	1.577	0.024	0.082	0.293	-0.171	0.001	0.000

CA case scores

	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7
Wetherells Pond Dam	-0.597	-1.017	-0.200	-0.888	-1.421	0.556	2.208
Falls Pond Dam	-0.662	1.533	-0.481	0.076	-0.151	-1.777	0.411
Upstream Cedar St.	-0.713	-1.397	-1.432	1.650	1.209	-0.016	0.027
Mechanics Pond Dam	-0.351	-0.363	1.668	-0.927	1.779	-0.201	0.259
Dodgeville Pond Dam	-0.621	1.333	-0.280	-0.044	0.109	1.902	-0.459
Hebronville Pond Dam	0.848	0.026	1.415	1.640	-0.860	0.033	0.015
Rt.15 Pond Dam	2.128	0.023	-0.926	-0.727	0.350	-0.023	-0.012
Wetherell Pond #2	-0.581	-0.974	0.010	-0.847	-1.090	-0.466	-1.982

Numerical Ordination Results of Ten Mile Total Chemistry Analyses

PRINCIPAL COORDINATES ANALYSIS
Data file - C:\Data\GHELLYER\SEDTOX\10MILE\Ten Mile Total Chemistry.mvs

Analysing 65 variables x 8 cases
Data log(10) transformed
Tolerance of eigenanalysis set at 1E-7

Average Distance

Eigenvalues

	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7
Eigenvalues	0.91	0.72	0.38	0.28	0.15	0.10	0.08
Percentage	34.65	27.58	14.67	10.69	5.57	3.98	2.86
Cum. Percentage	34.66	62.23	76.90	87.6	93.17	97.14	100.0

PCO case scores

	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7
Wetherells Pond Dam	-0.120	0.323	0.373	-0.223	-0.124	-0.022	-0.071
Falls Pond Dam	0.552	-0.282	-0.036	-0.286	0.094	-0.061	0.056
Upstream Cedar St.	0.431	-0.138	0.255	0.342	-0.012	0.073	-0.024
Mechanics Pond Dam	-0.251	-0.297	-0.109	0.116	-0.176	-0.201	0.021
Dodgeville Pond Dam	-0.263	-0.348	-0.182	-0.093	-0.028	0.183	-0.119
Hebronville Pond Dam	-0.210	0.195	-0.049	0.090	0.274	-0.105	-0.096
Rt.15 Pond Dam	0.262	0.524	-0.350	0.044	-0.100	0.043	0.027
Wetherell Pond #2	-0.401	0.022	0.098	0.011	0.073	0.090	0.205

PRINCIPAL COMPONENTS ANALYSIS
Data file - C:\Data\GHELLYER\SEDTOX\10MILE\Ten Mile Total Chemistry.mvs

Analysing 65 variables x 8 cases
Data log(10) transformed
Tolerance of eigenanalysis set at 1E-7

Eigenvalues

	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7
Eigenvalues	8.45	6.73	3.579	2.61	1.36	0.97	0.7
Percentage	34.65	27.58	14.67	10.69	5.57	3.98	2.86
Cum. Percentage	34.66	62.23	76.90	87.6	93.17	97.14	100.0

PCA variable loadings

	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7
Acenaphthene	0.191	0.230	-0.281	-0.018	-0.346	0.023	-0.115
Acenaphthylene	-0.023	0.005	-0.003	0.022	-0.038	0.137	0.019
Anthracene	-0.004	0.059	-0.048	0.067	-0.048	0.023	-0.022

Numerical Ordination Results of Ten Mile Total Chemistry Analyses

Benzoic Acid	0.174	0.070	0.243	-0.448	-0.030	0.256	-0.117
Benzo(a)anthracene	0.042	0.095	-0.030	0.011	-0.031	0.040	-0.046
Benzo(b)fluoranthene	0.031	0.081	-0.023	0.030	0.002	0.056	-0.012
Benzo(k)fluoranthene	0.023	0.077	-0.044	0.079	-0.009	0.023	-0.006
Benzo(a)pyrene	0.030	0.089	-0.024	0.028	-0.008	0.045	-0.027
Benzo(e)pyrene	-0.053	-0.180	0.391	0.320	-0.343	-0.084	-0.380
Benzo(ghi)perylene	0.021	0.061	-0.017	0.054	0.036	0.026	-0.021
Bis(2-ethylhexyl)phthalate	-0.040	0.043	-0.111	0.112	-0.021	0.039	-0.058
Butyl benzyl phthalate	-0.109	0.274	0.252	0.059	0.181	-0.087	-0.114
Carbazole	0.178	0.475	-0.073	-0.026	-0.224	0.018	-0.280
Chloroaniline, 4-	-0.089	0.132	-0.091	-0.134	-0.388	-0.623	0.090
Chrysene	0.032	0.087	-0.023	0.036	-0.017	0.046	-0.009
Dibenzo(a,h)anthracene	0.022	0.068	-0.019	0.027	0.039	0.026	-0.023
Dibenzofuran	0.284	0.153	0.146	-0.043	0.149	0.025	0.116
Dichlorobenzene, 1,4	-0.089	-0.224	-0.281	-0.048	-0.210	0.127	0.112
Diethyl phthalate	-0.395	0.213	-0.217	-0.138	0.229	-0.110	0.020
Dimethyl phthalate	-0.316	0.273	-0.163	-0.024	-0.267	0.283	0.407
Di-n-butyl phthalate	-0.495	0.061	0.132	0.144	-0.001	-0.109	-0.198
Di-n-octyl phthalate	0.179	0.115	-0.027	0.301	0.189	-0.172	0.219
Fluoranthene	0.046	0.090	-0.015	0.027	-0.016	0.044	-0.013
Fluorene	0.055	0.073	-0.011	0.005	-0.078	0.069	0.033
Indeno(1,2,3-cd)pyrene	0.034	0.061	0.003	0.029	0.042	0.032	-0.015
Methylphenol, 4-	0.186	0.120	-0.029	0.313	0.197	-0.179	0.228
Naphthalene	0.203	-0.226	-0.089	0.367	-0.241	-0.058	0.082
Phenanthrene	0.057	0.104	0.007	0.021	-0.028	0.067	-0.006
Pyrene	0.043	0.095	-0.026	0.037	-0.066	0.074	-0.005
Aluminum (Al)	-0.026	0.015	-0.029	0.025	0.017	0.018	-0.029
Antimony (Sb)	-0.031	0.003	0.006	0.041	0.042	0.040	0.043
Arsenic (As), Total	0.005	-0.010	-0.077	0.017	-0.011	-0.050	-0.145
Barium (Ba)	-0.084	0.011	-0.026	0.027	0.002	0.044	-0.025
Beryllium (Be)	-0.027	0.003	0.007	0.031	0.034	0.034	0.035
Calcium (Ca)	-0.036	0.005	-0.036	0.024	0.015	-0.017	-0.011
Cadmium (Cd)	-0.081	-0.035	-0.221	0.008	-0.021	0.078	-0.266
Chromium (Cr), Total	-0.182	-0.059	-0.027	0.090	-0.081	0.041	0.102
Cobalt (Co)	-0.033	-0.026	-0.086	-0.020	0.069	0.035	-0.078
Copper (Cu)	-0.131	-0.065	-0.027	0.093	-0.051	0.147	0.020
Cyanide (Cn), Total	-0.030	0.038	-0.034	0.044	0.039	0.074	-0.103
Gold (Au)	-0.033	0.005	0.008	0.041	0.043	0.040	0.043
Iron (Fe)	-0.008	0.003	-0.053	-0.009	0.019	-0.001	0.000
Lead (Pb)	-0.045	0.015	-0.027	0.081	0.015	0.062	0.034
Manganese (Mn)	0.024	0.055	-0.002	-0.154	0.070	-0.081	-0.133
Magnesium (Mg)	-0.008	0.031	-0.036	0.024	0.045	-0.013	-0.022

Numerical Ordination Results of Ten Mile Total Chemistry Analyses

Mercury (Hg), Total	-0.148	-0.065	0.102	0.085	-0.068	0.100	0.026
Nickel (Ni)	-0.107	-0.092	-0.134	0.021	0.012	0.159	-0.100
Selenium (Se)	-0.022	-0.013	0.025	0.028	0.049	-0.024	0.100
Silver (Ag)	-0.173	-0.039	0.035	0.168	-0.029	0.191	0.047
Thallium (Tl)	-0.022	-0.013	0.025	0.028	0.049	-0.024	0.100
Vanadium (V)	0.001	0.040	-0.057	0.017	0.054	-0.013	-0.111
Zinc (Zn)	-0.057	-0.038	-0.088	0.072	-0.002	0.069	-0.001
BHC, alpha-	0.057	0.039	-0.164	0.157	0.166	0.101	-0.175
Chlordane, alpha(cis)-	-0.039	0.179	0.034	0.052	0.126	-0.079	-0.070
Chlordane, gamma(trans)-	0.061	0.152	-0.097	0.241	0.083	0.191	-0.132
DDD, p, p'- (4,4')	-0.010	0.082	-0.008	0.113	0.045	-0.028	0.107
DDE, p,p'- (4,4')	-0.019	0.053	-0.083	0.053	0.021	-0.037	0.040
DDT, p,p'- (4,4')	0.008	0.029	-0.119	0.051	0.080	-0.042	0.021
Dieldrin	-0.051	-0.086	0.018	-0.201	-0.051	-0.218	0.144
Endosulfan I (alpha)	0.042	-0.106	-0.133	-0.023	-0.099	0.060	0.053
Endrin ketone	-0.009	-0.031	0.246	-0.083	-0.046	0.192	0.218
Heptachlor	0.019	0.008	0.026	-0.049	-0.003	0.028	-0.013
PCB (Aroclor-1254)	-0.052	0.021	-0.090	0.007	0.014	0.043	-0.028
PCB (Aroclor-1260)	-0.051	0.031	-0.155	-0.008	-0.001	-0.013	-0.088
PCB (Aroclor-1268)	0.040	-0.326	-0.354	-0.140	0.259	-0.123	-0.211

PCA case scores

	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7
Wetherells Pond Dam	-0.36	-0.98	1.14	0.68	-0.38	-0.07	-0.22
Falls Pond Dam	1.68	0.89	-0.11	0.87	0.28	-0.18	0.17
Upstream Cedar St.	1.31	0.42	0.78	-1.04	-0.04	0.22	-0.07
Mechanics Pond Dam	-0.76	0.90	-0.33	-0.35	-0.54	-0.61	0.06
Dodgeville Pond Dam	-0.80	1.06	-0.56	0.28	-0.09	0.56	-0.36
Hebronville Pond Dam	-0.64	-0.59	-0.15	-0.27	0.84	-0.32	-0.29
Rt.15 Pond Dam	0.80	-1.58	-1.07	-0.13	-0.30	0.13	0.08
Wetherell Pond #2	-1.22	-0.07	0.3	-0.03	0.22	0.27	0.62

CORRESPONDENCE ANALYSIS
Data file - C:\Data\GHELLYER\SEDTOX\10MILE\Ten Mile Total Chemistry.mvs

Analysing 65 variables x 8 cases
Data log(10) transformed
Tolerance of eigenanalysis set at 1E-7
Scores scaled by Chemical 'species'

Eigenvalues

	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7
Eigenvalues	0.07	0.06	0.04	0.04	0.02	0.01	0.01
Percentage	27.98	24.94	17.29	15.6	7.22	4.19	2.79

Numerical Ordination Results of Ten Mile Total Chemistry Analyses

Cum. Percentage	27.98	52.92	70.21	85.80	93.02	97.21	100.0

CA variable scores

	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7
Acenaphthene	0.471	0.060	-0.252	-0.325	0.324	-0.254	-0.127
Acenaphthylene	-0.025	0.019	0.048	0.002	-0.013	-0.025	0.021
Anthracene	0.015	0.004	-0.003	0.006	0.016	-0.012	-0.002
Benzoic Acid	1.118	-0.398	2.032	-1.454	-0.067	-0.100	-0.135
Benzo(a)anthracene	0.053	-0.001	0.026	-0.025	0.012	-0.003	-0.008
Benzo(b)fluoranthene	0.040	0.004	0.028	-0.012	-0.001	0.002	0.002
Benzo(k)fluoranthene	0.041	0.007	0.003	0.006	0.006	-0.002	0.001
Benzo(a)pyrene	0.044	-0.002	0.025	-0.014	0.003	0.000	-0.002
Benzo(e)pyrene	-0.720	0.117	1.384	2.058	0.747	-0.200	-0.450
Benzo(ghi)perylene	0.034	0.008	0.023	0.003	-0.008	0.012	-0.001
Bis(2-ethylhexyl)phthalate	-0.018	0.022	-0.024	0.013	-0.002	-0.008	-0.008
Butyl benzyl phthalate	0.062	-0.336	0.057	0.085	-0.055	0.064	-0.033
Carbazole	0.696	-0.436	-0.162	-0.271	0.249	-0.229	-0.227
Chloroaniline, 4-	-0.496	-1.027	-0.825	-0.695	1.939	0.635	-0.031
Chrysene	0.044	0.000	0.025	-0.011	0.006	-0.001	0.002
Dibenzo(a,h)anthracene	0.045	-0.002	0.020	-0.010	-0.011	0.012	-0.004
Dibenzofuran	1.635	-0.062	0.550	-0.229	-0.032	0.166	0.109
Dichlorobenzene, 1,4-	-0.491	2.447	-0.274	-0.756	0.440	-0.510	0.299
Diethyl phthalate	-0.516	-0.573	-0.484	-0.224	-0.215	0.103	-0.018
Dimethyl phthalate	-0.461	-0.781	-0.548	-0.220	0.043	-0.481	0.347
Di-n-butyl phthalate	-0.564	-0.430	-0.090	0.252	-0.071	0.029	-0.046
Di-n-octyl phthalate	2.135	0.263	-0.886	0.958	0.002	0.425	0.345
Fluoranthene	0.051	0.003	0.033	-0.014	0.007	0.001	0.001
Fluorene	0.084	0.005	0.042	-0.032	0.033	-0.031	0.016
Indeno(1,2,3-cd)pyrene	0.043	0.007	0.039	-0.004	-0.009	0.016	0.001
Methylphenol, 4-	2.135	0.263	-0.886	0.958	0.002	0.425	0.345
Naphthalene	0.261	1.099	0.010	0.584	0.391	-0.130	0.099
Phenanthrene	0.072	-0.008	0.042	-0.016	0.010	-0.008	0.003
Pyrene	0.049	0.003	0.028	-0.014	0.016	-0.015	0.004
Aluminum (Al)	-0.017	0.020	0.032	-0.001	-0.007	0.018	0.002
Antimony (Sb)	-0.046	-0.006	0.018	0.048	-0.053	0.012	0.040
Arsenic (As), Total	-0.020	0.089	-0.022	-0.020	0.022	0.028	-0.083
Barium (Ba)	-0.077	-0.012	0.009	0.011	-0.021	0.003	0.004
Beryllium (Be)	-0.072	-0.035	0.003	0.078	-0.088	0.003	0.061
Calcium (Ca)	-0.028	0.021	0.025	0.000	-0.005	0.025	0.005
Cadmium (Cd)	-0.214	0.135	-0.175	-0.087	-0.045	-0.070	-0.155
Chromium (Cr), Total	-0.176	0.000	-0.003	0.059	-0.006	-0.007	0.047
Cobalt (Co)	-0.087	0.076	-0.023	-0.051	-0.067	0.027	-0.037
Copper (Cu)	-0.119	0.029	0.023	0.045	-0.023	-0.021	0.025
Cyanide (Cn), Total	-0.026	-0.066	-0.086	0.031	-0.103	-0.072	-0.098
Gold (Au)	-0.035	0.001	0.029	0.031	-0.037	0.016	0.030
Iron (Fe)	-0.013	0.033	0.032	-0.016	-0.004	0.024	0.006

Numerical Ordination Results of Ten Mile Total Chemistry Analyses

Lead (Pb)	-0.033	0.010	0.005	0.030	-0.021	-0.003	0.020
Manganese (Mn)	0.024	-0.008	0.067	-0.082	-0.004	0.063	-0.035
Magnesium (Mg)	-0.001	0.017	0.021	-0.005	-0.009	0.026	-0.001
Mercury (Hg), Total	-0.281	-0.059	0.106	0.179	-0.032	-0.043	0.063
Nickel (Ni)	-0.145	0.085	-0.009	-0.007	-0.052	-0.021	-0.012
Selenium (Se)	-0.038	0.013	0.045	0.041	-0.027	0.059	0.062
Silver (Ag)	-0.189	-0.032	0.009	0.138	-0.059	-0.061	0.050
Thallium (Tl)	-0.038	0.013	0.045	0.041	-0.027	0.059	0.062
Vanadium (V)	0.024	0.009	-0.029	-0.025	-0.026	0.026	-0.061
Zinc (Zn)	-0.067	0.057	-0.005	0.016	-0.019	-0.003	0.010
BHC, alpha-	0.448	0.375	-0.626	0.117	-0.384	-0.150	-0.358
Chlordane, alpha(cis)-	0.140	-0.346	-0.105	0.039	-0.062	0.070	-0.070
Chlordane, gamma(trans)-	1.039	-0.190	-0.849	0.445	-0.344	-0.652	-0.346
DDD, p, p'- (4,4')	0.070	-0.073	-0.070	0.076	-0.011	0.015	0.053
DDE, p,p'- (4,4')	0.006	-0.006	-0.086	-0.006	0.000	0.017	0.012
DDT, p,p'- (4,4')	0.032	0.062	-0.111	-0.025	-0.030	0.042	-0.003
Dieldrin	-0.359	0.071	0.217	-0.257	0.156	0.321	0.148
Endosulfan I (alpha)	-0.491	2.447	-0.274	-0.756	0.440	-0.510	0.299
Endrin ketone	-0.088	-0.333	1.135	0.141	-0.127	-0.137	0.591
Heptachlor	1.118	-0.398	2.032	-1.454	-0.067	-0.100	-0.135
PCB (Aroclor-1254)	-0.052	0.013	-0.023	-0.027	-0.021	0.000	-0.004
PCB (Aroclor-1260)	-0.058	0.026	-0.074	-0.060	-0.004	0.005	-0.035
PCB (Aroclor-1268)	-0.581	1.461	-0.249	-0.496	-0.348	0.517	-0.312

