Water Quality Analyses of Copper, Lead, Selenium, and Zinc in Zekiah Swamp, Prince George's and Charles Counties, Maryland

FINAL

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List of Abbreviations

ANOVA	Analysis of Variance
COMAR	Code of Maryland Regulations
Cu	Copper
CWA	Clean Water Act
DNR	Maryland Department of Natural Resources
EPA	Environmental Protection Agency
HAC	Hardness Adjusted Criteria
MDE	Maryland Department of the Environment
MDP	Maryland Department of Planning
mg/l	Milligrams per Liter
NPDES	National Pollution Discharge Elimination System
NRCS	Natural Resources Conservation Service
Pb	Lead
ppt	Parts per Thousand
Se	Selenium
SHA	State Highway Administration
TMDL	Total Maximum Daily Load
UMCES	University of Maryland Center for Environmental Science
µg/l	Micrograms per Liter
WQA	Water Quality Analysis
WQLS	Water Quality Limited Segment
Zn	Zinc

EXECUTIVE SUMMARY

Section 303(d) of the federal Clean Water Act (CWA) and the U.S. Environmental Protection Agency's (EPA) implementing regulations direct each state to identify and list waters, known as water quality limited segments (WQLSs), in which current required controls of a specified substance are inadequate to achieve water quality standards. This list of impaired waters is commonly referred to as the "303(d) list". For each WQLS, the State is to either establish a Total Maximum Daily Load (TMDL) for the specified substance that the waterbody can receive without violating water quality standards, or demonstrate that water quality standards are being met.

Zekiah Swamp (basin code 02-14-01-08), located in Charles County and southern Prince George's County, MD, was identified on the State's list of WQLSs as impaired by nutrients (1996 listing), suspended sediments (1996 listing), copper (Cu) (1996 listing), lead (Pb) (1996 listing), selenium (Se) (1996 listing), zinc (Zn) (1996 listing), and impacts to biological communities (2002/2004 listing). All impairments were listed for the tidal waters except for impacts to biological communities and nutrients, which are listed as non-tidal impairments. Code of Maryland Regulations (COMAR) 26.08.02.03-1(B)(3)(m)(ii) defines tributaries to the Potomac River upstream of St. Catherine's Island, which includes Zekiah Swamp, as freshwater. The listing for Cu, Pb, Se, and Zn is based on a water quality assessment found in the 1996 305(b) report developed by the Maryland Department of Natural Resources (DNR).

This report provides analyses of recent monitoring data, which shows that the aquatic life criteria and designated uses associated with Cu, Pb, Se, and Zn are being met in Zekiah Swamp, and that the 303(d) impairment listings for Cu, Pb, Se, and Zn are not supported by the analyses contained herein. The analyses support the conclusion that TMDLs for Cu, Pb, Se, and Zn are not necessary to achieve water quality standards. Barring the receipt of contradictory data, this report will be used to support a Cu, Pb, Se, and Zn listing change for the Zekiah Swamp from Category 5 ("waterbodies impaired by one or more pollutants requiring a TMDL") to Category 2 ("Surface waters that are meeting some standards and have insufficient information to determine attainment of other standards"), when the Maryland Department of the Environment (MDE) proposes the revision of Maryland's 303(d) list for public review in the future. The listings for nutrients, suspended sediments, and impacts to biological communities will be addressed separately at a future date.

Although the waters of the Zekiah Swamp watershed do not display signs of toxic impairments due to Cu, Pb, Se, and Zn, the State reserves the right to require additional pollution controls in Zekiah Swamp if evidence suggests that these metals are contributing to downstream water quality problems.

1.0 INTRODUCTION

Section 303(d) of the federal Clean Water Act (CWA) and U.S. Environmental Protection Agency (EPA)'s implementing regulations direct each State to identify and list waters, known as water quality limited segments (WQLSs), in which current required controls of a specified substance are inadequate to achieve water quality standards. This list of impaired waters is commonly referred to as the "303(d) list". For each WQLS, the State is to either establish a Total Maximum Daily Load (TMDL) for the specified substance that the waterbody can receive without violating water quality standards, or demonstrate that water quality standards are being met.

A segment identified as a WQLS may not require the development and implementation of a TMDL if current information contradicts the previous finding of impairment. The most common factual scenarios obviating the need for a TMDL are as follows: 1) more recent data indicating that the impairment no longer exists (i.e., water quality criteria are being met); 2) more recent and updated water quality modeling demonstrates that the segment is now attaining criteria; 3) refinements to water quality criteria, or the interpretation of those standards, which result in standards being met; or 4) correction to errors made in the initial listing.

Zekiah Swamp (basin code 02-14-01-08) was identified on the State's 1996 303(d) list as impaired by nutrients (1996 listing), suspended sediments (1996 listing), copper (Cu) (1996 listing), lead (Pb) (1996 listing), selenium (Se) (1996 listing), zinc (Zn) (1996 listing) and impacts to biological communities (2002/2004 listing). All impairments were listed for the tidal waters except for the impacts to biological communities and nutrients, which were listed for the non-tidal waters. The Code of Maryland Regulations (COMAR, Ch. 26.08.02.03-1(B)(3)(m)(ii)) defines tributaries of the Potomac River upstream of St. Catherine's Island, which includes Zekiah Swamp, as freshwater. The listings for Cu, Pb, Se, and Zn were based on a water quality assessment found in the 1996 305(b) report developed by the Maryland Department of Natural Resources (DNR). The informational basis for this assessment was the Maryland Department of the Environment (MDE) 1988 304(l) list, which states that concentrations of Cu, Pb, Se, and Zn in the Zekiah Swamp exceeded the EPA chronic aquatic life criteria. This report considers recent data to establish if an impairment currently exists.

The Water Quality Analyses (WQAs) of Cu, Pb, Se, and Zn for the Zekiah Swamp was conducted by MDE using recent water column chemistry data and sediment toxicity data to determine if an impairment currently exists. The listings for suspended sediments, nutrients, and impacts to biological communities will be addressed separately at a future date.

The remainder of this report lays out the general setting of the waterbody within the Zekiah Swamp watershed, presents a discussion of the water quality characterization process, and provides conclusions with regard to the characterization.