CA case scores

	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7
Wetherells Pond Dam	-0.72	0.12	1.38	2.06	0.75	-0.20	-0.45
Falls Pond Dam	2.14	0.26	-0.89	0.96	0.00	0.42	0.34
Upstream Cedar St.	1.12	-0.4	2.03	-1.45	-0.07	-0.1	-0.14
Mechanics Pond Dam	-0.5	-1.03	-0.82	-0.7	1.94	0.64	-0.03
Dodgeville Pond Dam	-0.14	-0.68	-0.81	-0.11	-0.72	-1.81	-1.09
Hebronville Pond Dam	-0.7	0.16	-0.21	-0.15	-1.39	1.88	-1.12
Rt.15 Pond Dam	-0.49	2.45	-0.27	-0.76	0.44	-0.51	0.3
Wetherell Pond #2	-0.8	-0.66	-0.01	0.11	-0.95	-0.12	2.25

Appendix C: Biology Analytical Results - Chironomid *(C. tentans)* Toxicity Data

10 Mile River Watershed Sediment Toxicity Test - March 27 - April 7, 1998											
Weight and Survival Results - Chironomus tentans											
Pan #	Sample ID #	Tare Wt. (g.)	Total Wt. (g.)	Dry Wt Orgs	Total Ash Wt	Net Ash Wt	# of Orgs IN	#Orgs LIVE	X wt. Orgs (mg.)	% survival	Sample ID #
1	ART SED AA	1.2545	1.2641	0.0096	1.2571	0.0026	10	10	0.96	100	ART SED AA
4	ART SED III	1.2646	1.2754	0.0108	1.2674	0.0028	10	9	1.2	90	ART SED III
7	ART SED K	1.259	1.2709	0.0119	1.2625	0.0035	11	11	1.08	100	ART SED K
8	ART SED KK	1.27	1.2774	0.0074	1.2725	0.0025	10	9	0.82	90	ART SED KK
2	ART SED MM	1.2553	1.2651	0.0098	1.2576	0.0023	10	10	0.98	100	ART SED MM
5	ART SED OOO	1.2649	1.2811	0.0162	1.2714	0.0065	10	9		90	ART SED OOO
3	ART SED XX	1.2509	1.2571	0.0062	1.2528	0.0019	10	9	0.69	90	ART SED XX
6	ART SED YY	1.2629	1.2714	0.0085	1.2656	0.0027	10	9	0.94	90	ART SED YY
20	DOD D	1.2779	1.283	0.0051	1.279	0.0011	10	5	1.02	50	DOD D
38	DOD E	1.2519	1.2542	0.0023	1.2524	0.0005	10	3	0.77	30	DOD E
9	DOD EEE	1.2592	1.261	0.0018	1.2601	0.0009	10	3	0.6	30	DOD EEE
15	DOD F	1.2652	1.2726	0.0074	1.267	0.0018	10	9	0.82	90	DOD F
32	DOD I	1.2733	1.2771	0.0038	1.2743	0.001	10	6	0.63	60	DOD I
64	DOD L	1.2615	1.2651	0.0036	1.2624	0.0009	10	8	0.45	80	DOD L
63	DOD LL	1.2537	1.2551	0.0014	1.2542	0.0005	10	1	1.4	10	DOD LL
43	DOD S	1.2744	1.2784	0.004	1.2752	0.0008	10	5	0.8	50	DOD S
24	HEB	1.2635	1.2755	0.012	1.2662	0.0027	10	8	1.5	80	HEB
28	HEB C	1.2497	1.2603	0.0106	1.2517	0.002	10	5	2.12	50	HEB C

Chironomid *(C. tentans)* Toxicity Data

25	HEB CC	1.2628	1.28	0.0172	1.2673	0.0045	10	10	1.72	100	HEB CC
27	HEB G	1.2664	1.2859	0.0195	1.2708	0.0044	10	10	1.95	100	HEB G
22	HEB II	1.2799	1.2907	0.0108	1.2819	0.002	10	7	1.54	70	HEB II
50	HEB N	1.2651	1.2707	0.0056	1.2661	0.001	10	5	1.12	50	HEB N
26	HEB O	1.2766	1.2873	0.0107	1.2794	0.0028	10	10	1.07	100	HEB O
57	HEB W	1.2465	1.268	0.0215	1.2506	0.0041	12	12	1.79	100	HEB W
10	MECH BB	1.2668	1.2783	0.0115	1.2697	0.0029	10	9	1.28	90	MECH BB
54	MECH FFF	1.2513	1.2589	0.0076	1.2527	0.0014	10	4	1.9	40	MECH FFF
12	MECH KKK	1.2541	1.2653	0.0112	1.2564	0.0023	10	6	1.87	60	MECH KKK
14	MECH M	1.2702	1.2782	0.008	1.2715	0.0013	10	7	1.14	70	MECH M
40	MECH R	1.2683	1.281	0.0127	1.2712	0.0029	10	8	1.59	80	MECH R
11	MECH T	1.2678	1.278	0.0102	1.2707	0.0029	10	9	1.13	90	MECH T
13	MECH WW	1.2507	1.2666	0.0159	1.2552	0.0045	11	11	1.45	100	MECH WW
52	MECH Z	1.2748	1.2868	0.012	1.2773	0.0025	10	9	1.33	90	MECH Z
19	NAT BBB	1.2605	1.2656	0.0051	1.2614	0.0009	10	5	1.02	50	NAT BBB
33	NAT DDD	1.2544	1.2591	0.0047	1.255	0.0006	10	4	1.18	40	NAT DDD
29	NAT J	1.2645	1.2714	0.0069	1.266	0.0015	10	9	0.77	90	NAT J
44	NAT NN	1.2739	1.2834	0.0095	1.2761	0.0022	10	10	0.95	100	NAT NN
16	NAT TT	1.2676	1.2736	0.006	1.2691	0.0015	10	10	0.6	100	NAT TT
37	NAT U	1.2565	1.2631	0.0066	1.2581	0.0016	10	10	0.66	100	NAT U
17	NAT UU	1.2633	1.2692	0.0059	1.2645	0.0012	10	10	0.59	100	NAT UU
18	NAT V V	1.2754	1.2845	0.0091	1.2773	0.0019	10	8	1.14	80	NAT V V
59	RES A	1.2562	1.2619	0.0057	1.2578	0.0016	10	8	0.71	80	RES A
53	RES B	1.2718	1.276	0.0042	1.2729	0.0011	10	4	1.05	40	RES B
30	RES CCC	1.2634	1.2706	0.0072	1.265	0.0016	10	7	1.03	70	RES CCC
23	RES EE	1.273	1.2773	0.0043	1.274	0.001	10	3	1.43	30	RES EE
21	RES LL	1.2741	1.2741	N/A	N/A	-1.2741	10	0	ERR	0	RES LL

Chironomid *(C. tentans)* Toxicity Data

45	RES QQQ	1.2597	1.2603	0.0006	1.2593	-0.0004	10	1	0.6	10	RES QQQ
55	RES RR	1.2795	1.285	0.0055	1.2807	0.0012	10	6	0.92	60	RES RR
51	RES Y	1.2614	1.2638	0.0024	1.2614	0	10	3	0.8	30	RES Y
34	TEN DD	1.2601	1.2731	0.013	1.2653	0.0052	10	10	1.3	100	TEN DD
49	TEN H	1.2622	1.2754	0.0132	1.2646	0.0024	10	9	1.47	90	TEN H
60	TEN HH	1.26	1.2708	0.0108	1.2623	0.0023	10	8	1.35	80	TEN HH
41	TEN LLL	1.2729	1.289	0.0161	1.2772	0.0043	10	10	1.61	100	TEN LLL
62	TEN PP	1.2766	1.2794	0.0028	1.2775	0.0009	10	1	2.8	10	TEN PP
47	TEN QQ	1.2626	1.2706	0.008	1.2644	0.0018	10	8	1	80	TEN QQ
48	TEN V	1.269	1.2843	0.0153	1.2727	0.0037	10	10	1.53	100	TEN V
39	TEN X	1.2618	1.2722	0.0104	1.265	0.0032	10	10	1.04	100	TEN X
36	WET GG	1.2632	1.2671	0.0039	1.264	0.0008	10	4	0.97	40	WET GG
46	WET GGG	1.2527	1.2574	0.0047	1.2529	0.0002	10	5	0.94	50	WET GGG
58	WET HHH	1.2683	1.2778	0.0095	1.2696	0.0013	10	10	0.95	100	WET HHH
31	WET JJJ	1.2476	1.2529	0.0053	1.2481	0.0005	10	7	0.76	70	WET JJJ
35	WET OO	1.2593	1.2597	0.0004	1.2597	0.0004	10	1	0.4	10	WET OO
61	WET P	1.2573	1.2648	0.0075	1.2588	0.0015	10	9	0.83	90	WET P
56	WET Q	1.2517	1.2559	0.0042	1.2522	0.0005	10	6	0.7	60	WET Q
42	WET ZZ	1.2631	1.2737	0.0106	1.2642	0.0011	10	8	1.33	80	WET ZZ
Key to Replicates											
ARTSED		Artificial Sediment (Control)									
DOD	(DODG01)	Dodgeville Pond Dam									
HEB	(HEBR01)	Hebronville Pond Dam									
MECH	(MECH01)	Mechanics Pond Dam									
NAT	(NATP01)	Upstream Cedar St									
RES	(RESE01)	Rt. 15 Pond Dam									
TEN	(TENM01)	Falls Pond Dam									
WET	(WETH01/02)	Wetherells Pond Dam									

Amphipod *(H. azteca)* Toxicity Data

10 Mile River Watershed Sediment Toxicity Test - March 27 - April 6, 1998						
Survival Results - Hyallela azteca						
Sample ID #	# of Orgs IN	#Orgs LIVE	#Dead	% survival	Initials	Notes
ART SED A	10	10	0	100	PLT	very small, narcosis
ART SED B	10	3	0	30	PLT	very small, narcosis
ART SED C	10	4	1	40	PLT	very small, narcosis
ART SED D	10	4	1	40	PLT	very small, narcosis
ART SED E	10	4	0	40	PLT	very small, narcosis
ART SED F	10	6	0	60	PLT	very small, narcosis
ART SED G	10	9	0	90	PLT	very small, narcosis
ART SED H	10	9	0	90	PLT	very small, narcosis
TOTAL ART SED	80	49	2	61.25		TEST INVALID
DOD A	10	1	0	10	MCH	
DOD B	10	1	0	10	MCH	
DOD C	10	1	0	10	MCH	
DOD D	10	0	0	0	MCH	
DOD E	10	3	1	30	MCH	
DOD F	10	5	1	50	NR	
DOD G	10	2	0	20	MCH	
DOD H	10	1	0	10	PLT	
TOTAL DOD	80	14	2	17.5		
HEB A	10	4	0	40	MCH	
HEB B	10	4	0	40	MCH	
HEB C	10	5	1	50	MCH	
HEB D	10	4	0	40	MCH	
HEB E	10	6	0	60	MCH	
HEB F	10	6	2	60	MCH	
HEB G	10	7	0	70	MCH	green 'caddisfly'?
HEB H	10	2	0	20	MCH	
TOTAL HEB	80	38	3	47.5		

Amphipod *(H. azteca)* Toxicity Data

MECH A	**10**	**7**	**0**	**70**	**PLT**	
MECH B	**10**	**4**	**0**	**40**	**PLT**	
MECH C	**10**	**5**	**0**	**50**	**PLT**	
MECH D	**10**	**3**	**0**	**30**	**DIS**	
MECH E	**10**	**9**	**0**	**90**	**NR**	
MECH F	**10**	**7**	**0**	**70**	**PLT**	
MECH G	**10**	**2**	**0**	**20**	**DIS**	
MECH H	**10**	**5**	**0**	**50**	**PLT**	
TOTAL MECH	**80**	**42**	**0**	**52.5**		
NAT A	**10**	**7**	**0**	**70**	**DIS**	
NAT B	**10**	**9**	**0**	**90**	**PLT**	
NAT C	**10**	**10**	**0**	**100**	**PLT**	
NAT D	**10**	**9**	**0**	**90**	**PLT**	
NAT E	**10**	**10**	**0**	**100**	**PLT**	
NAT F	**10**	**9**	**0**	**90**	**PLT**	
NAT G	**10**	**10**	**0**	**100**	**DIS**	
NAT H	**10**	**8**	**1**	**80**	**DIS**	
TOTAL NAT	**80**	**72**	**1**	**90**		
RES A	**10**	**1**	**0**	**10**	**?**	
RES B	**10**	**1**	**0**	**10**	**?**	
RES C	**10**	**0**	**0**	**0**	**?**	
RES D	**10**	**0**	**0**	**0**	**?**	**See Note Below**
RES E	**10**	**2**	**0**	**20**	**?**	
RES F	**10**	**1**	**0**	**10**	**?**	
RES G	**10**	**0**	**0**	**0**	**?**	
RES H	**10**	**1**	**0**	**10**	**?**	
TOTAL RES	**80**	**6**	**0**	**7.5**		
TEN A	**10**	**5**	**0**	**50**	**MCH**	
TEN B	**10**	**1**	**0**	**10**	**MCH**	
TEN C	**10**	**4**	**1**	**40**	**MCH**	
TEN D	**10**	**3**	**0**	**30**	**MCH**	
TEN E	**10**	**2**	**0**	**20**	**MCH**	
TEN F	**10**	**0**	**0**	**0**	**MCH**	
TEN G	**10**	**6**	**1**	**60**	**MCH**	
TEN H	**10**	**6**	**0**	**60**	**MCH**	
TOTAL TEN	**80**	**27**	**2**	**33.75**		
WET A	**10**	**3**	**0**	**30**	**GMH**	

Amphipod *(H. azteca)* Toxicity Data

WET B	10	0	0	0	GMH	
WET C	10	0	0	0	GMH	
WET D	10	1	0	10	GMH	
WET E	10	5	0	50	GMH	
WET F	10	0	0	0	GMH	
WET G	10	0	0	0	GMH	
WET H	10	4	0	40	GMH	
TOTAL WET	80	13	0	16.25		

NOTES:

RES D Raw data sheet had no value entered. A zero value was interpreted as the most likely observed value.

Key to Replicates		
ARTSED		Artificial Sediment (Control)
DOD	(DODG01)	Dodgeville Pond Dam
HEB	(HEBR01)	Hebronville Pond Dam
MECH	(MECH01)	Mechanics Pond Dam
NAT	(NATP01)	Upstream Cedar St
RES	(RESE01)	Rt. 15 Pond Dam
TEN	(TENM01)	Falls Pond Dam
WET	(WETH01/02)	Wetherells Pond Dam

Chironomid *(C. tentans)* Growth and Survival Data Statistical Analysis

Ten Mile Sediment C. tentans Survival Data

```
File: 10ctsurv       Transform: NO TRANSFORMATION

Chi-square test for normality: actual and expected frequencies
--------------------------------------------------------------------------

INTERVAL     <-1.5     -1.5 to <-0.5     -0.5 to 0.5     >0.5 to 1.5     >1.5
             _____     _____________     ___________     ___________     _____

EXPECTED     4.288        15.488            24.448          15.488       4.288
OBSERVED     4            16                17              26           1

--------------------------------------------------------------------------
Calculated Chi-Square goodness of fit test statistic =  11.9612
Table Chi-Square value (alpha = 0.01) = 13.277

Data PASS normality test. Continue analysis.


Hartley test for homogeneity of variance
--------------------------------------------------------------------------

Calculated H statistic (max Var/min Var) =   16.37
Closest, conservative, Table H statistic =   22.0  (alpha = 0.01)

Used for Table H ==>     R (# groups) =   8,    df (# reps-1) =       7
Actual values    ==>     R (# groups) =   8,    df (# avg reps-1) =   7.00

--------------------------------------------------------------------------

Data PASS homogeneity test. Continue analysis.

NOTE: This test requires equal replicate sizes. If they are unequal
      but do not differ greatly, the Hartley test may still be used
      as an approximate test (average df are used).
```

Chironomid *(C. tentans)* Growth and Survival Data Statistical Analysis

Bartletts test for homogeneity of variance

Calculated B statistic = 11.37
Table Chi-square value = 18.48 (alpha = 0.01)
Table Chi-square value = 14.07 (alpha = 0.05)

Average df used in calculation ==> df (avg n - 1) = 7.00
Used for Chi-square table value ==> df (#groups-1) = 7

Data PASS homogeneity test at 0.01 level. Continue analysis.

NOTE: If groups have unequal replicate sizes the average replicate size is used to calculate the B statistic (see above).

ANOVA TABLE

SOURCE	DF	SS	MS	F
Between	7	2.025	0.289	4.587
Within (Error)	56	3.552	0.063	
Total	63	5.578		

Critical F value = 2.25 (0.05,7,40)
Since F > Critical F REJECT Ho:All groups equal

DUNNETTS TEST - TABLE 1 OF 2 Ho:Control<Treatment

GROUP	IDENTIFICATION	TRANSFORMED MEAN	MEAN CALCULATED IN ORIGINAL UNITS	T STAT	SIG
1	ARTSED	0.950	0.950		
2	DOD	0.500	0.500	3.586	*
3	HEB	0.838	0.838	0.896	
4	MECH	0.787	0.787	1.295	
5	NAT	0.825	0.825	0.996	
6	RES	0.400	0.400	4.383	*
7	TEN	0.825	0.825	0.996	
8	WET	0.625	0.625	2.590	*

Dunnett table value = 2.42 (1 Tailed Value, P=0.05, df=40,7)

DUNNETTS TEST - TABLE 2 OF 2 Ho:Control<Treatment

GROUP	IDENTIFICATION	NUM OF REPS	Minimum Sig Diff (IN ORIG. UNITS)	% of CONTROL	DIFFERENCE FROM CONTROL

Chironomid *(C. tentans)* Growth and Survival Data Statistical Analysis

1	ARTSED	8			
2	DOD	8	0.304	32.0	0.450
3	HEB	8	0.304	32.0	0.113
4	MECH	8	0.304	32.0	0.163
5	NAT	8	0.304	32.0	0.125
6	RES	8	0.304	32.0	0.550
7	TEN	8	0.304	32.0	0.125
8	WET	8	0.304	32.0	0.325

Ten Mile Sediment C. tentans Growth Data

File: 10milect Transform: NO TRANSFORMATION

Chi-square test for normality: actual and expected frequencies

INTERVAL	<-1.5	-1.5 to <-0.5	-0.5 to 0.5	>0.5 to 1.5	>1.5
EXPECTED	2.680	9.680	15.280	9.680	2.680
OBSERVED	0	12	18	8	2

Calculated Chi-Square goodness of fit test statistic = 4.1843
Table Chi-Square value (alpha = 0.01) = 13.277

Data PASS normality test. Continue analysis.

Hartley test for homogeneity of variance

Calculated H statistic (max Var/min Var) = 5.53
Closest, conservative, Table H statistic = 16.5 (alpha = 0.01)

Used for Table H ==> R (# groups) = 5, df (# reps-1) = 7
Actual values ==> R (# groups) = 5, df (# avg reps-1) = 7.00

Data PASS homogeneity test. Continue analysis.

NOTE: This test requires equal replicate sizes. If they are unequal
but do not differ greatly, the Hartley test may still be used
as an approximate test (average df are used).

Bartletts test for homogeneity of variance

Chironomid *(C. tentans)* Growth and Survival Data Statistical Analysis

```
Calculated B statistic =    5.63
Table Chi-square value =   13.28  (alpha = 0.01)
Table Chi-square value =    9.49  (alpha = 0.05)

Average df used in calculation  ==>   df (avg n - 1) =   7.00
Used for Chi-square table value ==>   df (#groups-1) =   4
```

```
Data PASS homogeneity test at 0.01 level. Continue analysis.

NOTE: If groups have unequal replicate sizes the average replicate size is
      used to calculate the B statistic (see above).
```

ANOVA TABLE

SOURCE	DF	SS	MS	F
Between	4	3.283	0.821	5.701
Within (Error)	35	5.030	0.144	
Total	39	8.314		

```
  Critical F value =   2.69  (0.05,4,30)
  Since  F > Critical F  REJECT  Ho:All groups equal
```

DUNNETTS TEST - TABLE 1 OF 2 Ho:Control<Treatment

GROUP	IDENTIFICATION	TRANSFORMED MEAN	MEAN CALCULATED IN ORIGINAL UNITS	T STAT	SIG
1	ARTSED	1.059	1.059		
2	HEB	1.601	1.601	-2.859	
3	MECH	1.461	1.461	-2.121	
4	NAT	0.864	0.864	1.028	
5	TEN	1.513	1.513	-2.391	

Dunnett table value = 2.25 (1 Tailed Value, P=0.05, df=30,4)

DUNNETTS TEST - TABLE 2 OF 2 Ho:Control<Treatment

GROUP	IDENTIFICATION	NUM OF REPS	Minimum Sig Diff (IN ORIG. UNITS)	% of CONTROL	DIFFERENCE FROM CONTROL
1	ARTSED	8			
2	HEB	8	0.427	40.3	-0.542
3	MECH	8	0.427	40.3	-0.402
4	NAT	8	0.427	40.3	0.195
5	TEN	8	0.427	40.3	-0.454

Appendix D. Sediment Ecotoxicological Screening Benchmark Tables

Inorganic Chemicals (Metals) Benchmark Tables

(See File - Ten Mile Inorganics (Metals))

Click inside red box for file.

Chlorinated Pesticide and Polychlorinated Biphenyl (PCB) Benchmark Tables

(See File - Ten Mile PCBs Pesticides)

Click inside red box for file.

Volatile and Semi-Volatile Organic Compound Benchmark Tables

(See File - Ten Mile VOAs)

Click inside red box for file.

APPENDIX E:

Derivation, Application, Strengths and Limitations of Sediment Ecotoxicological Screening Benchmarks (ESBs)[4]

Gregory M. Hellyer [a,5], George E. Balog [b]

[a] Ecosystem Assessment Unit, Office of Environmental Measurement and Evaluation,
U.S.E.P.A. New England Regional Laboratory,
60 Westview St., Lexington, MA, USA 02421-3185
[b] Sovereign Consulting, Inc. 111-A North Gold Drive, Robbinsville, NJ, USA 08691

Abstract

Sediment Ecotoxicological Screening Benchmark (ESB) templates (Lotus and Excel spreadsheets) were developed using available technical references for (1) inorganic chemicals (primarily metals) (2) volatile and semi-volatile organic compounds and (3) chlorinated pesticides and polychlorinated biphenyls (PCBs). Formulas for Total Organic Carbon (TOC) adjustment are provided for the latter two tables. Graphing templates depict exceedance of ecotoxicological thresholds.

Derivation, strengths, and limitations of various sediment benchmarks are briefly discussed. Some benchmarks were derived through analysis of data from a combination of spiked sediment bioassays, chemical analysis, and bulk sediment toxicity testing. Other benchmarks were derived using a combination of sediment chemistry and benthic species presence/absence data. Others utilize models that predict the exposure of benthic organisms based on sediment chemistry data. These equilibrium partitioning models predict the interstitial (pore) water concentration of a sediment based on bulk sediment contaminant concentration and sediment TOC.

Application of ESBs to river sediment data is illustrated.

Keywords: Sediment; Ecotoxicological; Benchmarks; Screening; Criteria

---

[4] This paper and the referenced ESB templates and their documentation have not been subjected to the formal EPA peer review process and thus do not necessarily reflect the opinion of the Agency. No endorsement of specific approaches or methods by the U.S. Government should be inferred or is implied.

[5] Corresponding Author. Tel: 781-860-4677, fax: 781-860-4397,
e-mail: hellyer.greg@epa.gov

Introduction

Determining the ecotoxicological implications of sediment contamination continues to remain a central concern in ecological risk assessment. In it's comprehensive report to Congress EPA [1, adapted from 2] concluded that sediment ecotoxicology was important for the following reasons:

- "Various toxic contaminants found only in barely detectable amounts in the water column can accumulate in sediments to much higher levels.
- Sediments serve as both a reservoir for contaminants and a source of contaminants to the water column and organisms.
- Sediments integrate contaminant concentrations over time, whereas water column contaminant concentrations are much more variable and dynamic.
- Sediment contaminants (in addition to water column contaminants) affect bottom-dwelling organisms and other sediment-associated organisms, as well as both the organisms that feed on them and humans.
- Sediments are an integral part of the aquatic environment that provide habitat, feeding, spawning, and rearing areas for many aquatic organisms."

Numerous criteria and quantitative thresholds have been derived for inorganic chemicals (primarily metals), volatile and semi-volatile organic compounds, and chlorinated pesticides and polychlorinated biphenyls (PCBs) [3, 4, 5, 6, 7, 8, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28]. However, no comprehensive compilation or method has hitherto been available to apply these ecotoxicological screening benchmarks (ESBs) in assessing sediment contaminants. This paper describes a method of screening sediment for ecotoxicological risk using Lotus 1-2-3® and Excel® spreadsheet templates based on available technical references for (1) inorganic chemicals (primarily metals) (2) volatile and semi-volatile organic compounds and (3) chlorinated pesticides and polychlorinated biphenyls (PCBs). Formulas for Total Organic Carbon (TOC) adjustment are provided for the latter two tables. Graphing templates depict exceedance of ecotoxicological thresholds. These ESBs are available with a written review document, which is expanded in this article, from the Sediments Research Web at:

www.sediments.org Links to Resources Downloads.

A wide range of methods were used to develop these ESBs. Some benchmarks were derived through analysis of data from a combination of spiked sediment bioassays, chemical analysis, and bulk sediment toxicity testing. Other benchmarks were derived using a combination of sediment

chemistry and benthic species presence/absence data. In general, these "associative" measures involve a review of biological effects associated with various concentrations of a chemical or group of chemicals. Their value is influenced by the size of the available data set.

Other benchmarks were derived using models that predict the exposure of benthic organisms based on sediment chemistry. Equilibrium partitioning models predict the interstitial (pore) water concentration of a sediment based on bulk sediment contaminant concentration and the total organic carbon (TOC) of the sediment. The two organic compound tables allow adjustment of several ecotoxicological thresholds based on site-specific TOC.

Ecotoxicological Screening Benchmarks

Discussion of the derivation, strengths and limitations of the ESBs used in the screening templates follows. In conclusion, an application of this method to a historically contaminated watershed in south-eastern Massachusetts is provided.

Interstitial Water Concentrations: Sediment/Water Equilibrium Partitioning (EqP)

The equilibrium partitioning (EqP) approach is used to calculate a sediment quality benchmark (SQB) using site-specific organic carbon, chemical-specific partitioning data, and water quality benchmarks [23]. The principal assumptions used in this model are as follows:

- Organic chemicals in sediment tend to be partitioned between interstitial water and sediment particles. This partitioning is assumed to be in a state of equilibrium determined primarily by the organic carbon content of the sediment and the partitioning behavior of each chemical.

- Sediment-dwelling organisms will be exposed to an organic chemical in sediment primarily through exposure to the fraction of the chemical in interstitial water, as opposed to the fraction bound to sediment particles; therefore the concentration of organic chemicals in interstitial water should correlate with biological effects.

- Sediment-dwelling organisms have a range of sensitivities to organic chemicals that is similar to the range of sensitivities exhibited by the aquatic organisms used to develop water quality benchmarks.

It follows from these assumptions that a water quality benchmark can be used to predict the concentration in sediment associated with biological effects, provided the organic carbon content of the sediment and the partitioning behavior of each chemical is known. It must be noted that this methodology applies primarily to non-polar organic compounds. The partitioning behavior of the chemical with respect to organic carbon (K_{oc}) can be predicted from the octanol-water partition coefficient of the chemical (K_{ow}) using the formula [29]:

$$Log_{10}(K_{oc}) = (0.00028 + 0.983\ log_{10}(K_{ow}) \quad (1)$$

The sediment benchmark can be calculated using the following formula:

$$SQB = WQB \times f_{oc} \times K_{oc} \quad (2)$$

Where:

SQB = Sediment Quality Benchmark (µg/kg)
WQB = Water Quality Benchmark (µg/L)
f_{oc} = the fraction organic carbon of the sediment (unitless)
K_{oc} = the partitioning coefficient of the chemical in sediment (L/Kg)
K_{ow} = octanol-water partition coefficient

Any water quality benchmark, such as a Federal Ambient Water Quality Criterion (AWQC), or a Tier II Secondary Chronic Value (SCV), can be used in this model to calculate a sediment benchmark for non-polar organic compounds.

The bulk sediment concentrations measured at a site can be compared directly to the Sediment Quality Benchmarks (SQBs) [22]. However, these benchmarks should be adjusted by multiplying the SQB by the site-specific percent TOC. The EqP methodology and subsequent benchmarks are appropriate for sediments with 0.2% to 10% TOC. The ESB templates standardize TOC of sediment samples outside these limits to these values.

The EqP approach has the following strengths:

- Benchmarks can be developed for any non-polar organic compound if a WQB value and the K_{ow} of the chemical are available.
- EqP-derived benchmarks are site-specific if they are derived using a site-specific TOC value.

The EqP approach has the following limitations:

- The theory that chemicals exist at equilibrium in sediment is not universally accepted.
- Factors other than TOC that may influence the availability of chemicals to benthic organisms are not accounted for.
- EqP-derived benchmarks may not be protective with regard to biomagnification.

EqP has been widely used in the development of sediment benchmarks [9, 16, 22, 23, 25]. The

volatile and semi-volatile organic compound template lists several benchmarks developed using EqP-based approaches. These include benchmarks developed for the Oak Ridge National Laboratory (ORNL) [9, 16, 31], and EPA Sediment Quality Advisory Levels (SQALs) and Sediment Quality Criteria (SQC) [22, 23, 25]. A template for adjusting these values for site-specific TOC, within the 0.2% and 10% limits noted above, is provided. Similar TOC adjustment is provided for the SQAL/SQC and SEL sediment benchmarks in the chlorinated pesticides and PCBs template.

Field Survey Methods

Screening Level Concentration (SLC)

The screening level concentration (SLC) was designed to estimate the highest concentration of a particular contaminant in sediment that can be tolerated by approximately 95% of benthic infauna, as measured by species abundance [14].

The SLC is derived from synoptic data on sediment chemical concentrations and benthic invertebrate distributions [14]. First, the species screening level concentration (SSLC) is calculated by plotting the frequency distribution of the contaminant concentrations over all sites (at least 10) where the species is present. The 90^{th} percentile of this distribution is taken as the SSLC for that species. Next a large number of SSLCs are plotted as a frequency distribution to determine the contaminant concentration above which 95% of the SSLCs occur. The final concentration is the SLC.

The SLC approach has the following strengths:

- The approach can be used with any chemical contaminant.
- SLCs can be developed using existing databases and methodologies.
- The method does not require assumptions concerning mechanisms of interaction between organisms and contaminants.

The SLC approach has the following limitations:

- A large amount of field data is required.
- A precise level of infaunal taxonomic identification is required.
- Calculation of SLCs is affected by the range and distribution of contaminant concentrations and species.
- Selection criteria for species used in this approach have not been established.

- No mechanism has been established to separate single contaminant effects from multiple contaminant effects.

Various benchmarks developed using the SLC approach are discussed in the following sections.

Specific SLC-Derived Benchmarks

Provincial Sediment Quality Guidelines (PSQGs)

The Ontario Ministry of the Environment (OMOE) has prepared Provincial Sediment Quality Guidelines (PSQGs) [8] using the SLC approach [14]. These values are based on sediments and benthic species from a wide range of geographical areas within the province.

The PSQGs are numerical sediment guidelines using a tiered approach, that were developed for the protection of sediment dwelling organisms. These guidelines also protect against biomagnification of contaminants through the food chain. The PSQGs define three levels of ecotoxicological effects and are based on chronic, long term effects of contaminants on benthic organisms. The three levels are as follows:

- No Effect Level (NEL) is the concentration at which no toxic effects have been observed on aquatic organisms, or at which biomagnification is not expected. Sediments at this level are considered to be clean.

- Lowest Effect Level (LEL) is a level of contamination which can be tolerated by a majority of benthic organisms. Sediments at this level are considered clean to marginally contaminated.

- Severe Effect Level (SEL) is a level at which pronounced disturbance of a sediment-dwelling community is expected; the sediment concentration would be detrimental to a majority of benthic organisms. Sediments at this level would be considered heavily contaminated.

The PSQGs are often referred to as the Ontario Ministry of the Environment (OMOE) sediment guidelines [8]. The following is a brief description of how the guidelines were developed.

The Low Effect Level (LEL) is derived using field-based data on the co-occurrence of sediment concentrations and benthic organisms. Calculation of the SLC is a two step process, and is calculated separately for each parameter. The procedure is based on the Screening Level Concentration (SLC) method [14]:

- Individual SLCs are calculated for each of the benthic species. Sediment concentrations at all locations where the species was present are plotted in order of increasing concentration. The 90^{th} percentile of this concentration distribution is determined. The 90^{th} percentile was

chosen to provide a conservative estimate of the tolerance range for that species.

- The 90th percentiles for all of the species present are plotted in order of increasing concentration. From this plot, the 5th percentile is calculated; this level becomes the contaminant-specific LEL guideline.