2.0 GENERAL SETTING

The Zekiah Swamp watershed is located in the central Maryland region of the Potomac River tidal estuary. It is located in a small portion of southern Prince George's County and Charles County. The watershed drains south from southern Prince George's County in Zekiah Swamp Run until it discharges into the Wicomico River at Allens Fresh. The Zekiah Swamp is non-tidal except for the southern-most portion of the watershed near the discharge to the tidal Wicomico River.

The Zekiah Swamp watershed is located entirely in the Coastal Plains province. The topography is characterized as nearly level to moderately sloped. The soils are generally characterized as moderately drained, loamy soils, with a clayey sub-soil (Natural Resources Conservation Service (NRCS), 1974).

The land use in the Zekiah Swamp is mostly undeveloped (Figure 2), consisting mainly of forestland and crops. The only major community is the town of La Plata, MD. The watershed has an area of approximately 69,834 acres or 109 square miles. The land uses in the watershed consist of forest (40,822 acres or 58.5%), residential (10,410 acres or 14.9%), commercial (3,434 acres or 4.9%), crops (13,758 acres or 19.7%), and pasture lands (1,409 acres or 2.0%). These land uses are based on 2002 Maryland Department of Planning (MDP) land use/land cover data.

The Mirant-Faulkner fly ash management site, a facility that stores fly ash from Mirant's Morgantown, MD power plant, is located in the Zekiah Swamp watershed near Bowling Creek (Figure 3). The facility is permitted to discharge Cu, Pb, and Se into Bowling Creek under the National Pollution Discharge Elimination System (NPDES) permit number MD0056928. No additional industrial or municipal facilities are permitted to discharge metals in the Zekiah Swamp watershed.