The Severe Effect Level (SEL) is identical to the calculation of the LEL, except that the 95th percentile of the SLC (the level below which 95% of all SSLCs fall) is calculated in the second step of the SLC calculation; this level becomes the SEL guideline.

The strengths of using PSQGs include:

- The SEL values for organic chemicals can be normalized to site-specific TOC.

- The approach is based on chronic population-level effects on indigenous biota.

The limitations of using PSQGs include:

- Species "absence" endpoint used to derive the OMOE values is considered insensitive [5, 13]. Therefore, the SLC values may not be adequately protective.

- No direct cause-and effect relationship is established between a single contaminant and benthic organism survival.

- Values were derived to be applicable to sediment types throughout the Province of Ontario. Thus, differences between Ontario and other sediments and biota introduce a level of uncertainty.

The metals template lists the LEL and SEL values for inorganic chemicals (metals). The volatile and semi-volatile organic compound template provides LEL and SEL values. The SEL values are adjusted for site-specific TOC. LELs are not adjusted for TOC. The same sediment benchmarks and TOC adjustments are contained in the chlorinated pesticides/PCBs template.

Interim Criteria for the Evaluation of Sediment of the St. Lawrence River

These benchmarks were developed by the St. Lawrence Center of Environment Canada and the Québec Ministry of the Environment for the purpose of agency sediment management [19]. Periodic updates are expected as a result of future sampling efforts and further developments in ecotoxicology. Values are derived from the OMOE data base [8]. However, a higher percentile is used for the minimal (lowest) effect level, and a lower percentile for the toxic (severe) effect level. The result is that these benchmarks are less restrictive at the minimal level, and more restrictive at the toxic level. The following levels are assumed to correlate with acute and chronic, long-term

effects on benthic organisms:

- Minimal Effect Level (MEL) is the concentration of a substance at which some effects are noticeable, but are tolerated by most organisms. Most of the MELs are derived by 15th percentile screening level concentrations (SLCs).

- Toxic Effect Level (TOEL) is the concentration of a substance that will cause adverse effects in most living organisms. The TOELs are derived by 90th percentile SLC.

The strengths of this approach are similar to those for the OMOE sediment quality guidelines [8]. The MEL and TOEL values are not adjusted for TOC, which is a disadvantage of these benchmarks. These benchmarks were developed for inorganic chemicals (metals), volatile and semi-volatile organic compounds and chlorinated pesticides/PCBs.

Apparent Effects Threshold (AET)

The Apparent Effects Threshold (AET), developed by the Puget Sound Estuary Program [3], uses data from matched sediment chemistry and biological effects measures (i.e., benthic community survey, sediment toxicity tests). The narrative definition of an AET is the sediment concentration of a selected chemical above which statistically significant biological effects always occur. Barrick et al. [3] prepared specific AET values for several different species which are cited in EPA [1]. Chemical specific AET values were derived for amphipods, oysters, and benthic organisms, in order to represent a range of potentially sensitive receptors. The Apparent Effects Threshold-Low (AET-L) is defined as the lowest AET among applicable biological indicators. The Apparent Effects Threshold-High (AET-H) value is defined as the highest AET among applicable biological indicators. These values have been normalized to dry weight. No adjustment is made for site-specific TOC when AETs are used.

The strengths of AET approach are as follows:

- There are no constraints on the type of contaminant or biological effects that can be used.

- Contaminants most likely associated with observed biological effects are identified on a site-specific basis.

- Values are based on non-contradictory evidence of biological impacts [31].

The limitations of the AET approach include:

- The correlation between chemical concentrations and the biological effects measured in the field may vary from site to site, complicating and confounding widespread applicability of the AETs.

- AET benchmarks may be under protective; biological effects may be observed at chemical concentrations well below AET values.

- AET development requires, at a minimum, a large chemical database and one biological indicator.

- Combined contaminant effects cannot be separated from single contaminant effects.

The AET values were developed for inorganic (metals) and organic chemicals (volatile and semi-volatile organic compounds, pesticides/PCBs), however, no adjustment is made for site-specific TOC.

Washington State Sediment Quality Standards

The Washington State Department of Ecology has developed various regulatory standards for designating sediments that have acute or chronic adverse effects on aquatic organisms, or pose a significant risk to human health [4]. The sediment quality standards are based on the AET approach, using amphipod (*Rhepoxynius abronius*) mortality, bivalve (*Crassostrea gigas*) larval abnormality, and Microtox® (*Photobacterium phosphoreum*) bacterial luminescence bioassay endpoints, as well as abundance of major taxa of indigenous benthic infauna. The AET values were developed for Puget Sound.

The AET values adopted by Washington State are defined by Ginn and Pastorok [6] as

> "...the concentration of a single chemical (or chemical class) in sediments above which a particular biological effect has always been observed (and thus is predicted to be observed in other areas with similar concentrations of that chemical."

The strengths of the Washington State Sediment Quality Standards are as follows:

- The list of standards includes several polar (ionizable) organic compounds for which benchmark values are rare.

- The standards were developed using a range of potentially sensitive indicator species.

- Adjustment of the standards for site-specific TOC is possible for non-polar organic compounds.

The Washington State Sediment Quality Standards have the following limitations:

- The standards were developed on a site-specific basis for Puget Sound, therefore they may

not adequately predict chemical-associated effects in other areas.

- Application of the standards to freshwater may be unreliable because the standards were developed using marine species.

Only the Washington State Sediment Quality Standards for seven ionizable organic compounds are listed in the volatile and semi-volatile organic compound ESB template. No TOC adjustment is provided or appropriate for these compounds.

Integrative Methods

The following sections briefly describe several approaches that integrate laboratory and field-measured biological effects with chemical contaminant concentrations. These approaches are similar in the types of data needed to produce benchmarks, but differ in the exact calculations of the benchmarks.

National Oceanic and Atmospheric Administration (NOAA)

The National Oceanic and Atmospheric Administration (NOAA) annually collects and chemically analyzes sediment samples from sites located in coastal marine and estuarine environments throughout the United States [12]. These data were used to evaluate three basic approaches (i.e., EqP, spiked-sediment toxicity, synoptically collected biological and chemical data in field surveys) to the establishment of effects-based criteria. Chemical concentrations observed or predicted by these methods to be associated with biological effects were ranked. The lower 10^{th} percentile called the Effects Range-Low (ER-L) and median identified as the Effects Range-Median (ER-M) concentration were identified from this ranking. The ER-L and ER-M values were recalculated by Long et al. [11] after omitting a small amount of freshwater data included in the Long and Morgan [12] calculations and adding more recent data.

The major strength of these benchmarks is that they integrate several different types of biological effects data. The major disadvantage is that synoptically-collected biological and chemical data might have included groups of chemicals, and the NOAA method is not capable of accounting for possible antagonistic and synergistic effects of multiple chemicals.

The NOAA ER-L and ER-M values are listed in the templates for inorganic chemicals (metals), and organic chemicals (volatile and semi-volatile organic compounds, pesticides/PCBs). No site-specific TOC adjustments are made to these benchmarks.

Florida Threshold Effects Level (TEL-F) and Probable Effects Level (PEL-F)

The Florida Department of Environmental Protection (FDEP) approach, developed by MacDonald [5, 13], is similar to the NOAA approach [11, 12]. The updated and revised data set used by Long

et al. [11] was used by MacDonald [5, 13] to calculate Threshold Effects Levels (TEL-Fs) and Probable Effects Levels (PEL-Fs). However, unlike the ER-Ls and ER-Ms, the TEL-Fs and PEL-Fs also incorporate chemical concentrations observed or predicted to be associated with no adverse biological effects.

The TEL-F is the geometric mean of the 15th percentile in the effects data set and the 50th percentile in the no effects data set. Thus, the TEL-F represents the upper limit of the range of sediment contaminant concentrations dominated by the no effects data.

The PEL-F is the geometric mean of the 50th percentile in the effects data set and the 85th percentile in the no effects data set. Thus, the PEL-F represents the lower limit of the range of contaminant concentrations that are usually or always associated with adverse biological effects.

The strengths of this approach include:

- The FDEP values may be used to help identify sites with potential to cause adverse biological effects.

The limitations of this approach include:

- Data compiled by MacDonald et al. [5] are from marine and estuarine locations. Application of these benchmarks to freshwater systems may be inappropriate.

- Values are for single chemicals, although sediments containing chemical mixtures were used for their derivation

The TEL-F and PEL-F values are listed in the templates for inorganic chemicals (metals), and organic chemicals (volatile and semi-volatile organic compounds, pesticides/PCBs). No site-specific TOC adjustments are made to these benchmarks.

Canadian Freshwater Threshold Effect Level (TEL-C) and Probable Effect Level (PEL-C)

Smith et al. [17, 18] describe a procedure to develop TEL-Cs and PEL-Cs based on a large freshwater data set known as the Biological Effects Database for Sediment (BEDS). BEDS incorporates much of the work done in the Assessment and Remediation of Contaminated Sediments (ARCS) program [20, 21, 27] as well as the Ontario sediment data set [8].

The TEL-Cs and PEL-Cs are determined only for chemicals having at least 20 data entries for both effect and no effect. The TEL-C is derived by calculating the geometric mean of the 15th percentile of the effect data and the 50th percentile of the no effect data. The TEL-C was intended to estimate the concentration of a chemical below which biological effects only rarely occurred. The PEL-C was derived by calculating the geometric mean of the 85th percentile of the no effect data and the 50th

percentile of the effect data. The PEL-C was intended to estimate the concentration of a chemical above which biological effects frequently occurred.

The TEL-Cs and PEL-Cs can be used as tools in assessing sediment by delineating three distinct effects ranges:

- Minimal effect ranges; concentrations equal to or below the TEL-C.
- Occasionally possible effect ranges; concentrations above the TEL-C but below the PEL-C.
- Frequently detected effect ranges; concentrations equal to or greater than the PEL-C.

The confidence in the TEL-Cs, or alternatively the degree of internal reliability, is high based on the very low incidence (<10%) of biological effects below the TEL-C. The one exception is the value for total DDT which was most likely influenced by a small data set containing few no-effect entries.

The confidence in the PEL-Cs is generally lower than for the TEL-Cs. Several pesticides benchmarks showed high reliability, especially those for p, p' (4, 4')-DDD and total DDT. However, the reliability of PEL-Cs for all trace metals , all individual SVOCs, and two pesticides was less than 50%.

The strengths of the approach is primarily the high internal reliability of the TEL-Cs. This means that the TEL-Cs, when applied to the data used to develop the benchmarks, correctly identified samples in which no effects would be observed for most chemicals. Hence the TEL-Cs are reliable screening benchmarks.

There are several limitations in the use of these benchmarks. The PEL-Cs were not as reliable as the TEL-Cs for meeting their narrative purpose. The authors state that the TEL-Cs and PEL-Cs are currently too conservative for use as a screening tool in cases where it is necessary to identify high priority sites. In the case of the PEL-Cs, however, the relatively lower internal reliability indicates that they may not adequately identify sediment-associated chemical concentrations above which adverse effects biological effects are expected to frequently occur.

The freshwater TEL-C and PEL-C values are listed in the templates for inorganic chemicals (metals), and organic chemicals (volatile and semi-volatile organic compounds, pesticides/PCBs). No site-specific TOC adjustments are made to these benchmarks.

Screening Benchmark Compilations

Various agencies have compiled sediment screening benchmarks, including some of the benchmarks discussed in this report, and recommended screening benchmarks for ecological risk assessments. Several of these compilations are listed in the ESB tables. One of these, the State of Washington

Sediment Quality Standards [4], contains a few benchmarks that are unique, notably those for phenolic compounds. The following sections discuss the various compilations listed in the ESB tables.

Ecotoxicological Thresholds

In 1996 EPA [26] published Ecotoxicological Thresholds (ETs) intended to be used for screening contaminants at CERCLA (Superfund) sites. Sediment values are available for selected metals and organic compounds. The preferred method for determining sediment ETs was the proposed EPA Sediment Quality Criteria (SQC) values derived using the EqP method [22, 23, 25]. In the absence of SQC values, sediment quality benchmarks (SQB) were calculated using EqP and substituting Tier II Secondary Chronic Values for Ambient Water Quality Criteria. Four of the SQBs were from the Great Lakes Water Quality Initiative [20, 21], twelve were from Suter and Mabrey [31], and seventeen were calculated by EPA [25]. The NOAA ER-L value [11, 12] listed in the template is used if neither an SQC nor an SQB is available.

These benchmarks have the advantage of having been peer-reviewed and recommended by the EPA. The benchmarks are also based upon the widely-accepted EqP approach. EPA [25] notes that there is a relatively low correlation between the incidence of effects and values above the ER-L for mercury, nickel, total PCBs, and DDT [11] and that the ETs for these chemicals should be used cautiously.

The freshwater TEL and PEL values are listed in the templates for inorganic chemicals (metals), and organic chemicals (volatile and semi-volatile organic compounds, pesticides/PCBs). No site-specific TOC adjustments are made to these benchmarks.

USEPA Region IV Screening Values

Region IV has published ecological screening values for sediments [15]. The selected effect level is the lower of the ER-L [11] and TEL-F [5, 13]. The ER-L for antimony is taken from Long and Morgan [12]. When the Contract Laboratory Program's Practical Quantitation Limit (PQL) is above the effect level, the screening values defaults to the PQL. However, if concentrations below the PQL are reported, they should be compared with the effect level.

There are few strengths to this compilation of benchmarks. They are highly conservative for chemicals using the ER-L and TEL-F values. On the other hand, the PQL is not risk-based in any way, therefore adverse effects may be seen at levels below the PQL for some chemicals.

The Region IV values are listed in ESB templates for inorganic chemicals (metals), VOCs and SVOCs, and chlorinated pesticides/PCBs. No site-specific TOC adjustments are made to these benchmarks.

G. Hellyer and G. Balog, *Derivation, Application, Strengths and Limitations of Sediment Ecotoxicological Screening Benchmarks (ESBs)*
Assessment and Remediation of Contaminated Sediments (ARCS) Program

Under the aegis of EPA's ARCS program, sediments were collected and toxicity tests were performed from a number of locations throughout the Midwestern and south-central United States. The ARCS program [20, 21, 27] describes the procedures for calculating and evaluating sediment effect concentrations (SECs) using lab data on the toxicity of field-collected sediments to the amphipod, *Hyalella azteca* and the midge fly, *Chironomus riparius*.

SECs were calculated primarily for total metals, simultaneously extracted metals, PCBs, and volatile and semi-volatile organic compounds. The ranges of concentrations were too narrow in the ARCS database to adequately evaluate SECs for butylins, methyl mercury, polychlorinated dioxins and furans, or chlorinated pesticides. The SECs are further subdivided into three categories: (1) Effects Range Low (ERL) and Effects Range Median (ERM) (2) Threshold Effects Level (TEL) and probable effect level (PEL) and (3) no effect concentration (NEC). These acronyms refer to the methods employed by the original authors and also used in this ARCS program to derive benchmarks.

The SECs can be used as sediment assessment tools to:

- interpret historical sediment chemical data.
- identify chemicals or areas of concern.
- identify the need for more detailed studies.
- identify a potential problem before a chemical is discharged.
- establish a link between contamination source and sediment quality.
- trigger regulatory action.
- establish target remediation objectives.

The SECs are based on endpoints for amphipods (*H. azteca*) that include survival, growth (length), and sexual maturation. Endpoints for midges (*C. tentans*) include survival and growth (length). A sample was designated as toxic in replicated tests if there was a significant reduction in an endpoint relative to the response of the control sediment. Or, a sample was deemed toxic if there was greater than 50% reduction in response relative to the control sediment in non-replicated tests. Furthermore, SECs were derived only if five or more samples were toxic for the chemical and the number of toxic samples with concentrations above the SEC was greater than the number of toxic samples with concentrations below the SEC.

The authors note that if a chemical concentration exceeds an SEC threshold it does necessarily mean that the chemical *caused* the observed effect. Rather, the SEC is the concentration of a chemical that is *associated* with the effect. Correlation is not causation.

One of the limitations of this method the authors mention is the complex nature of field collected sediments versus lab controlled spiked sediments. There are many variables which can effect the toxicity of a sediment to a benthic organism such as the chemicals acting independently, additively, synergistically, or antagonistically. Therefore, the application of SECs is associated with uncertainty in field collected sediments. Paradoxically, one of the strengths of this type of approach is that, to a point, it mimics natural conditions, and can predict potential toxicity in field collected sediments.

The freshwater TEL and PEL values are listed in the ESB template for inorganic (metals) and organic chemicals (volatile and semi-volatile organic compounds, pesticides/PCBs). No site-specific TOC adjustments are made to these benchmarks.

Sediment Effect Concentrations for Amphipods and Midges

Ingersoll et al. [7] describe a method to determine the toxicity in sediments of inorganic and organic chemicals. This study is an offshoot of the ARCS program [20, 21, 27] where sediments were collected from a number of locations throughout the Midwestern and south central United States and toxicity tests were performed. Sediment effect concentrations (SECs) were determined based on these toxicity tests. The authors developed benchmarks based on each individual toxicity test in the same manner as presented in ARCS. The SECs are further subdivided into three categories: (1) Effects Range Low (ER-L) and Effects Range Median (ER-M) (2) Threshold Effects Level (TEL-HA) and probable effect level (PEL-HA) and (3) no effect concentration (NEC).