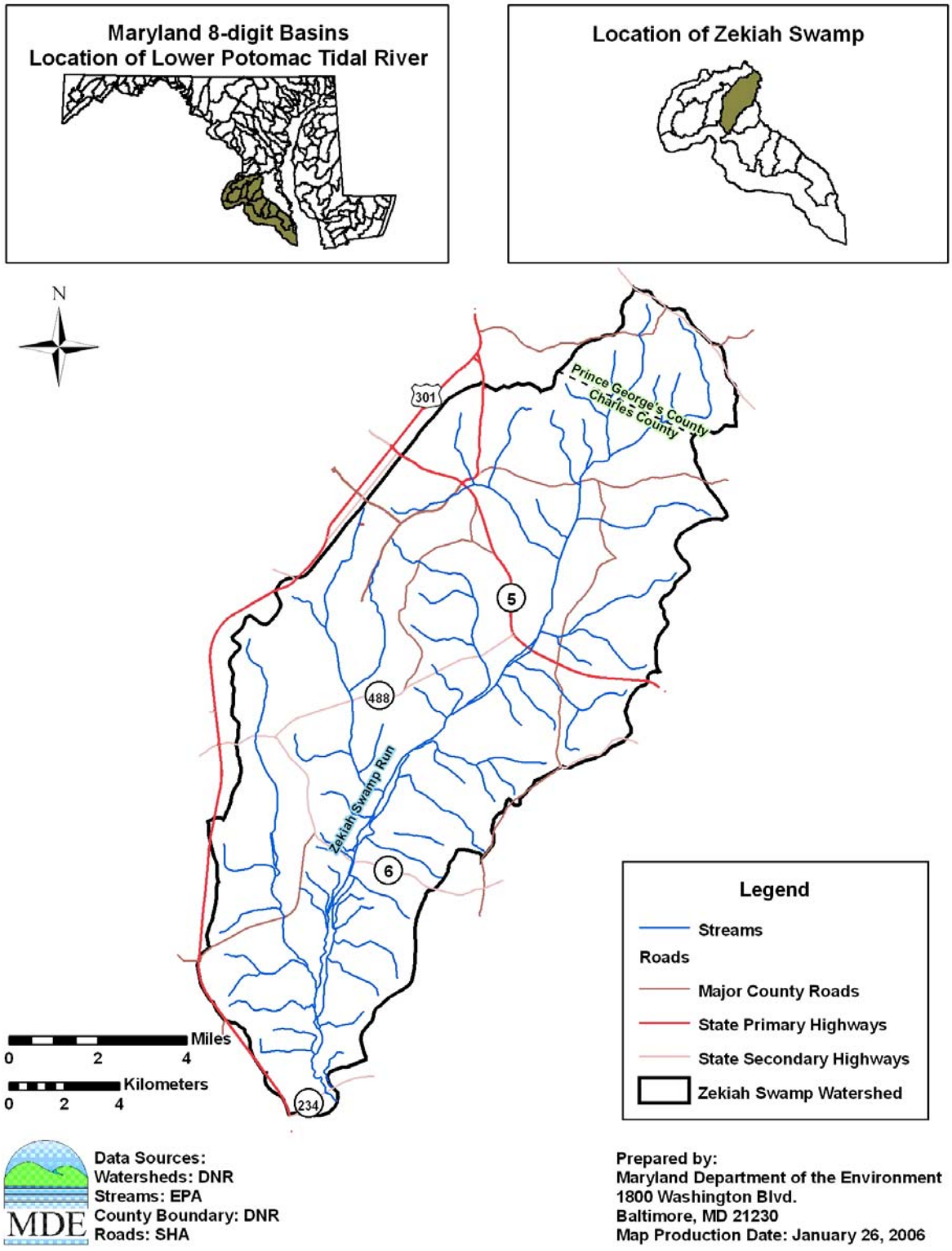

Figure 1: Location Map of the Zekiah Swamp Drainage Basin

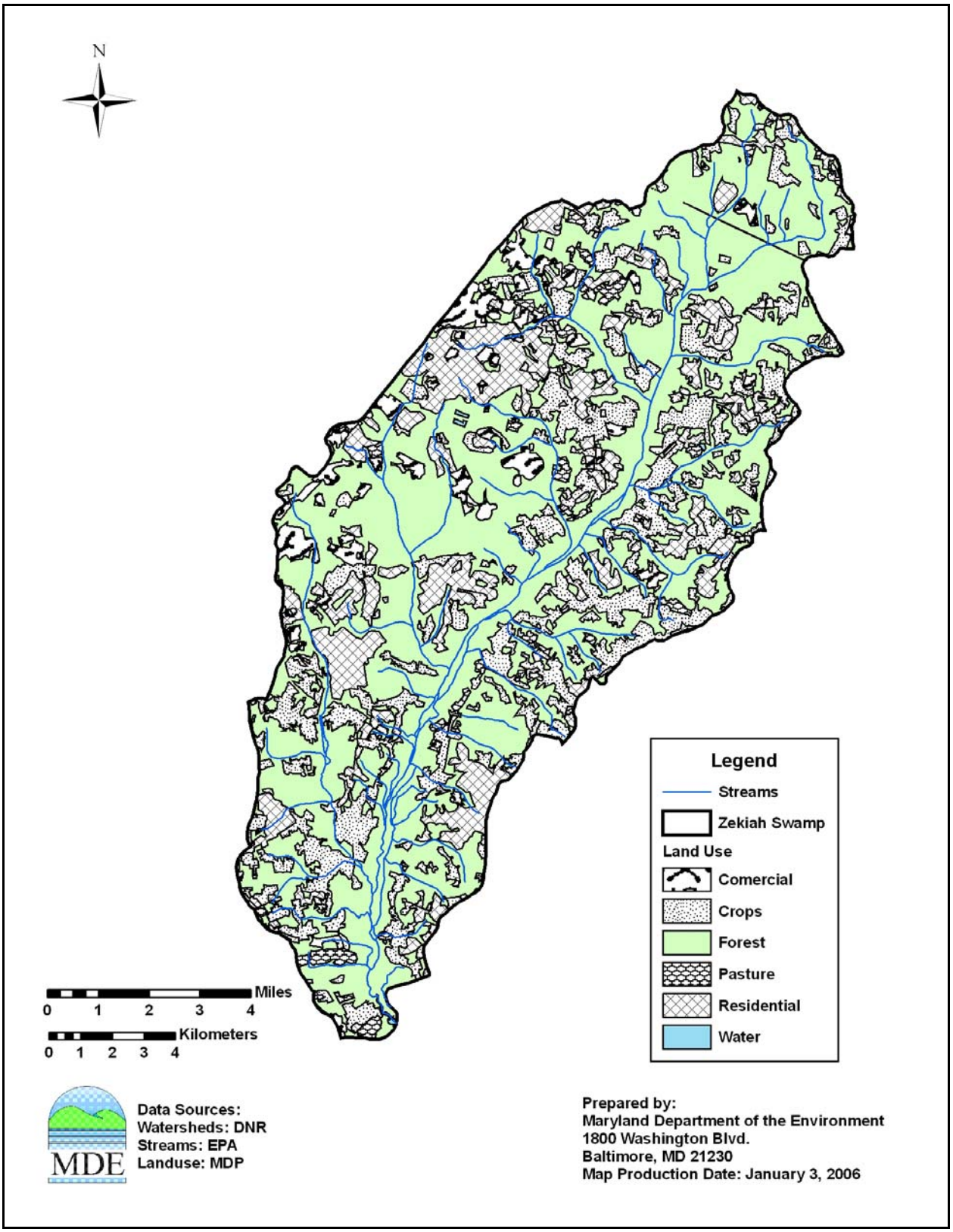

Figure 2: Land Use Map of the Zekiah Swamp Drainage Basin

3.0 WATER QUALITY CHARACTERIZATION

A water quality standard is the combination of a designated use for a particular body of water and the water quality criteria designed to protect that use. Designated uses include support of aquatic life, primary or secondary contact recreation, drinking water supply, and shellfish propagation and harvest. Water quality criteria consist of narrative statements and numeric values designed to protect the designated uses. The criteria developed to protect different designated uses may differ and are dependent on the specific designated use(s) of a waterbody. Maryland's water quality standards presently include numeric criteria for metals and other toxic substances based on the need to protect aquatic life, wildlife and human health. Water quality standards for toxic substances also address sediment quality to ensure the bottom sediment of a waterbody is capable of supporting aquatic life, thus protecting the designated uses.

The Maryland Surface Water Use Designation (COMAR 26.08.02.08N(2)(a)) for the Zekiah Swamp is Use II – *Support of Estuarine and Marine Aquatic Life and Shellfish Harvesting*. In addition, COMAR 26.08.02.07A requires that all waterbodies in the state of Maryland support a Use I designation - *Water Contact Recreation, and Protection of Nontidal Warmwater Aquatic Life.* COMAR 26.08.02.03-1(B)(3)(m)(ii) defines the tidal waters of the Zekiah Swamp watershed, considered in these WQAs, as freshwater. Additionally, salinity concentrations for the Zekiah Swamp are below 1ppt; thus, it is a freshwater body and freshwater criteria may be applied. The freshwater aquatic life and human health criteria for Cu, Pb, Se, and Zn are displayed below in Table 1 (COMAR 26.08.02.03-2G(1)).

Table 1: Numeric Water Quality Criteria

Metal	Fresh Water Aquatic Life Acute (µg/l)*	Fresh Water Aquatic Life Chronic (µg/l)*	Human Health Criteria (Water + Organism) (µg/l) (10-5 risk level)
Se	20	5	170
Zn	120	120	7400
Pb	65	2.5	-
Cu	13	9	1300

*Criteria based on default hardness of 100 mg/L

Water column surveys, used to support these WQAs, were conducted by the University of Maryland Center for Environmental Science (UMCES) in the tidal Potomac River and select tributaries. One station from this survey is located in the Zekiah Swamp tidal watershed, and was sampled in April 2005. MDE conducted an additional survey at six stations throughout the Zekiah Swamp. Two samples were collected at each station on August 23, 2005 and August 30, 2005 under dry and storm event conditions, respectively. Sediment bulk samples were collected at one station, Allens Fresh. The sediment sample was analyzed for toxicity using a standard

EPA freshwater 10-day amphipod test. Table 2 shows the list of stations with their geographical coordinates (See Figure 3 for station locations).

Table 2: Sample Stations for Zekiah Swamp

Station	Latitude	Longitude	Station Description
Allens Fresh	38.42	-76.95	Allens Fresh Run below Route 234 Bridge
ZEK-1	38.41	-76.93	Allens Fresh Run at outlet of watershed
ZEK-2	38.43	-76.94	Zekiah Swamp Run
ZEK-3	38.43	-76.94	Bowling Creek above confluence with Muddy Creek
ZEK-4	38.44	-76.95	Bowling Creek near Mirant-Faulkner Facility
ZEK-5	38.43	-76.94	Bowling Creek below confluence with Muddy Creek
ZEK-6	38.42	-76.94	Route 234 bridge

For the water quality evaluation, a comparison is made between dissolved metals water column concentrations and the freshwater aquatic life chronic criteria, the most stringent of the numeric water quality criteria for each of the metals. Water hardness concentrations were obtained for each station to adjust the freshwater aquatic life criteria that were listed based on a default hardness of 100 mg/l.