Like the ARCS program, the SECs are based on endpoints for the amphipod that include survival, growth (length), and sexual maturation. Endpoints for the midges include survival and growth (length). A sample was designated as toxic in replicated tests if there was a significant reduction in an endpoint relative to the response of the control sediment.

The strengths of this method include the use of field collected sediments. However, because of the complex nature of these sediments if a chemical exceeds an SEC it does not necessarily mean that the chemical *caused* the observed effect. Rather, the SEC is the concentration of a chemical that is *associated* with that effect. Another advantage of this method is the reliance of SECs on dry weight concentrations which, according to the authors, are generally more reliable than ECs calculated using sediment concentrations normalized to organic carbon for non-polar organic chemicals and SECs calculated using pore-water metals concentrations.

One of the limitations also happens to be one of the strengths of the method in that determining the toxicity of field collected sediments is complex because of the many factors which influence toxicity and can act either independently, additively, synergistically, or antagonistically.

The PEL-HA and TEL-HA values for *H. azteca* are listed in ESB templates for inorganic chemicals (metals), volatile and semi-volatile organic compounds, and chlorinated pesticides/PCBs. No site-specific TOC adjustments are made to these benchmarks.

Canadian Sediment Quality Guidelines

The Canadian strategy for developing sediment quality guidelines involves two separate approaches, as described by Smith et al. [17, 18]. The spiked sediment toxicity test approach uses dose-response information from sediments spiked with known concentrations of a chemical and adverse biological effects observed in the exposed organisms.

The second approach, the National Status and Trends Program (NSTP), uses field-collected data in which chemical mixtures occur that establish associations between chemical concentrations in the sediments and adverse biological effects that are classified as effects range low (ER-L) and effects range median (ER-M). These two values defined concentration ranges that attempted to identify the frequency associated with adverse effects. This approach was also used by the state of Florida to support the development of sediment quality guidelines.

The original derivation procedure was modified to calculate two guidelines, the lower value, or, lower Threshold Effects Level (TEL-C), representing the concentration below which adverse effects were expected to occur rarely. The upper value, or, probable effect level (PEL-C), represented the concentration above which adverse effects were expected to occur frequently.

The derivation of interim guidelines using the modified NSTP approach, as described in Smith et al. [18], involves the evaluation of data from studies conducted throughout North America, as noted above. Chemical and biological data as well as equilibrium partitioning models, were compiled in the biological effects database for sediments, (BEDS). Each entry included information on the measured chemical concentration, sample location, test approach, duration, presence or absence of adverse effects and life stage used. This information was sorted by chemical and sediment type and effect descriptors were assigned where adverse effects were noted. Adequate toxicological data were available to support the calculation of TEL-Cs and PEL-Cs for thirty-one substances in marine sediments and twenty-three substances in freshwater sediments.

Quantification of the incidence of adverse biological effects was used to estimate the degree to which the objective of the TEL-Cs and PEL-Cs were met. The TEL-Cs for all chemical in both freshwater and marine sediments adequately defined the concentration below which adverse effects occurred within the data compiled in BEDS. Similarly the PEL-Cs for most chemicals found in marine sediments were adequately defined as well. The PEL-Cs for most chemicals in freshwater sediments did not satisfy the narrative definition of the PEL-C. This problem may be corrected through further expansion of the database to include more toxicological information from sites covering a larger range of chemical concentrations.

The TEL-C and PEL-C values are listed in ESB templates for inorganic chemicals (metals), volatile and semi-volatile organic compounds, and pesticides/PCBs. No site-specific TOC adjustments are made to these benchmarks.

Conclusions

A comprehensive, easy to use and interpret, method has been developed and illustrated using available ecotoxicological screening benchmarks (ESBs) for inorganics (metals), volatile and semi-volatile organic compounds, and chlorinated pesticides/polychlorinated biphenyls (PCBs). It allows rapid screening of sediment contaminants for potential ecotoxicological risk. It complements and readily integrates with other biological and chemical information, including sediment bioassays, grain size determination, and SEM/AVS data. Sites identified by this method may be investigated further with more rigorous chemical and biological sampling and modeling techniques, particularly focusing on potential exposure pathways to organisms of ecological or societal concern.

Acknowledgments: We appreciate review, support and comments provided by our colleagues, Patti Lynne Tyler, Alan VanArsdale, and Peter Nolan.

References

[1] U.S. Environmental Protection Agency (U.S. EPA). The Incidence and Severity of Sediment Contamination in Surface Waters of the United States, Science and Technology. EPA 823-R-97-006, Washington, D.C, 1997.

[2] E.A. Power and P.M. Chapman, Assessing Sediment Quality, in G.A. Burton (Ed.) Sediment Toxicity Assessment, Lewis Publishers, Ann Arbor, MI, 1992.

[3] R. Barrick, S. Becker, L. Brown, H. Beller, and R. Pastorok, Sediment Quality Values Refinements:1988 Update and Evaluation of Puget Sound AET, Volume 1, Prepared for the Puget Sound Estuary Program, Office of Puget Sound, 1988.

[4] D. Batts, and J. Cubbage, Summary of Guidelines for Contaminated Freshwater Sediments. Washington State Department of Ecology. Environmental Investigations and Laboratory Services Program, Olympia, Washington, 1995.

[5] Florida Department of Environmental Protection (FDEP), Approach to the Assessment of Sediment Quality in Florida Coastal Waters, Volume 1. Development and Evaluation of Sediment Quality Guidelines. Prepared for Florida Department of Environmental Protection, Office of Water Quality, Tallahassee, FL., by MacDonald Environmental Sciences Ltd. Ladysmith, British, Columbia, 1994.

[6] T.C. Ginn and R.A. Pastorak, Assessment and Management of Contaminated Sediments in Puget Sound, in G.A. Burton (Ed.) Sediment Toxicity Assessment, Lewis Publishers, Ann Arbor, MI, 1992.

[7] C.G. Ingersoll, P.S. Haverland, E. L. Brunson, T. J. Canfield, F. J. Dwyer, C. E. Henke, N. E. Kemble, D. R. Mount, and R.G. Fox, Calculation and Evaluation of Sediment Effect Concentrations for the Amphipod *Hyalella azteca* and the Midge *Chironomus riparius*. Journal of Great Lakes Research, 22(3) (1996) 602-623.

[8] R. Jaagumagi, D. Persaud and D. Bedard, Ontario's Approach to Sediment Assessment and Remediation, Second SETAC World Congress (16th Annual Meeting), Vancouver, British Columbia, Canada, November 5-9, 1995.

[9] D.S. Jones, G. W. Suter II, and R.N. Hull, Toxicological Benchmarks For Screening Contaminants Of Potential Concern For Effects On Sediment Associated Biota: 1997 Revision, ES/ER/TM-95/R4, Oak Ridge National Laboratory, Oak Ridge, TN, 1997.

[10] J.O. Lamberson and R. C. Swartz, Spiked-Sediment Toxicity Test Approach, in Sediment Classification Methods Compendium, EPA 823-R-92-006, Washington, D.C., 1992, Chapter 4.

[11] E.R. Long, D.D. MacDonald, S.L. Smith, and F.D. Calder, Incidence of adverse biological effects within ranges of chemical concentrations in marine and estuarine sediments, Environmental Management 19(1) (1995) 81-97.

[12] E.R. Long and L. G. Morgan, The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program, NOAA Technical Memorandum NOS OMA 52, National Oceanic and Atmospheric Administration, 1991.

[13] D.D. MacDonald, Approach to the Assessment of Sediment Quality in Florida Coastal Waters, Florida Department of Environmental Protection, Tallahassee, Florida, 1994.

[14] J.M. Neff, B.W. Cornaby, R.M. Vaga, T.C. Gulbransen, J. A. Scanlon, and D. J. Bean, An Evaluation of the Screening Level Concentration Approach for Validation of Sediment Quality Criteria for Freshwater and Saltwater Ecosystems, in W. J. Adams, G. A. Chapman, and W. G. Landis (Eds.), Aquatic Toxicology and Hazard Assessment: 10th Volume, ASTM STP 971, American Society for Testing and Materials, Philadelphia, 1988, pp. 115-127.

[15] U.S. Environmental Protection Agency (U.S. EPA) Region IV, Ecological Screening Values, Ecological Risk Assessment Bulletin No.2, Waste Management Division, U.S. Environmental Protection Agency Region IV, Atlanta, Georgia, 1995.

[16] B.E. Sample, G.W. Suter, R.A. Efroymson, and D.S. Jones, A Guide to the ORNL Ecotoxicological Screening Benchmarks: Background, Development, and Application, Environmental Sciences Division, Publication #4783, Oak Ridge National Laboratory, Oak Ridge, TN, 1998.

[17] S.L. Smith, D.D. MacDonald, K.A. Keenleyside, C.G. Ingersoll, and L.J. Field, A Preliminary Evaluation of Sediment Quality Assessment Values for Freshwater Ecosystems, Journal of Great Lakes Research 22(3) (1996) 624-638.

[18] S.L. Smith, D.D. MacDonald, K.A. Keenleyside, and C.L. Gaudet, The Development and Implementation of Canadian Sediment Quality Guidelines, in Development and Progress in Sediment Quality Assessment: Rationale, Challenges, Techniques & Strategies, 1996, pp: 233-249.

[19] MENVIQ/EC (Ministère de l'Environnement du Québec et Environnement Canada), Criteres Interimaires pour L'evaluation de la Qualité des Sediments du Saint-Laurent, Ministere des Approvisionnements et Services Canada, EM 30-418/1991F, Environnement Canada-Centre Saint-Laurent, Montreal, 1992.

[20] U.S. Environmental Protection Agency (U.S. EPA), Assessment and Remediation of Contaminated Sediments (ARCS) 1992 Work Plan, Chicago, Ill.: Great Lakes National Program Office (GLNPO), 1992.

[21] U.S. Environmental Protection Agency (U.S. EPA), Assessment and Remediation of Contaminated Sediments (ARCS) Program Risk Assessment and Modeling Overview Document, EPA 905-R93-007. Chicago, Ill.: Great Lakes National Program Office (GLNPO), 1993.

[22] U.S. Environmental Protection Agency (U.S. EPA), Guidelines for Deriving Site-Specific Sediment Quality Criteria for the Protection of Benthic Organisms, Office of Science and Technology, EPA-822-R-93-017, Washington, D.C., 1993.

[23] U.S. Environmental Protection Agency (U.S. EPA), Technical Basis for Deriving Sediment Quality Criteria for Nonionic Organic Contaminants for the Protection of Benthic Organisms by Using Equilibrium Partitioning, EPA-822-R-93-011, Washington, D.C., 1993.

[24] U.S. Environmental Protection Agency (U.S. EPA), Methods For Measuring The Toxicity and Bioaccumulation Of Sediment-Associated Contaminants With Freshwater Invertebrates, EPA/600/R-94/024, June 1994, United States Environmental Protection Agency, Office Of Research and Development, Washington, D.C., 1994.

[25] U.S. Environmental Protection Agency (U.S. EPA), Derivation of EPA's Sediment Quality Advisory Levels. Draft. Office of Science and Technology, USEPA, Washington, D.C., 1996.

[26] U.S. Environmental Protection Agency (U.S. EPA), ECO Update: Ecotox Thresholds. Office of Solid Waste and Emergency Response (OSWER). USEPA 540/F-95/038, Washington, D.C., 1996.

[27] U.S. Environmental Protection Agency (U.S. EPA), Assessment and Remediation of Contaminated Sediments (ARCS) Program, Great Lakes National Program Office, Chicago, Illinois. EPA 905-R96-008, Washington, D.C., 1996.

[28] U.S. Environmental Protection Agency (U.S. EPA), Bioaccumulation Testing and Interpretation for the Purpose of Sediment Quality Assessment: Status and Needs, Offices of Water and Solid Waste, EPA-823-R-00-001, Washington, D.C. 2000.

[29] G.M. Rand (Ed.), Fundamentals of Aquatic Toxicology, 2nd Edition, Taylor and Francis, Washington, D.C., 1995.

[30] P.M. Chapman, Current Approaches to Developing Sediment Quality Criteria, Environmental Toxicology and Chemistry 8 (1989) 589-599.

[31] G.W. Suter II and J.B. Mabrey, Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1994 revision, ES/ER/TM-96/R1, Oak Ridge National Laboratory, Oak Ridge, TN, 1994.

Tables:

Table 1. Ecotoxicological Screening Thresholds

Ecotoxicological Thresholds	Source
ORNL-AWQC	Oak Ridge National Laboratory - NAWC chronic [9, 16, 31]
ORNL-SCV	Oak Ridge National Laboratory - Secondary Chronic Value [9, 16, 31]
OSWER Type	Office of Solid Waste and Emergency Response hEcotox Thesholds [26]
Region IV	U.S. EPA Region IV Ecological Screening Values [15]
AET-L	Apparent Effects Threshold-Low, for selected organics and metals [3, 30]
AET-H	Apparent Effects Threshold-High [3, 30]
LEL	Lowest Effects Level [8, 14]
SEL	Severe Effects Level [8, 14]
MEL	Minimum Effect level [8, 17, 19]
TOEL	Toxic Effect Level [8, 17, 19]
ERL	Effects Range-Low (lower 10th percentile of the marine/estuarine effects data distribution) [11, 12]
ERM	Effects Range-Median [11, 12]
WA State	Washington State Sediment Quality Standards for ionizable organic compounds [4, 6]
SQAL/SQC	Sediment Quality Advisory Levels/Sediment Quality Criteria (values are lower limit of 95% confidence limit) [22, 24, 25]
TEC-ARCS	Threshold Effect Concentration-Assessment and Remediation of Contaminated Sediments (ARCS) Program [20, 21, 27]
PEC-ARCS	Probable Effect Concentration-Assessment and Remediation of Contaminated Sediments (ARCS) Program [20, 21, 27]
NEC-ARCS	No Effect Concentration- ARCS Program [20, 21, 27]
TEL-C	Threshold Effects Levels - Canada; for selected nonionic organics and metals (Freshwater) [17, 18]
TEL-F	Threshold Effects Levels - Florida (Marine) [5, 13]
TEL-HA	Threshold Effects Level for *Hyalella azteca*; 28 day test [7]
PEL-C	Probable Effects Levels - Canada (Freshwater) [17, 18]
PEL-F	Probable Effects Levels -Florida (Marine) [5, 13]
PEL-HA	Probable Effects Levels - *Hyalella azteca*; 28 day test [7]

Appendix F:

Project Work/QA Plan

Ten Mile River Sediment/Water Quality Assessment

Project Work/QA Plan Acceptance

EPA QA Officer Acceptance:

Signature: _____

Andy Beliveau, EPA/OEME/EQA Date

EPA Project Officer Acceptance:

Signature: _____

Greg Hellyer, EPA/OEME/ECA Date

TABLE OF CONTENTS

Page
LIST OF TABLES AND ATTACHMENTS ii

1.0 1. Project Objective 1

1.1 Project Organization 1

2.0 Data Usage 1

3.0 Design and Rationale 2

4.0 Field Sampling 2

4.1 Water Collection 2

4.2 Sediment Collection 3

5.0 Interferences and Potential Problems 4

6.0 Sample Handling and Preservation 4

7.0 Station Monitoring 5

8.0 Analytical Parameters 6

ADDITIONAL INFORMATION

9.0 Schedule of Tasks and Products 10

10.0 Field Safety 10

11.0 Data Quality Requirements and Assessments 10

12.0 Final Report 12

LIST OF TABLES AND ATTACHMENTS

TABLES Page

Table 1: Sampling Station Summary 5

Table 2: Analytical Parameters for Water 6

Table 3: Analytical References and QC Goals for Water 6

Table 4: Analytical Parameters for Sediment 7

Table 5: Analytical References and QC Goals for Sediment 8

ATTACHMENTS

ATTACHMENT A: WHOLE SEDIMENT TOXICITY TEST PROCEDURES 13

ATTACHMENT B: YSI6000 CALIBRATION PROCEDURES 20

ATTACHMENT C: REPORTING LIMITS FOR PAHS 27

ATTACHMENT D: REPORTING LIMITS FOR CHLORINATED PESTICIDES AND POLYCHLORINATED BIPHENYLS 29

ATTACHMENT E: SEDIMENT SAMPLING PROCEDURES 30

ATTACHMENT F: TRIMBLE NAVIGATION GEOEXPLORER GPS RECEIVER . . . 38

1.0 Project Objective

The Massachusetts Department of Environmental Protection Office of Watershed Management (OWM) has requested Office of Environmental Measurement and Evaluation (OEME) assistance in evaluating the ambient water/sediment quality in the 10 Mile River. The 10 Mile River has a history of physical alteration and chemical contamination, particularly from jewelry and electro-plating industries. The purpose of this investigation is to determine chemical concentrations in the river sediment upstream of several impoundments and a Waste Water Treatment Plant (WWTP), to evaluate the potential toxicity of these sediments to benthic invertebrates, and to determine current surface water quality conditions associated with the sampling locations.

Chemical constituents (metals, mercury, SVOCs, PCBs, pesticides, TOC, and AVS/SEM (Cu, Zn, Pb, Cd, Cr, Hg, Ni) in sediments will be determined for 7 stations. These sediment concentrations will be compared to biological effects guidelines and laboratory control toxicity results and will be used to evaluate the sediment contamination and screen for potential ecological risk in the river.