MDE calculates freshwater aquatic life criteria as a function of a hardness adjustment formula for metals (Cu, Pb and Zn), where toxicity is a function of total hardness. The freshwater aquatic life chronic criteria are not adjusted for Se either because hardness does not affect the bioavailability of this metal to aquatic life or there is significant uncertainty in the correlation between hardness and criteria. According to EPA's National Recommended Water Quality Criteria (EPA, November 2002), allowable hardness values must fall within the range of 25 – 400 mg/l. When the measured hardness exceeds 400 mg/l, MDE will use this value as an upper limit when calculating the hardness adjusted criteria (HAC). EPA's Office of Research and Development does not recommend a lower limit on hardness for adjusting criterion (EPA, July 2002). A lower limit may result in criteria that are less protective of the water quality standard. In analyses where available hardness data indicates a value below 25 mg/l, MDE may perform additional analyses to insure data quality objectives for the assessments were met. When data are of questionable quality, MDE will take additional samples to establish the validity of the initial assessment.

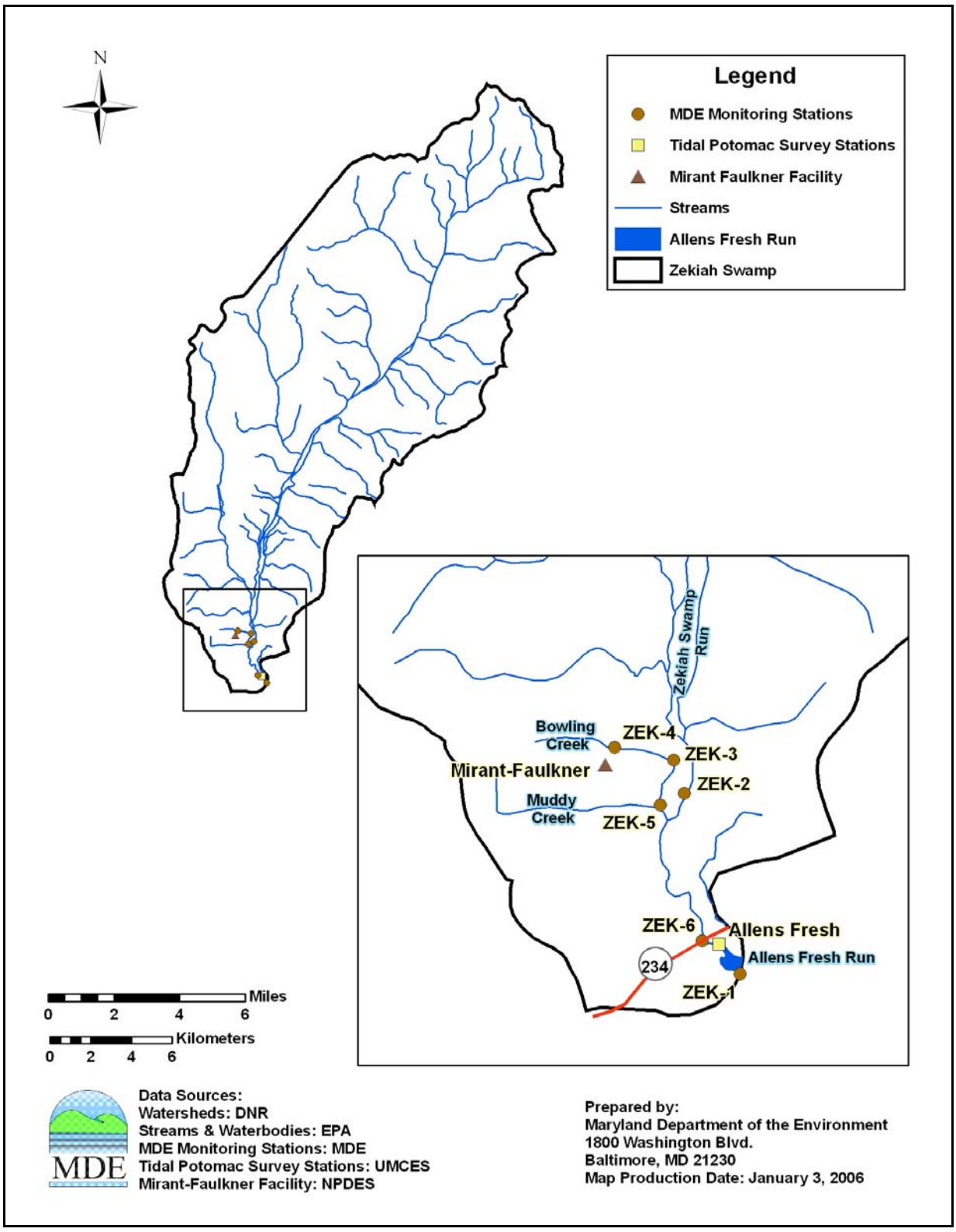

Figure 3: Zekiah Swamp Sample Station Location Map

The HAC equation for metals is as follows (EPA, November 2002):

$HAC = e^{(m[\ln (Hardness(mg/l))]+b)} * CF$

Where,
HAC = Hardness Adjusted Criteria (µg/l)
m = slope
b = y intercept
CF = Conversion Factor (conversion from totals to dissolved numeric criteria)

The chronic HAC parameters for Cu, Pb, and Zn are presented in Table 3 (EPA, November 2002).

Table 3: HAC Parameters (Fresh Water Aquatic Life Chronic Criteria)

Metal	Slope (m)	y Intercept (b)	Conversion Factor (CF)
Cu	0.8545	-1.702	0.96
Pb	1.273	-4.705	1.46203-[(ln hardness)(0.145712)]
Zn	0.8473	0.884	0.986

3.1 Water Quality Evaluation

MDE conducted a data solicitation for metals and considered all readily available data from the past five years in the WQAs. The water column data are presented in Table 4 for each station, and are evaluated using the fresh water chronic criteria (Baker, 2005). Chronic criteria are adjusted for hardness when applicable. Table 4 displays hardness (mg/l), dissolved metals sample concentrations (µg/l), and metals criteria (µg/l). The metals water column data are also presented in Figures 4 through 7. Table 5 shows the method detection limits for each metal.

Table 4: Zekiah Swamp Water Column Data

			Se		Zn		Cu		Pb	
Station	**Date**	**Hardness (mg/l)**	**Criteria* (µg/l)**	**Sample (µg/l)**	**Criteria* (µg/l)**	**Sample (µg/l)**	**Criteria* (µg/l)**	**Sample (µg/l)**	**Criteria* (µg/l)**	**Sample (µg/l)**
Allens Fresh	4/13/2005	50.6	5	0.2	66.35	0.1	5.01	1.75	1.19	0.14
ZEK-1	8/23/2005	116	5	0.08	133.97	1.17	10.17	0.28	2.96	MD
	8/30/2005	414	5	0.07	382.4	0.83	29.28	0.28	10.94	0.054
ZEK-2	8/23/2005	32	5	0.095	44.99	0.56	3.38	0.34	0.71	0.106
	8/30/2005	44	5	0.098	58.92	0.59	4.44	0.36	1.02	0.11
ZEK-3	8/23/2005	30	5	0.117	42.59	0.54	3.2	0.23	0.66	0.06
	8/30/2005	30	5	0.088	42.59	0.69	3.2	0.38	0.66	0.097
ZEK-4	8/23/2005	32.4	5	0.11	45.41	0.64	3.41	0.35	0.72	0.098
	8/30/2005	30	5	0.069	42.59	0.86	3.2	0.35	0.66	0.108
ZEK-5	8/23/2005	27	5	0.118	38.96	0.64	2.93	0.29	0.59	0.067
	8/30/2005	44	5	0.081	58.92	0.64	4.44	0.35	1.02	0.103
ZEK-6	8/23/2005	90.6	5	0.089	108.68	1.26	8.23	0.27	2.26	0.052
	8/30/2005	324	5	0.091	319.87	0.8	24.45	0.29	8.81	0.062

*Fresh Water Aquatic Life Hardness Adjusted Chronic Criteria

1) Se criterion is not hardness adjusted
2) MD = Missing data due to laboratory error

Hardness ranged from 27 mg/l to 414 mg/l. All sample concentrations of Cu, Pb, Se, and Zn in the water column are well below their associated criteria.

Table 5: Metals Method Detection Limits

Metal	**Detection Limit (µg/L)**
Cu	0.05
Pb	0.05
Se	0.05
Zn	0.08

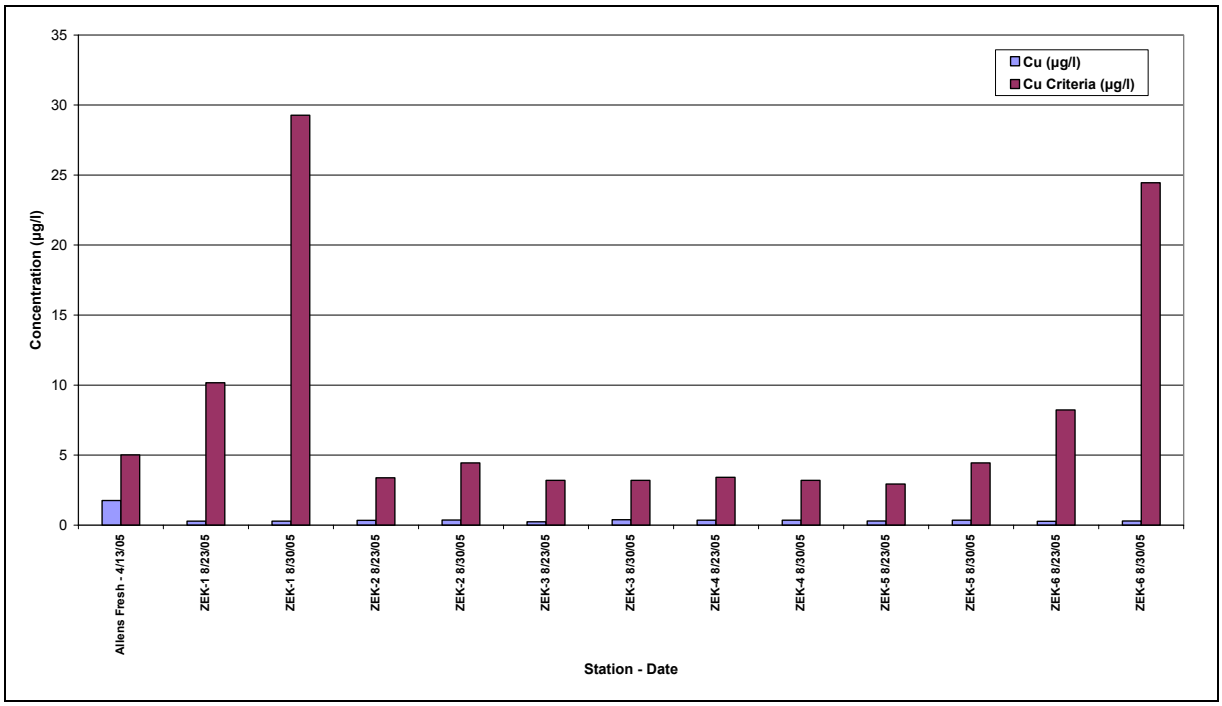

Figure 4: Zekiah Swamp Water Column Data (Cu)