1.1 Project Organization

The organizational hierarchy for this project includes the MADEP project manager (MADEP/PM) Robert Maietta (MADEP/OWM) and the EPA project manager (EPA/PM) Greg Hellyer (EPA/OEME/ECA). Chemical Analyses will be performed at EPA's New England Regional Laboratory (NERL) under the direction of Robert Maxfield (EPA/EIA). Field activities will take place as a cooperative effort with teams comprised of both EPA and MADEP personnel. Interpretation of data and the evaluation of useability will be provided by EPA's PM.

2.0 Data Usage

The sediment toxicity test results will be used to determine if exposure to contaminants in the sediments has adverse biological effects (i.e. mortality) to benthic organisms. The sediment chemical concentrations will be evaluated against the survival responses from the whole sediment toxicity tests. As part of that evaluation, results from Simultaneously Extracted Metals and Acid Volatile Sulfide (SEM/AVS) analysis and TOC will be compared with the toxicity test data in an attempt to identify mechanisms possibly controlling the bioavailability of toxic contaminants. In addition, Any outstanding ecological concerns noted from the site visits will be recorded in the final report.

3.0 Design and Rationale

This project will take place in an effort to provide evidence of degradation and the need for possible future remedial action. This project will include monitoring at seven sites in the 10 Mile River. The sites selected will be determined by the MADEP and EPA PMs. A site reconnaissance visit will take place in March, 1998 to determine access points in the river and sampling locations.

Sampling locations will in part be based on accessibility, historical information and areas of low energy (depositional environments). Each sampling location will be documented through the use of the Global Positioning System (GPS) using the OEME SOP (Standard Operating Procedure in Attachment E).

Surface water chemistry will be performed at each location. Sediment samples will be collected at each of the sites for chemical and physical analyses, as well as toxicity testing . A list consisting of sampling site descriptions, medium for analyses and analytical parameters can be found in Table 1.

If toxicity occurs in any of the biological assays, the chemical analysis may assist in identifying the causal agent responsible for toxicity. If chemical analysis indicates high concentrations of various toxicants, and no toxicity occurs, then the bioavailability or toxicity of the contaminants may be altered by other physical or chemical parameters such as elevated levels of total organic carbon (TOC) or acid volatile sulfides (AVS).

4..0 FIELD SAMPLING

4.1 Water Collection

Field water quality measurements will be performed with a YSI 6000 Sonde operated with portable computer or an equivalent method at all 7 field sites listed in Table 1. The measurements recorded will consist of pH, dissolved oxygen (DO), temperature and specific conductance. See Attachment B for YSI 6000 calibration procedures.

Field water quality measurements will be made prior to sediment collection just below the surface of the water where the depth is less than 0.3 meter (1 ft) in depth. If the water depth is greater than 1 meter, measurements will be collected at 1 meter depth intervals. Table 2 contains information on parameters and analytical methods.

4.2 Sediment Collection

Sediment samples will be collected from the bioactive layer (< 10 cm.) from 7 locations in the 10 Mile River. A petit ponar dredge will be used to collect sediment samples. If a problem with the substrate is encountered, a hand corer may be used instead. Sediments will be collected from the upper six inches of bottom substrate. The dredge may be used several times in slightly different spots at each sampling station to obtain adequate sample volume. Sediments will be emptied from the dredge into a precleaned 5 gallon HDPE container for each location. The sampling containers for Simultaneously-Extracted Metals (SEM)/AVS analysis will be filled immediately prior to homogenization with no head space in the sample container using a plastic scoop. Aliqouts for analyses of PAH, PCB, pesticide, TOC and grain size will be taken next . Containers for total metals will then be filled using a plastic scoop. The toxicity sample will be taken last from the homogenized sample. The dredge will be decontaminated between sampling stations with soapy water, tap water and a deionized (DI) water rinse. All sampling containers for chemical and physical analyses will be appropriately pre-cleaned plastic or glass (amber when necessary) bottles.

Every effort will be made in the field to meet the 30 % solids requirement for sediment analysis. This will consist of initially allowing adequate time for excess water to drain from the dredge. Once the sample settles in the 5 gallon container, overlying water will again carefully be poured off (avoiding loss of fines), prior to distribution into individual sample containers. If necessary, special arrangements may be made with OEME's Chemistry Section for possible sample filtration in the laboratory should there be any questions with respect to meeting this requirement. Samples will not be dried prior to analysis.

NOTE Sediments will be sampled during the reconnaissance and analyzed at OEME to assess the % of solids. If sediments are not expected to meet 30% solids, analyst should meet with EPA/PM and NERL Chemistry Section Chief to determine next steps to be taken, including, if necessary, additional sampling of the apparent problematic sites.

For more information on sediment collection see OEME/ECA, Sediment Sample Collection Methods SOP #2.25 (Attachment E).

Sediment samples will be analyzed for: total organic carbon (TOC), polychlorinated biphenyls (PCBs), semivolatile organic compounds (SVOCs), pesticides, grain size, total metals analysis, SEM/AVS and toxicity. Table 4 lists specific analytes of interest, appropriate sample containers and analytical methods.

Whole sediment toxicity tests will be conducted utilizing the two freshwater macroinverebrate species, *Chironomus tentans* and *Hyalella azteca*. Toxicity testing procedures will follow EPA's *Methods for Measuring the Toxicity and Bioaccumulation of Sediment-Associated Contaminants with Freshwater Invertebrates* (EPA/600/R-94/024)

and OEME/ECA Standard Operating Procedure # 2.7 (Attachment A).

5.0 Interferences and Potential Problems

Sampling will be conducted at low energy depositional areas. Every effort will be made to collect depositional sediment rather than sand or gravel. Sand and gravel does not bind the contaminants that may be present. In addition, sediment samples should be collected upgradient of major bridge and roadways so as to avoid contaminants from road runoff.

6.0 Sample Handling and Preservation

Samples will be preserved on ice in a cooler for transport to the EPA Region 1 laboratory. Proper paperwork including labeling and chain of custody will be maintained at all times. Upon arrival at the laboratory, all samples will be logged in and then refrigerated at 4 degrees Celsius. Table 2 and 4 list the holding time and preservation necessary for each parameter collected.

The sample label will contain the following information:

1. Sample number
2. Sample location or identifier
3. Date and time of collection
4. Sampling personnel

A bound field notebook will be maintained by field personnel to record sample collection information. A chain of custody form will be used to document the types and numbers of samples collected and logged. The storage coolers and refrigerators will be taped with signed chain-of-custody tape while the samples are being stored.

7.0 Station Monitoring

Table 1: Sampling Station Summary

	Field Analysis					Sample Analysis							
Station	GPS	pH	D.O.	Temp.	Cond.	Metals	AVS/SEM (Cu, Zn, Pb, Cd, Ni, Hg)	SVOCs	PCBs	Pest.	TOC	Toxicity	Grain Size
1) Wetherells Pond, Plainville, MA	W	W	W	W	W	S	S	S	S	S	S	S	S
2) Falls Pond, North Attleborough, MA	W	W	W	W	W	S	S	S	S	S	S	S	S
3) Ten Mile River, North Attleborough, MA	W	W	W	W	W	S	S	S	S	S	S	S	S
4) Mechanics Pond, Attleborough, MA	W	W	W	W	W	S	S	S	S	S	S	S	S
5)Dodgeville Pond, Attleborough, MA	W	W	W	W	W	S	S	S	S	S	S	S	S
6) Hebronville Pond, Attleborough, MA	W	W	W	W	W	S	S	S	S	S	S	S	S
7) Ten Mile Reservoir, Seekonk, RI	W	W	W	W	W	S	S	S	S	S	S	S	S
8) Field Duplicate						S	S	S	S	S	S		S
9) Equipment Rinse Blank						W	W	W	W	W	W	W	W

S=Sediment W=Water

8.0 ANALYTICAL PARAMETERS

Table 2: Analytical Parameters for Water

PARAMETER	# of Samples	Container	Analytical Method Reference	Sample Preservation	Holding Time
pH	7	n/a	EPA 150.1	n/a	immediate
Conductivity	7	n/a	EPA 120.1	n/a	immediate
Dissolved Oxygen	7	n/a	EPA 360.1	n/a	immediate
Temperature	7	n/a	EPA 170.1	n/a	immediate

Table 3: Analytical References and QC Goals for Water

PARAMETER	Number of Samples	Analytical Method Reference	Reporting Limits	Precision Goals	Accuracy Goals	Completeness Goals
pH	7	EPA 150.1	1-13 S.U.	+/- 0.2	+/- 0.2	90%
Conductivity	7	EPA 120.1	10-200µS	+/-10	+/-10	90%
Dissolved Oxygen	7	EPA 360.1	2-14 mg/L.	+/-0.1	+/-0.1	90%
Temperature	7	EPA 170.1	0-35^{O}C	+/-1.0	+/-1.0	90%

Table 4: Analytical Parameters for Sediment

PARAMETER	# of Stations.	+DUP.[1] +BLANK	TOTAL SAMPLES TO LAB	CONTAINER	ANALYTICAL METHOD REFERENCE	SAMPLE PRES.	HOLDING TIME
All other metals	7	+1 Dup	8	4 OZ Glass Jar (1/2 full)	EPA 200.7	Cool,4°C	6 months
Mercury	7	+1 Dup	8		EPA 245.5	Cool,4°C	28 days
SVOCs	7	+1 Dup	8	1 Liter amber Glass Jar ½ full	OEME BNASOLL2.SOP	Cool,4°C	14 days to Extraction, 40 days to analysis
PCBs	7	+1 Dup	8	1 Liter amber Glass Jar ½ full	OEME PESSOLL1.SOP	Cool,4°C	14 days to Extraction, 40 days to analysis
Pesticides	7	+1 Dup	8		OEME PESSOLL1.SOP	Cool,4°C	14 days to Extraction, 40 days to analysis
TOC	7	+1 Dup	8	40ml Glass vial	OEME TOC190.SOP	Cool,4°C Freeze	21 days 1 month
AVS/SEM(Cu, Zn,Pb,Cd,Cr, Hg,Ni)	7	+1 DUP	8	2 OZ Glass jar (no head space)	See Foot note 2	Cool,4°C	21 days
Toxicity	7		7	2x2 litter Plastic container	Attachment A	Cool,4°C	2 weeks
Grain size	7	+1 Dup	8	From Toxicity samples	ASTM D422	n/a	n/a

Notes:

1 Duplicates samples will be collected in the field.

2 Determination of Simultaneously-Extracted metals and Acid-Volatile Sulfide in sediment using Sulfide-Specific Electrode Detection. (Region I SEM/AVS SOP, Jan. 1997)

All metals analysis will include a laboratory duplicate and a matrix spike.

All SVOCs, PCBs, Pesticides analysis will include a matrix spike and a matrix spike duplicate.

Table 5: Analytical References and QC Goals for Sediment

PARAMETER	ANALYTICAL METHOD REFERENCE	Reporting Limits[3]	Precision Goals	Accuracy Goals	Completeness Goals
Aluminum	EPA 200.7	10 ppm	Lab. & Field Dup. RPD. 20%	MS %Recovery ±25%	90%
Mercury(total)	EPA 245.5	0.13 ppm	Lab. & Field Dup. RPD. 20%	MS %Recovery ±25%	90%
Antimony	EPA 200.7	10 ppm	Lab. & Field Dup. RPD. 20%	MS %Recovery ±25%	90%
Arsenic (total)	EPA 200.7	10 ppm	Lab. & Field Dup. RPD. 20%	MS %Recovery ±25%	90%
Beryllium	EPA 200.7	1 ppm	Lab. & Field Dup. RPD. 20%	MS %Recovery ±25%	90%
Cadmium	EPA 200.7	2 ppm	Lab. & Field Dup. RPD 20%	MS %Recovery ±25%	90%
Chromium(total)	EPA 200.7	10 ppm	Lab. & Field Dup. RPD 20%	MS %Recovery ±25%	90%
Copper	EPA 200.7	10 ppm	Lab. & Field Dup. RPD 20%	MS %Recovery ±25%	90%
Cyanide					
Gold	EPA 200.7	??	Lab. & Field Dup. RPD 20%	MS %Recovery ±25%	90%
Iron	EPA 200.7	50 ppm	Lab. & Field Dup. RPD 20%	MS %Recovery ±25%	90%
Lead	EPA 200.7	10 ppm	Lab. & Field Dup. RPD 20%	MS %Recovery ±25%	90%
Manganese	EPA 200.7	50 ppm	Lab. & Field Dup. RPD. 20%	MS %Recovery ±25%	90%
Selenium	EPA 200.7	10 ppm	Lab. & Field Dup. RPD 20%	MS %Recovery ±25%	90%

PARAMETER	ANALYTICAL METHOD REFERENCE	Reporting Limits[3]	Precision Goals	Accuracy Goals	Completeness Goals
Silver	EPA 200.7	5 ppm	Lab. & Field Dup. RPD 20%	MS %Recovery ±25%	90%
Thalliun	EPA 200.7	10 ppm	Lab Dup. RPD 20%	MS %Recovery ±25%	90%
Zinc	EPA 200.7	10 ppm	Lab Dup. RPD 20%	MS %Recovery ±25%	90%
Calcium	EPA 200.7	20 ppm	Lab Dup. RPD 20%	MS %Recovery ±25%	90%
Magnesium	EPA 200.7	20 ppm	Lab Dup. RPD 20%	MS %Recovery ±25%	90%
Nickel	EPA 200.7	10 ppm	Lab. Dup. RPD. 20%	MS %Recovery ±25%	90%
PAHs	OEME BNASOLL2.SOP	See Attachment C	MS/MSD RPDs 19-50%[2] Field. Dup. RPD. 35%[1]	MS/MSD % Recovery 11-126%[2]	90%
PCBs	OEME PESSOLL1.SOP	0.8 ppb See Attachment D	Lab. Dup. RPD. 20% Field. Dup. RPD. 35%[1]	MS/MSD % Recovery 50-150%	90%
Pesticides	OEME PESSOLL1.SOP	20 ppb See Attachment	Lab. Dup. RPD. 20% Field. Dup. RPD. 35%[1]	MS/MSD % Recovery 50-150%	90%
TOC	OEME TOC190.SOP	0.5-160 ul/C	Field. Dup. RPD. 35%[1]	na	90%
AVS/SEM(Cu,Zn Pb,Cd,Cr,Hg,Ni)	See Foot note 4	1 uM	Lab. Dup. RPD. 20%	MS/MSD %Recovery ±25%	90%
Toxicity	Attachment A	n/a	n/a	n/a	90%
Grain size	Modifed ASTM D422	n/a	n/a	n/a	90%

Notes:
[1] For Homogenous Field Duplicate.
[2] Within CLP Limits (OLMO3.1) See OLMOS.1 for specific compounds.
[3] Reporting limit will vary based on % dry weight.
[4] Determination of Acid-Volatile Sulfide and Simultaneously-Extracted metals in sediment using Sulfide-Specific Electrode Detection. (Region I SOP SEM/AVS, Jan. 1997)

Metals reporting limits based on 1 gram sample dry weight/100 ml of final volume.

ADDITIONAL INFORMATION

9.0 Schedule of Task and Products

1)Collect water and sediment samples 4/1/98

2)Complete all chemical analysis and toxicity testing 4/30/98

3)Complete all analytical and toxicity reports 5/31/98

4)Meet with MADEP to discuss data 6/30/98

10.0 Field Safety

All field samplers will be approved by their immediate supervisors to perform field work. The supervisors are responsible for assuring the field samplers are trained (OSHA 1910-120) in safety issues regarding field work.

All boat operation and safety protocol will adhere to EPA Environmental Studies Section, Standard Operating and Safety procedures.

11.0 Data Quality Requirements and Assessments

Precision and Accuracy:

The precision and accuracy of the data is to be within ranges associated with the specific approved protocols. See Tables 4 and 5 for QC goals and reporting limits. For the sediment toxicity test to be acceptable, survival at 10 day must equal or exceed 80% for *H. azteca* and 70% for *C. tentans* in the laboratory formulated sediment (negative control). Refer to parameter methods and standard operating procedures for more information.

Data Representativeness:

Samples must be representative of conditions existing at the time of sample collection. Standardized procedures will be used at all times in an effort to insure representativeness of conditions preent at the site. Samples must be preserved immediately according to protocol in Tables 2 and 4. The metals rinseate blank will be preserved with nitric acid at

the time of collection. Field and laboratory conditions which may affect sample integrity are to be documented on the field collection forms or laboratory logs.

Data Comparability and Completeness:

Data must be comparable for all samples within each media, i.e. all analyzed with the same detection limits and method for each parameter. Again, standardized procedures will be used at all times in an effort to insure representativeness of conditions present at the site which allows for a higher level of comparability . Data will be compared with existing databases and water quality criteria. Analytical methods will be those cited in the parameter tables. At least 90% of the data must be determined to be valid/useable for the project to be considered complete. This will be determined by comparing the ratio of the total number of valid/useable samples to the total number of samples analyzed and multiplying by 100 to convert to a percentage value.

Data Validation and Useability:

All analytical results will be reviewed and the QC requirements evaluated by the primary analyst and a second laboratory QC chemist before they are released. Data reports will then be evaluated by the EPA/PM for use in obtaining project objectives.

Corrective Action

When it is found that data is incomplete or that results are unacceptable, the Project Officer may determine that one or more of the following procedures for corrective action shall be undertaken:

1. Incomplete data: Omissions from logs, notebooks and worksheets place the entire analysis in question. If data does not meet the 90% data completeness requirement, a meeting will be held with the analyst and QA officer to determine an appropriate response. Incomplete field sampling data may require resampling of the questionable location. Incomplete laboratory data usually calls for reintroduction or reanalysis of the questionable sample if feasible.

2. Conflicting or poor quality data: When results from duplicates, spikes, blanks, etc. do not meet the described QC goals, the available data will be reviewed by the project officer and QA officer. Upon examination, all or some of the following actions may be applied:

    a. Systems audit for analyte in question.
    b. Determination of matrix interference.
    c. Re-sampling of the questionable sample.

d. Reconsideration of acceptable limits with statements explaining the results of the action/rationale taken.
e. Rejection of data and exclusion from the report with written explanation.
f. Rejection of the entire sample/site location with recommendation of relocation of sample site or reconsideration of results.

12.0 Final Report

The final report will include all analytical results and water/sediment quality evaluations. The report will be sent to the MADEP for future decision making. A meeting will be scheduled after the final report is released to discuss the results and future monitoring or management activities.

ATTACHMENT A

STATIC BULK SEDIMENT TOXICITY TESTING PROCEDURES

Biology Section

New England Regional Laboratory

SOP number: 2.7
Revision number: 1
March 9, 1998

Filename:G:\allshare\bio-sops\busedtes.sop

1.0 Purpose of Method

This procedure is used to evaluate the toxicity of freshwater bulk sediments to the benthic community. A two species test is prescribed due to species sensitivity differences.

2.0 Summary of Method

Two species of benthic macroinvertebrates are exposed to sediments for a 10 day period. Sediment and overlying water are placed in each of 8 replicates/sample/species and allowed to settle overnight. The following day, after water renewal, test organisms are introduced to each test vessel. Test chemistry is performed on the overlying water on a daily basis for the duration of the test. The test is ended, determining the number of surviving organisms. Subsequent to test termination, survival and growth endpoints are examined statistically. Procedures follow those described in the EPA document,Methods For Measuring The Toxicity and Bioaccumulation of Sediment-associated contaminants with Freshwater Invertebrates, EPA/600/R-94/024, June 1994.

3.0 Apparatus/Materials

a. 300 ml lipless test vessels

b. turbulence reducers

c. aluminum pans

d. drying oven

e. muffle oven

f. analytical balance

g. pH/specific ion electrode meter, DO meter and conductivity meter

h. ammonia probe

i. pH probe

j. DO probe

k. environmental chamber

l. precleaned nalgene trays

3.0 Apparatus/Materials (cont'd)

m. precleaned spatulas

n. crystallizing dishes

o. 6.0 ml disposable transfer pipets

p. forceps

q. light table

r. # 35 sieves

s. *Hyallela azteca*, 3rd and 4th instar (<7 days old): 2-3 mm in length

t. *Chironomus tentans*, 2nd and 3rd instar larvae, 50% of which are 2nd instar

4.0 Reagents

a. laboratory control sediment (see artificial sediment SOP)

b. deionized (DI) water

c. pH buffers

d. conductivity standards

e. ammonium chloride standard

f. 0.02N H_2SO^4

g. calmagite

h. 10N NaOH

i. 0.01M EDTA

5.0 Procedure

5.1 SEDIMENT STORAGE

a. Solid-phase sediment will be stored at 4^0C in air-tight containers in the dark. All samples must be accompanied with proper identification and sample tracking information. Storage of sediments will be for no longer than 2 weeks prior to testing.

5.2 ENVIRONMENTAL CONTROLS WHILE TESTING

See the EPA method referenced for the specified environmental controls.

5.3 SAMPLE PREPARATION and DISTRIBUTION

a. The day before the toxicity test starts (Day -1), sediments are poured from the 2 liter Nalgene (or equivalent) containers and homogenized to a uniform distribution, in a large precleaned Nalgene tray, making sure that complete mixing is achieved. Excess sediments will be returned to the sample containers and held in the biology refrigerator until testing is complete.

b. One hundred ml. of each test sediment, reference sediment, and laboratory control sediment is added to each of 8 replicates per species. The sediment in each test vessel should be smoothed using a spoon or spatula. Next, carefully add 175 ml of overlying water to each vessel. The sediments are then allowed to settle for 12-24 hours. Water quality parameters should be measured prior to the addition of the test organisms.

5.4 ORGANISM INTRODUCTION

a. Test organisms are randomly selected from the test population for inoculation into the test. Each replicate will receive 10 organisms. No more than 5 individuals should be placed in a vessel during a complete pass of all sample replicates.

With a 6 ml. disposable transfer pipet, test organisms are very carefully transferred from the test population into the test vessel, being sure to release the organisms below the surface of the overlying water.

Note: If the test overlying water hardness is 1/2 or less than the culture water, then acclimating with a 1:1 dilution of the test population with overlying water on a 2 hour schedule until the overlying water is approximated is required.

Note: Inspect the test chambers <2 hours after introduction to insure that organisms are not

trapped in the surface tension of the water. If floaters are detected, replace with new organisms.

5.5 TEST CHEMISTRY (See test chemistry SOP for details)

a. Test chemistry will be performed on a daily basis and results will be recorded in the test chemistry log book.

1) Initial test chemistry is performed on an overlying water composite from each sample prior to the introduction of test organisms. Chemical analyses will consist of the determination of pH, temperature, conductivity, dissolved oxygen(DO), hardness, alkalinity and ammonia.

2) Daily test chemistry consisting of a DO, temperature and conductivity measurement of overlying water will take place in the morning after renewal.

3) Final test chemistry will be done on a composite of replicates for each sample per species. Parameters tested will be identical to initial parameters.

Note: In order to accurately measure chemical parameters under test conditions, beakers of water to be tested should be kept in the environmental chamber until ready to perform the analyses.

Note: If the DO concentration on any sample falls below 40% of saturation, that species specific set of replicates must be aerated.

5.6 FEEDING

a. Feeding of each replicate is performed daily following the morning renewal.

1) *C. tentans* is fed 1.0 ml of Tetramin of a 20 g/L suspension daily. *Feeding for all replicates is suspended for a day or more if fungus appears on sediment.*

2) *H. azteca* is fed 1.5 ml of YAT daily. *Feeding for all replicates is suspended for a day or more if fungus appears on sediment.*

5.7 RENEWAL

a. A 50% renewal using turbulence reducers to minimize resuspension is performed in the early morning and late afternoon. Renewal water is transferred from the drum in the Wet Lab to the environmental chamber between renewal so that the water will be at the test temperature.

5.8 TERMINATING SEDIMENT TESTS

a. Removal of sediment from the test chambers will be handled with the same protective garb used in setting up the test.

b. There are various techniques that can be used for retrieval of test organisms. *H. azteca* are counted. *C. tentans* are counted and then are rinsed clean and placed on muffled, preweighted, and numbered aluminum pans. The replicate #, species, sample ID and number of organisms recovered are documented on tally sheets. The retrieval process should take place in a white plastic tray on a light table for increased visibility. Approximately 50% of the overlying water is poured into a white translucent tray on the light table. All organisms detected are counted and, in the case of C. tentans, placed on aluminum trays. Next, since the majority of organisms dwell in the upper few millimeters of sediment, the beakers can be swirled to lift this layer into water column and then poured into the sieve or translucent tray placed on a light table. Again organisms are retrieved as prescribed. This suspension process is repeated, adding additional water to the beaker if necessary, with a thin layer at a time being poured into the tray.

c. Once all organisms are retrieved or the test vessel finished, and the total number of organisms tallied, the label can be removed, the vessel is rinsed, with the rinsate being poured into a waste bucket, and the vessel is placed on the wash table in the Wet Lab.

d. All tally sheets are to be copied and the copies stapled into the specific project section of the sample project log book.

5.9 ENDPOINTS and OBSERVATIONS

Endpoints for this test are survival (both species) and growth (*C. tentans*) as ash free weight. Make notes of behavioral changes during the conduct of the test i.e. floating on surface, sediment avoidance.

6.0 Safety

a. All workers involved with handling and testing contaminated sediment must undergo health monitoring annually.

b. Hands should always be kept away from the eyes and mouth ie. no fingernail biting. After removing gloves, and possibly contaminated lab clothing, dispose of it in a trash bag marked non-hazardous, and wash hands with soap.

c. Lab coats must be worn at all times when working with sediments. Tyvec may be worn during sediment manipulation and mixing. The sediment may be checked with an HNU to

determine if respirator use is necessary. Gloves must be worn to avoid skin contamination. Latex, rubber and vinyl gloves however may not provide full protection. Wear latex liners with nitrile or other protective glove if necessary. Safety glasses must be worn during the manipulation of sediments. If mixing is messy, face shields may be worn.

d. Mixing of sediment will occur under a hood if the potential for generating toxic aerosols, fumes or dusts exist.

7.0 Waste

a. Overlying water waste can be placed in the "dirty tank" unless suspected of being toxic or otherwise hazardous. If suspected of being hazardous, the overlying water waste should be isolated in a properly labeled drum and the EIA. and chemistry groups contacted to schedule sampling of the drum and analyses. When the analytical data is made available, it is to be forwarded to the H&S officer for review and ultimate disposal.

b. Sediment waste should be collected in labeled drums put into the Wet Lab next to the "dirty tank" and the biology lab manager contacted when sed waste is available for disposal.

c. Chemical waste from test activities is disposed of as per the test chem SOP (testchem.sop)

8.0 QA/QC

a. An artificial sediment is prepared and used as a laboratory control for each species during each test. The material used are of high quality. Test acceptability criteria for survival of each species must be met on exposure to this control or the test may be invalidated.

b. Facility QC is documented through the monitoring and recording of temperature in the environmental chamber.

c. Organisms provided by this laboratory undergo water column only reference toxicant testing for each tank of cultures to document the quality of the test organisms. Organisms from outside laboratories have documentation of QC testing available upon request.

d. Test chemistry is performed on overlying waste water on a daily basis. Based on the results, response would include, aeration of all beakers associated with the specific sample and species or for problems indicated by the development of fungi, food would be reduced or eliminated.

e. Calibration of instrumentation used during the test is peformed and documented. If

problems are identified they are corrected prior to test measurement being performed or so noted if inpossible to correct.

ATTACHMENT B:
YSI 6000 CALIBRATION PROCEDURES

Standard Operating Procedure 5/23/96

For: YSI 6000 Sonde with Omnidata Polycorder

Calibration and Measurements of: Dissolved Oxygen, pH, Temperature, Conductivity, Depth.

CALIBRATION

Dissolved Oxygen

1. Inspect D.O. probe for air bubbles, or damaged membrane. If air bubbles or damage, repair according to manufacturer suggestions.

2. Insert Sonde in calibration cup with wet sponge, and wait 15 minutes to assure equilibration with water saturated air is complete. Place the probe with the cup attached into water that is approximately at the temperature of the water to be sampled.

3. Attach Sonde to Omnidata Polycorder. Turn on the Polycorder and enter PC6000 software. (Type "CD PC6000" <enter>, and "PC6000" <enter>)

4. Position the cursor and enter "SONDE"

   * If an error or a not communicating message appears, check the cable connections, check batteries (dead or inserted incorrectly), make sure all battery and cable connections are dry, and finally type "setup" at the C:> and make sure Serial Ports are set "ON".

5. At the Main Menu, type "1" 3 times to enter the Discrete Sampling Mode.

   Wait for the temperature to become stable and using the YSI D.O. (10-15 min). Return to main menu.

6. Select 2 Calibrate

7. Select D.O%

8. Enter the current Barometric Pressure in mm of Hg. (760 mmHg is Standard conditions).

9. Press enter after approx. 1 minute calibration will be complete (note calibration in DO% also results in calibration of DO mg/l).

YSI D.O. Solubility Table (to check calibration)

Temp. (°C)	Solubility mg/L	Temp. (°C)	Solubility mg/L
16.0	9.87	23.0	8.58
16.3	9.81	23.3	8.53
16.6	9.75	23.6	8.48
16.9	9.69	23.9	8.44
17.0	9.67	24.0	8.42
17.3	9.61	24.3	8.37
17.6	9.55	24.6	8.32
17.9	9.49	24.9	8.28
18.0	9.47	25.0	8.26
18.3	9.41	25.3	8.22
18.6	9.36	25.6	8.17
18.9	9.30	25.9	8.13
19.0	9.28	26.0	8.11
19.3	9.22	26.3	8.07
19.6	9.17	26.6	8.03
19.9	9.11	26.9	7.98
20.0	9.09	27.0	7.97
20.3	9.04	27.3	7.93
20.6	8.99	27.6	7.89
20.9	8.94	27.9	7.84
21.0	8.92	28.0	7.83
21.3	8.87	28.3	7.79
21.6	8.81	28.6	7.75
21.9	8.76	28.9	7.70
22.0	8.74	29.0	7.69
22.3	8.69	29.3	7.65
22.6	8.64	29.6	7.61
22.9	8.60	29.9	7.57

Alt.(ft.)	mmHg	Corr. Factor
0	760	1.00
278	752	0.99
558	745	0.98
841	737	0.97
1126	30	0.96

10. Press "0" 3 times to return to the Main Menu.

11. At the Main Menu, type "2" , (Calibration Menu)
    * The left side of the screen cannot be easily viewed. The screen can be moved left by pressing the RED KEY and the ARROWS. The menus are attached on the printed sheets.

12. Wait for "Calibration Accepted" message and press any key to continue.

13. Press "0" to the Main Menu and 2 for the Calibration Menu.

pH

1. At the Calibration Menu, type "6" (pH 2 Point)

2. Unscrew the hex nuts and remove the shield. Be very careful not to touch the D.O. membrane. Place the pH probe into a low ionic strength pH buffer of 6.97.

3. Press any key to begin calibration.

4. Wait for "Calibration ACCEPTED" message. If an "Out of Range" message appears, do not accept, and re-calibrate in the 6.97 buffer. If the error continues check the probe condition, accept the error and make note on the field forms.

5. Rinse probe with D.I. water and wipe dry with a paper towel.

6. Place the pH probe into a low ionic strength pH buffer of 4.10.

7. Press any key to "continue calibration"

8. When prompted, enter the pH of the second buffer.

9. Wait for "Calibration Accepted" message, and press any key to continue.

10. Press "0" 1 time to return to the Main Menu. At the Main Menu type "1" 3 times to enter into the Discrete Sampling Mode.

11. Make sure the probe is reading the second buffer correctly (± 0.05).

12. Rinse probe with D.I. water and dry.

13. Insert probe into pH 7 buffer and make sure it is reading correctly (± 0.05). If either of the buffer readings are not correct, repeat the calibration procedure. If the second calibration does not check correctly, make note on the field form.

* Write the meter reading on the field note form.

14. If the river sample has a pH greater than 7.0, recalibrate the meter using a second buffer of 10.00.

Conductivity

1. At the Calibration Menu, press 1, (Conductivity)

2. Place Sonde into a conductivity standard that is typical of the sample expected, (i.e., 718 umhos/cm (0.718mS/cm) for fresh water).

3. Enter the standard specific conductance in mS/cm (0.718).

4. Wait for "Calibration Accepted" message, and press any key to continue.

5. Return to the Main Menu by pressing "0".

6. Enter "1" 3 times to run and write the meter reading on the field note form.

7. Rinse probe with D.I. water after calibration is complete.

Depth

1. Depth calibration must be performed at the site with the Sonde in the air. This is only necessary at sites with expected depths greater than 2 meters.

2. At the Calibration Menu, press 4, (Depth)

3. Press any key to zero depth.

4. Wait for "Calibration Accepted" message, and press any key to continue.

5. Press "0" and <enter> to return to the previous menu, (Main Menu).

MEASUREMENTS

Measurement procedures below are for discrete sample measurements. If timed or conditional samples are to be measured, follow the procedures outlined in the YSI 6000 Operating and Service Manual.

1. At the Main Menu, press "1", (Run).

2. At the Run Menu, press "1", (Discrete).

3. At the Run Discrete-sample Menu, press "2", (Site description).

4. Enter the Site number. (see Team List for site #).

5. At the Run Discrete-sample Menu, press "1", (Start discrete sample).

6. Within 15 seconds measurements should be displayed on the screen.
   If measurements do not begin to appear on the screen, press "0" to return to the previous menu and re-enter "1" to begin discrete sampling.

7. Place the Sonde into the water to be analyzed, and watch the variations in temperature, D.O., pH and conductivity.

8. When the variations are less than: 0.1°C temperature
   0.02su pH
   0.02mg/l D.O.
   5 uS/cm conductivity
   Press "2" -to begin logging

   * Make note of the readings on the Field Note Form.

9. After approximately 15 readings, Press "2" -to end logging.

10. Press "0" to return to the Run Discrete-sample Menu.

11. Press "4" and <enter>, (Close file). Confirm with "y".
    If a "NO OPEN FILE" message appears, re-run the sampling and logging procedures.

12. Press "0" twice to return to the Main Menu.

13. Turn off Omnidata between sites to save batteries.

After all of the samples have been collected for the day, check the probe readings in the conductivity standard and the pH buffers.