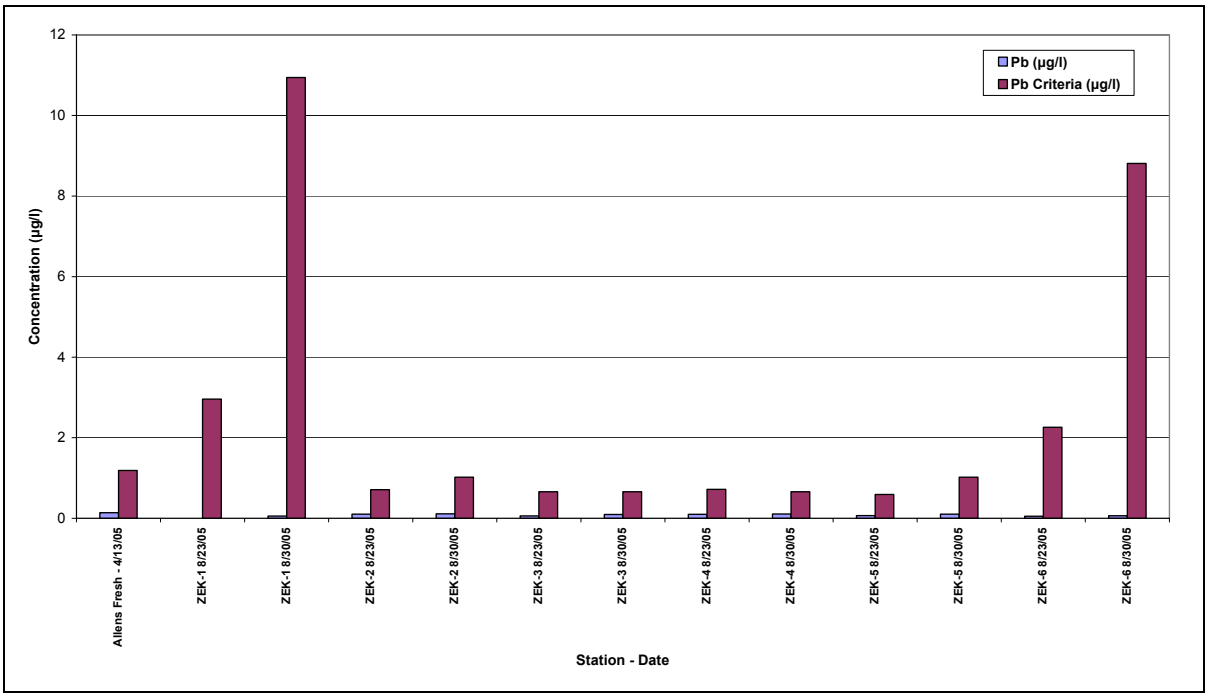

Figure 5: Zekiah Swamp Water Column Data (Pb)

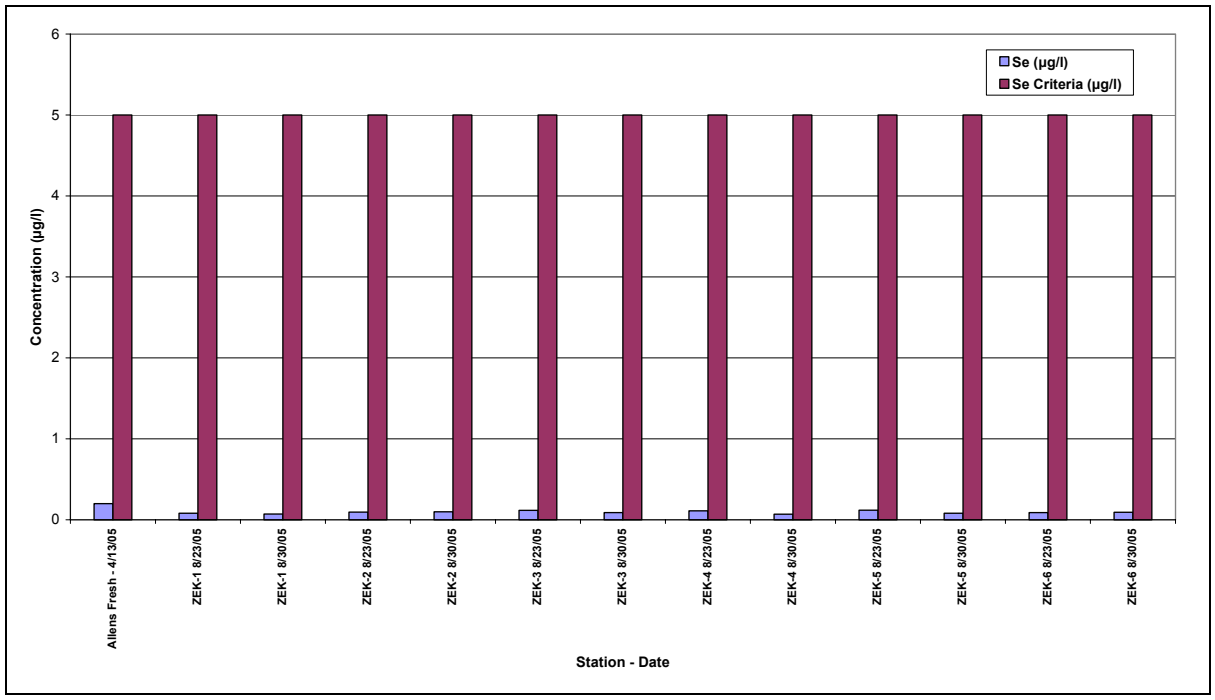

Figure 6: Zekiah Swamp Water Column Data (Se)