1. Insert probe in pH buffer 6.97, press "1" 3 times from the Main Menu to enter into the discrete sample mode.

2. Make note on the final Field Note Form, the probe reading in this buffer (wait for readings to stabilize -2 minutes).

3. Rinse and dry probe. Insert in pH buffer 4.10 and wait for stable readings. Make note on the final Field Note Form.

4. Rinse and dry probe. Insert in the conductivity standard and wait for stable readings. Make note of true probe reading on the final Field Note Form.

5. Rinse probe and exit from sampling mode by pressing "0" 3 times. Turn off Polycorder.

ATTACHMENT C: REPORTING LIMITS FOR PAHS

US ENVIRONMENTAL PROTECTION AGENCY
REGION I LABORATORY
GC/MS EXTRACTABLE ORGANIC ANALYSIS

Reporting limits are based on 30 gram extracted and a 100% dry weight and no dilutions.

CAS NO.	STORET NO.	Compound	Reporting Limit (ug/Kg)
		Priority Pollutants	
83-32-9	34205	Acenaphthene	210
208-96-8	34200	Acenaphthylene	210
120-12-7	34220	Anthracene	210
309-00-2	39330	Aldrin	210
56-55-3	34526	Benzo(a)anthracene	210
205-99-2	34230	Benzo(b)fluoranthene	210
207-08-9	34242	Benzo(k)fluoranthene	210
50-32-8	34247	Benzo(a)pyrene	210
191-24-2	34521	Benzo(ghi)perylene	210
85-68-7	34292	Benzyl butyl phthalate	210
319-85-7	39338	beta-BHC	210
319-86-8	34259	delta-BHC	210
111-44-4	34273	Bis(2-chloroethyl)ether	210
111-91-1	34278	Bis(2-chloroethoxy)methane	210
117-81-7	39100	Bis(2-ethylhexyl)phthalate	210
108-60-1	34283	Bis(2-chloroisopropyl)ether	210
101-55-3	34636	4-Bromophenylphenyl ether	210
86-74-8		Carbazole	210
59-50-7	34452	4-Chloro-3-methylphenol	420
91-58-7	34581	2-Chloronaphthalene	210
95-57-8	34586	2-Chlorophenol	420
7005-72-3	34641	4-Chlorophenylphenyl ether	210
218-01-9	34320	Chrysene	210
72-54-8	39310	4,4'-DDD	210
72-55-9	39320	4,4'-DDE	210
50-29-3	39300	4,4'-DDT	210
53-70-3	34556	Dibenzo(a,h)anthracene	210

84-74-2	39110	Di-n-butylphthalate	210
541-73-1	34566	1,3-Dichlorobenzene	210
95-50-1	34536	1,2-Dichlorobenzene	210
106-46-7	34571	1,4-Dichlorobenzene	210
91-94-1	34631	3,3'-Dichlorobenzidine	210
120-83-2	34601	2,4-Dichlorophenol	420
60-57-1	39380	Dieldrin	210
84-66-2	34336	Diethylphthalate	210
105-67-9	34606	2-4-Dimethylphenol	420
131-11-3	34341	Dimethylphthalate	210
51-28-5	34616	2,4-Dinitrophenol	520
121-14-2	34611	2,4-Dinitrotoluene	210
606-20-2	34626	2,6-Dinitrotoluene	210
117-84-0	34596	Di-n-octylphthalate	210
206-44-0	34376	Fluoranthene	210
86-73-7	34381	Fluorene	210
76-44-8	39410	Heptachlor	210
1024-57-3	39420	Heptachlor epoxide	210
118-74-1	39700	Hexachlorobenzene	210
87-68-3	34391	Hexachlorobutadiene	210
77-47-4	34386	Hexachlorocyclopentadiene	210
67-72-1	34396	Hexachloroethane	210
193-39-5	34403	Indeno(1,2,3-cd)pyrene	210
78-59-1	34408	Isophorone	210
534-52-1	34657	2-Methyl-4,6-dinitrophenol	520
91-20-3	34696	Naphthalene	210
98-95-3	34447	Nitrobenzene	210
88-75-5	34591	2-Nitrophenol	420
100-02-7	34646	4-Nitrophenol	520
86-30-3	34433	N-Nitrosodiphenylamine	210
621-64-7	34428	N-Nitrosodi-n-propylamine	210
87-86-5	39032	Pentachlorophenol	520
85-01-8	34461	Phenanthrene	210
108-95-2	34694	Phenol	420
129-00-0	34469	Pyrene	210
120-82-1	34551	1,2,4-Trichlorobenzene	210
88-06-2	34621	2,4,6-Trichlorophenol	420

		Hazardous Substances	
65-53-3	77089	Aniline	210
65-85-0	77247	Benzoic Acid	520
100-51-6	77147	Benzyl Alcohol	210
106-47-8		4-Chloroaniline	210
132-64-9	81302	Dibenzofuran	210
91-57-6		2-Methylnaphthalene	210

95-48-7		2-Methylphenol	210
106-44-5		4-Methylphenol	210
88-74-4		2-Nitroaniline	520
99-09-2		3-Nitroaniline	520
100-01-6		4-Nitroaniline	520
95-95-4	34621	2,4,5-Trichlorophenol	520

ATTACHMENT D: REPORTING LIMITS FOR CHLORINATED PESTICIDES AND POLYCHLORINATED BIPHENYLS

CAS NO.	STORET NO.	Compound	Reporting Limit (ug/Kg)
309-00-2	39330	Aldrin	8E-01
319-84-6	39337	alpha-BHC	8E-01
319-85-7	39338	beta-BHC	8E-01
319-86-8	34259	delta-BHC	8E-01
58-89-9	39340	gamma-BHC	8E-01
5103-71-9	---	Alpha Chlordane	8E-01
5103-74-2	---	gamma Chlordane	8E-01
57-74-9	39350	Chlordane (technical)	8E+01
72-54-8	39310	4,4'-DDD	8E-01
72-55-9	39320	4,4'-DDE	8E-01
50-29-3	39300	4,4'-DDT	8E-01
60-57-1	39380	Dieldrin	8E-01
959-98-8	34361	Endosulfan I	8E-01
33212-65-9	34356	Endosulfan II	8E-01
1031-078	34351	Endosulfan sulfate	8E-01
72-20-8	39390	Endrin	8E-01
7421-93-4	34366	Endrin aldehyde	8E-01
53494-70-5	---	Endrin ketone	8E-01
76-44-8	39410	Heptachlor	8E-01
1024-57-3	39420	Heptachlor epoxide	8E-01
72-43-5	---	Methoxychlor	8E-01
8001-35-2	39400	Toxaphene	8E+01
12674-11-2	34671	Aroclor-1016	2E+01
11104-28-2	39488	Aroclor-1221	2E+01

11141-16-5	39492	Aroclor-1232	2E+01
53469-21-9	39496	Aroclor-1242	2E+01
12672-29-6	39500	Aroclor-1248	2E+01
11097-69-1	39504	Aroclor-1254	2E+01
11096-82-5	39508	Aroclor-1260	2E+01
11100-14-4	81649	Aroclor-1262	2E+01
37324-23-5	81650	Aroclor-1268	2E+01

ATTACHMENT E:
SEDIMENT SAMPLING PROCEDURES

Sediment Sample Collection Methods
Standard Operating Procedures

Biology Section

New England Regional Laboratory

SOP #:2.25
Revision #:1
Date: March 11, 2003
Filename
G:/allshare/bio.sops/sedsamp.sop

1.0 Purpose of Method

This procedure is developed to document protocols used with the collection of representative sediment samples. Sediment samples will be taken for the purposes of chemical and physical analyses and toxicity testing. Please note; a Quality Assurance Project Plan (QAPP) is necessary for sediment sampling projects.

2.0 Summary of Method

The method described below involves the taking of sediment samples. Sediment for the purpose of this SOP, is defined as one of a solid matrix made up of inorganic and/or organic components and is located underwater in either a lotic or lentic system. Samples are taken from the benthic substrate of either system by means of a coring or dredging technique. Depending on the purpose of sampling, as defined in a workplan, sediments are homogenized in a large precleaned holding container of sufficient volume to contain all replicates. If necessary, to minimize % moisture, the sample is allowed to settle for a short time and any free standing water is decanted off prior to homogenization. Volatiles are taken prior to homogenization . Acid volatile sulfide subsamples are taken immediately after homogenization. Using a precleaned scoop or spoon the homogenized sample is subsampled into the designated properly labeled sample containers. The containers are sealed with a chain of custody seal, put into a "ziploc" bag and placed in a cooler on ice.

3.0 Apparatus

a. sample containers - precleaned clear /amber glass or plastic bottles

b. coring tubes

c. hand corer

d. Phleger corer

e. dredges e.g. Ekman, Ponar

f. new 5 gallon plastic bucket (1 per sampling station)

g new plastic scoops,spoons or spatulas (1 per sampling station)

h. cleaning brush

i. chemical waste cubetainers

3.0 (cont'd)

j. 250 ml squirt bottles

k. waders

l. boat, motor, oars (if necessary)

m. rubber stoppers

n. GPS unit

o. COC seals

p. coolers

q. ice

r. COC sheets

s. waterproof writng utensils

t. "zip loc" bags

u. cellular phone

4.0 Reagents Required

a. Laboratory grade, non-phosphate detergent

b. Deionized water

c. 5% Nitric Acid (HNO_3) solution

d. Isopropanol

e. Baking soda (acid neutralizer)

f. boat motor fuel (if necessary)

5.0 Procedures

5.1 Cleaning procedures

a. Sampling containers for metals, extractable organics, pesticides, and PCB's are purchased precleaned. Sampling containers for extractable organics, PCBs and pesticides are to be amber colored glass. Metals sample containers may be either of HDPE or glass, but preferably HDPE for safety purposes.

b. Sampling containers for volatile organics are glass vials with a Teflon septum and are purchased precleaned.

c. Homogenizing containers are to be only new 5 gallon HDPE pails cleaned prior to use with non-phosphate soap and water followed by a tap and DI rinse.

c. All sampling equipment must be cleaned prior to use and in between sampling stations.

d. For chemical analysis, sampling equipment used to collect any combination of metals, extractable organics, volatile organics, pesticides, PCBs, TOC and toxicity testing must be cleaned according to the following procedure.

a. Wash with laboratory grade, non-phosphate detergent
b. Rinse 3 times with tap water
c. Rinse with 5% HNO_3 (only for sampling metals)
d. Rinse 3 times with deionized water

e. Isopropanol rinse (only for sampling organics)
f. Rinse 3 times with deionized water
g. Air dry in contaminant free area
e. sampling equipment for grain size analyses require only soap and water wash with a tap water rinse.

5.2 Volume Requirement

a. Refer to the appropriate section of the tables based on the test being performed.

TABLE 1 - SAMPLING CONTAINERS, PRESERVATIVES AND HOLDING TIMES

PARAMETER	MATRIX	CONTAINER[1]	PRESERVATIVE	HOLDING TIME[2]
MERCURY	SED	8 OZ. (P,G)[3] (1/2 full)	ICE TO 4^{O}C ($\pm$2^{O}C)	28 DAYS
ALL OTHER METALS	SED	8 OZ. (P,G) (1/2 full)	ICE TO 4^{O}C ($\pm$2^{O}C)	180 DAYS
CYANIDE	SED	8 OZ. (P,G)	ICE TO 4^{O}C ($\pm$2^{O}C)	14 DAYS
VOA	SED	2 X 40 ML VOA VIALS	ICE TO 4^{O}C ($\pm$2^{O}C)	14 DAYS
TOC	SED	1 40 ML VOA VIAL	ICE TO 4^{O}C ($\pm$2^{O}C)	28 DAYS
GRAIN SIZE	SED	8 OZ (P,G)	NA	NA
AVS/SEM	SED	20 ml vial	ICE TO 4^{O}C ($\pm$2^{O}C)	7days
TOX TESTING	SED	1 GAL[4] (PLASTIC)	ICE TO 4^{O}C ($\pm$2^{O}C)	14 DAYS
EXTRACTABLES	SED	8 OZ. (GLASS)	ICE TO 4^{O}C ($\pm$2^{O}C)	14 DAYS
PESTICIDE/ PCBS	SED	8 OZ. (GLASS)	ICE TO 4^{O}C ($\pm$2^{O}C)	14 DAYS

NOTES:
1. SAMPLE CONTAINERS MUST BE FILLED COMPLETELY, UNLESS SPECIFIED OTHERWISE
2. HOLDING TIMES ARE MEASURED FROM THE TIME OF SAMPLE COLLECTION.
3. P,G = PLASTIC OR GLASS
4. 2 SPECIES TEST

5.3 Sediment sampling procedure

a. Vertical sediment sampling depths should be based on the projects data quality objective

which are described in the QAPP. Typically, the Ponar and Ekman dredges will collect sediments from the first 6 inches of sediment. However, this will very greatly based on technique and sediment characteristics. A corer can be used to collect sediments of greater depths. A dredge or a corer should always be used when collecting sediments.

b. When collecting samples for worst case scenarios an attempt should be made to collect from areas that have depositional sediment with silty organic substrate. Notation should be made of the actual extent of depositional areas in relation to the substrate as a whole.

c. When collecting sediment at a site, the location where the dredge or corer is dropped should be moved slightly each time in order to avoid collecting in a pocket where sediment has already been removed.

d. Prior to sampling, samplers should become familiar with the operation of the particular sampling device and proper technique. For example, a Ponar dredge is set for sampling by opening the jaws and inserting the spring loaded pin completely through both holes in the scissor bracket located above the jaws. The Ponar is then lower below the surface of the water and allowed to drop. Once the Ponar is on the bottom the rope is quickly "jerked" to release and close the jaws. Once at the surface, the water is allowed to drain from the dredge. If coring is required it can be done by hand if water depth allows. The core is driven into the sediment either manually or attached to a corer and then slowly retrieved. When the bottom of the corer is still below the surface, and as soon as it can be reached, a rubber stopper is plugged into the bottom of the core tube. The core is brought to the surface overlying water in decanted off and the specified depth of sediment is taken for subsampling.

e. Every attempt should be made to reduce the water content in the sample by pouring off overlying water before homogenizing the sample. This should be done by letting the sample settle then slowly and carefully decanting preventing loss of fine particle. A goal of at least 30% solids should be attempted.

5.4 Homogenization and subsampling for analyses

a. When metals, extractable organics, pesticides, TOC, grain size, PCBs, AVS/SEM and toxicity testing are requested, homogenize the sample in a new pre cleaned 5 gallon plastic pail with a disposable plastic spatula or spoon or cleaned according to procedure 5.1.d. Samples are transferred to the appropriate container using new or precleaned plastic spatulas or spoons.

b. AVS/SEM samples should be collected immediately after samples have been taken and homogenized. Containers should be filled with no head space.

c. VOA samples should be taken immediately prior to homogenized filled completely with no

head space.

6.0 Safety

a. Extreme care should be taken when handling any chemicals. Proper PPE should be worn. Follow OEME's procedure for acid washing and the Health and Safety Plan (HASP) for the project .

b. When using a boat, refer to OEME's boat operation SOP and follow the HASP for the project.

c. Be extremely careful when handling and transporting dredges. Always place the storage pin in the dredge when they are not being used. Keep hands away from jaws or scissor bracket.

d. Always wear proper equipment for the job including waders, PFDs, etc.

e. When sampling around water be aware of unsafe conditions caused by water depth and speed or slippery substrates.

f. Take adequate precautions when sampling in extreme weather. Always wear and bring enough clothing and be aware of water temperatures and hypothermia potential.

7.0 Waste Disposal

a. All isopropanol and acid rinsate from the decontamination procedures is collected in separate labeled waste containers and disposed of according to proper OEME waste disposal procedures .

b. Soap and water rinsate may be disposed of on site by pouring it onto the soil surface at a reasonable distance from any water body.

8.0 Quality Assurance and Quality Control

a. Follow all procedures in this SOP and the project specific QAPP.

b. Consult with the Quality Control officer or designee before deviating from any procedures.

c. Pay particular attention to the need for rinsate blanks, field duplicates and extra sample volumes for duplicate and spike analyses.

ATTACHMENT F:

Rev #3
8/29/96

Standard Operating Procedure

Trimble Navigation GeoExplorer GPS Receiver

On Site

Hold the receiver at eye level with the antennae part horizontal.

Turn the unit on by pressing bottom black button at the bottom of the keypad once.

Go to “3. GPS Status”, then select “1. Sat Tracking”.

When 4 Satellites are being received, press “ESC,ESC” to the Main Menu

From the “Main Menu”, press go to “1. Data Capture” hit yellow diamond key in middle, when Data Capture is flashing.

Press "1. Open Rov. File" once.

Record file name on field sheet.

File name will be created automatically, you can not change file name.

If the number next to "Pts." does not increase, check SV's by pressing “ ESC,ESC” to main menu and going into “2. Position”

Make sure 4 SV's are being tracked.
If not signals may be blocked.
Try moving to a different area, there may be tree canopy or buildings blocking the signals.

After 85 Pts. are logged Press “3. Close File”,”yes”.

ESC to Main Menu and go to 2. Position, record position on field sheet.

To turn unit off, Hold down bottom black button for 5 seconds to turn off.

(after the file has been closed)