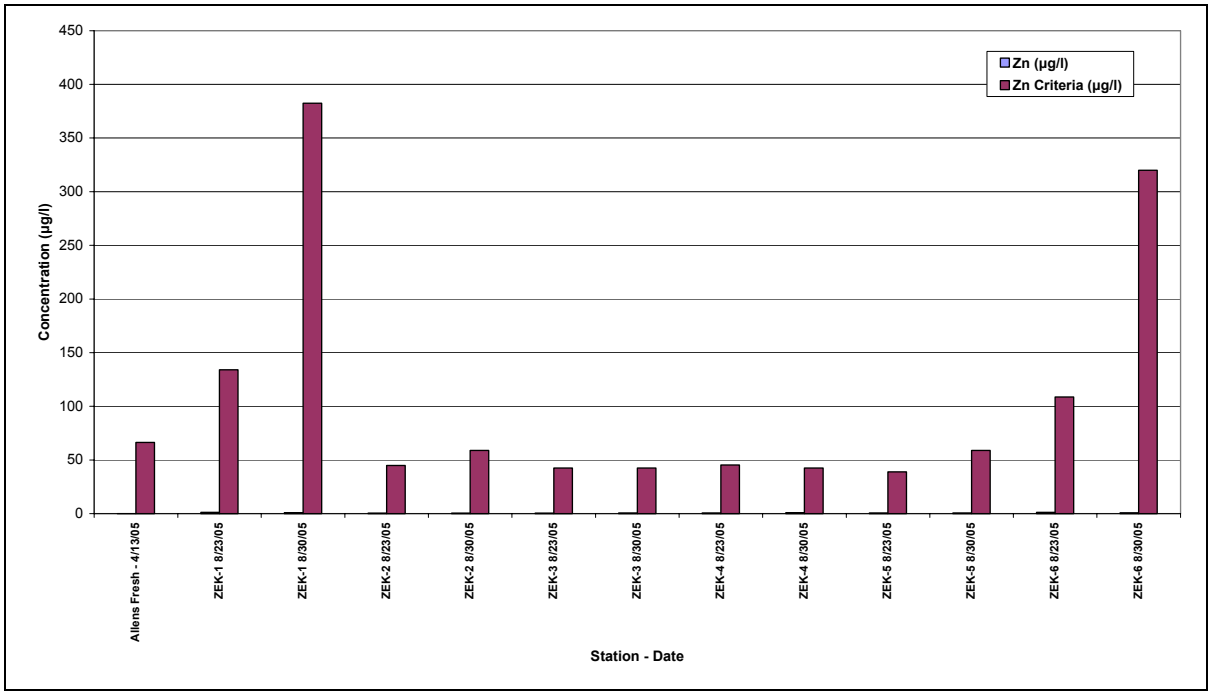

Figure 7: Zekiah Swamp Water Column Data (Zn)

3.2 Sediment Quality Evaluation

Sediment quality in the Zekiah Swamp was evaluated using a 10-day whole sediment test with the representative freshwater amphipod Hyalella azteca (Fisher, 2005). This species was chosen because of its ecological relevance to the waterbody of concern. Hyalella azteca is an EPA-recommended test species for assessing the toxicity of freshwater (EPA, 2001). One surficial sediment sample was collected on April 26, 2005 using a petite ponar dredge (top 2 cm) in the Zekiah Swamp. Control sediments were collected from Bigwood Cove,Wye River, from a depositional area previously characterized as low in contaminants (Fisher, 2005). Refer back to Figure 3 for the station locations. The results are presented in Table 6. Five replicates containing twenty amphipods each were exposed to the contaminated sediment sample, as well as a control sediment sample, for testing. The table displays average amphipod survival (%) and average amphipod growth (mg dry weight).

Table 6: Zekiah Swamp Sediment Toxicity Test Results

Station	Average Amphipod Survival (%) (SD)*	Average Amphipod Growth (mg) (SD)*
Control	88.8 (9.91)	0.13 (0.006)
Allens Fresh	92.5 (8.86)	0.14 (0.016)

SD – Standard Deviation

The test considers two performance criteria: survival and growth. For the test to be valid the average survival of control samples must be greater than 80%, and there must be measurable growth.

Survival of amphipods in the field sediment sample was not significantly less than the average survival demonstrated in the control sample. The average survival for control sediment sample was 88.8%. The average survival for the field sediment sample was 92.5 %. Thus, the field sediment sample does not exhibit toxicity contributing to mortality.

Average amphipod growth for the field sediment sample was greater than the control sediment sample. The control sediment sample exhibited an average final dry weight of 0.13 mg, in contrast to an average final dry weight of 0.14 mg for the field sediment sample. Thus, the field sediment sample does not exhibit toxicity contributing to growth inhibition.

4.0 CONCLUSION

The WQAs establish that the water quality standards for Cu, Pb, Se, and Zn are being met in the Zekiah Swamp watershed. The water column data collected in April and August of 2005 at seven monitoring stations (presented in Section 3.1, Table 4) shows that concentrations of Cu, Pb, Se, and Zn in the water column do not exceed water quality criteria. An ambient sediment bioassay conducted in the Zekiah Swamp, by the University of Maryland Wye Research Center, established that there is no toxicity in the sediment as a result of Cu, Pb, Se, or Zn contamination. The water column and sediment in the Zekiah Swamp are therefore, not impaired by these metals. Thus, the designated uses are supported and the water quality standards are being met.

Barring the receipt of contradictory data, this report will be used to support a Cu, Pb, Se, and Zn listing change for the Zekiah Swamp from Category 5 ("waterbodies impaired by one or more pollutants requiring a TMDL") to Category 2 ("Surface waters that are meeting some standards and have insufficient information to determine attainment of other standards"), when MDE proposes the revision of Maryland's 303(d) list for public review in the future. Although the waters of the Zekiah Swamp watershed do not display signs of toxic impairments due to Cu, Pb, Se, or Zn, the State reserves the right to require additional pollution controls in the Zekiah Swamp watershed if evidence suggests that these metals are contributing to downstream water quality problems.

5.0 REFERENCES

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Appendix A

FINAL

Report # WREC-06-06

FINAL REPORT

Toxicity of Sediments from the Lower Potomac River and Wicomico River to *Hyalella azteca* and *Leptocheirus plumulosus*

2005 and 2006

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FOREWORD

This study was part of a larger study designed to characterize toxic conditions and sediment PCB concentrations in the lower portion of the Potomac River from Washington, DC to the Wicomico River. Most of the stations sampled were in the main stem of the Potomac River except for stations in the Wicomico River. A team of scientists worked jointly to complete this goal. Dr. Joel Baker of the University of Maryland Chesapeake Biological Laboratory was project coordinator and was in charge of collecting the sediment samples and conducting the chemical analyses. The toxicity test results that are covered in this report are based on studies conducted at the University of Maryland Wye Research and Education Center under the direction of Dr. Daniel Fisher. All stations were tested using a 10-d *Hyalella azteca* toxicity test that measured growth and survival as endpoints. In addition, estuarine sediments from downstream stations were also tested with *Leptocheirus plumulosus* using both a 10-d survival and growth test and a 28-d survival, growth and reproduction test.

ABSTRACT

The goal of this study was to assess the toxicity of sediments from the lower portion of the Potomac River from Washington, DC to the Wicomico River. Toxicity test results are presented in this report. The U.S. Environmental Protection Agency (U.S. EPA) whole sediment *Hyalella azteca* 10-d survival and growth test (all stations) and the U.S. EPA *Leptocheirus plumulosus* 28-d survival, growth and reproduction assay (estuarine stations) were used to determine toxicity. In addition, a recently developed 10-d survival and growth test with *L. plumulosus* was used for sediments from all of the estuarine stations. Nineteen stations were sampled in the Potomac River while five stations were sampled in the Wicomico River and its tributaries. All of the stations were tested twice, once in the spring/summer of 2005 and once in the spring of 2006.

Performance criteria of ∃80% amphipod survival in the *H. azteca* and *L. plumulosus* control treatments were obtained from all toxicity tests. In addition, all control amphipods had significant growth over the test periods and all control amphipods in the 28-d *L. plumulosus* had measurable reproduction. Over the two years of testing only one station proved to be toxic, MDE 11 in the Wicomico River in the spring of 2006 in the 28-d *L. plumulosus* chronic test. The toxicity was based on reductions in both growth and reproduction but survival was not significantly different than control amphipod survival. This station was not chronically toxic in the summer of 2005, nor was it toxic in the *H. azteca* or *L. plumulosus* 10-d tests either year.

INTRODUCTION

In the aquatic environment, many anthropogenic chemicals, metals and waste materials eventually accumulate in sediments. Historically, assessments of sediment quality have commonly included chemical characterizations and surveys of benthic community structure. However, the relationship between measured concentrations of sediment-associated chemicals and potential biological effects is difficult to predict because of the complexity of sediment-contaminant interactions. Likewise, benthic community surveys may also be inadequate in that they sometimes fail to discriminate between changes in community composition due to pollution and those that result from unrelated non-contaminant factors. In order to obtain a direct measure of sediment toxicity, laboratory tests have been developed in which benthic organisms are exposed to sediments under controlled conditions (U.S. EPA, 2000; U.S. EPA/U.S. ACE, 2001). Sediment toxicity tests are effective tools in assessments of sediment quality, as they provide direct, quantifiable evidence of the biological consequences of contamination that can only be inferred from chemical or biological community analyses. The current study was designed to assess the toxicity of sediments from the main stem of the lower portion of the Potomac River below Washington, DC and the Wicomico River.

The University of Maryland Wye Research and Education Center (WREC) via a contract with the University of Maryland Chesapeake Biological Laboratory (CBL), conducted an intensive two-year toxicity characterization of whole sediments from the main stem of the Lower Potomac River and the Wicomico River. The sediment toxicity studies are part of an effort to provide the Maryland Department of the Environment Technical and Regulatory Services Administration (MDE TARSA) with an overall assessment of sediment contaminant effects in aquatic systems of the Chesapeake Bay watershed.

Whole sediment toxicity at all stations was assessed using a 10-d survival and growth test with the freshwater amphipod *Hyalella azteca*. In addition, for the estuarine stations, both a 28-d survival, growth and reproduction test and a 10-d survival and growth test with the estuarine amphipod *Leptocheirus plumulosus* were used to assess whole sediment toxicity. These species was chosen because of their practical and ecological relevance and for the availability of U.S. Environmental Protection Agency (U.S. EPA) recommended test methods for assessing the

toxicity of freshwater and marine/estuarine sediments (U.S. EPA, 2000; U.S. EPA/U.S. ACE, 2001).

MATERIALS AND METHODS

Sample Stations

Nineteen stations in the lower Potomac River between Washington, D.C. and the Wicomico River were sampled in this study. In addition, five stations in the Wicomico River and its tributaries were also sampled (MDE 11, 12, 13, Allen's Fresh and Newport Run). The station abbreviations, numbers, coordinates, sampling dates, and toxicity test dates are presented in Table 1. As can be seen in Table 1, all of the stations were tested twice, once in the spring/summer of 2005 and once in the spring of 2006.

Sample Collection, Handling, and Storage

Dr. Joel Baker's group and Dr. Daniel Fisher's group both collected sediments for this study. Sediment collection methods followed those described in U.S. EPA/U.S. ACE (1995) and are briefly summarized below. Samples were collected at each site with a stainless steel petite ponar grab (0.023 m^2). Samples for sediment toxicity testing represent composite samples. At each site, the top 2 - 3 cm of several grabs were placed into a pre-cleaned stainless steel bowl and homogenized with a stainless steel spoon until uniform in color and texture. Sub samples were placed into separate pre-cleaned containers for sediment toxicological analyses. Observations of sample acceptability, depth of penetration and qualitative characteristics (i.e., odor, color, etc) were recorded on field data sheets. Care was taken to avoid sediments in direct contact with the sides of the grab sampler. Collected sediments were kept on ice in the dark and subsequently refrigerated until analyses. All sampling containers for chemical, biological and toxicological analyses were labeled with the date, type of sample, and sample location.

All toxicity samples were transported to the WREC on ice in coolers, out of direct sunlight. The samples were held at the WREC in refrigerators in the dark at 4EC until sieving and initiation of the toxicity tests. Fresh water sediments were not sieved prior to testing. Because of the possible presence of indigenous *L. plumulosus* at the estuarine sites, these

sediments were sieved through a 250 Φm mesh stainless steel sieve (28-d test) or a 500 Φm mesh stainless steel sieve (10-d test). Sieving was done to remove indigenous organisms that might interfere with the tests and to facilitate the recovery of offspring at test conclusion.

Sediment Toxicity Tests

Sediment toxicity was assessed at all stations using the U.S. EPA 10-d *Hyalella azteca* whole sediment toxicity test method with survival and growth as endpoints (U.S. EPA, 2000). *H. azteca* for these tests were purchased from Chesapeake Cultures in Hayes, Va. This test method is summarized in Table 2. Overlying water for the *H. azteca* test was a 95/5 mix of freshwater and estuarine water to attain a conductivity of approximately 2,400 µmhos. Sediments from the seven estuarine sites were tested using the chronic U.S. EPA 28-d *Leptocheirus plumulosus* whole sediment toxicity test method with survival, growth and reproduction as endpoints (U.S. EPA/U.S. ACE, 2001). This test method is summarized in Table 3. Our experience with the *L. plumulosus* 28-day test in the past has shown a high variability in the reproduction endpoint and thus a limited ability to distinguish toxic sediments using this endpoint. This has led us to develop a 10 day *L. plumulosus* test with survival and growth as endpoints. This new test is similar to the U.S. EPA 10-d *Hyalella azteca* survival and growth test with the exception of estuarine water renewals and ground tetramin as the food source. *L. plumulosus* used in the tests were from cultures maintained at the WREC. This new *L. plumulosus* test method is summarized in Table 4. Overlying water for both *L. plumulosus* tests was filtered estuarine water diluted to 5‰.

Test start dates are shown in Table 1. Due to the large numbers of samples and different collection dates sediments were tested in different groups. Each group of eight or less samples was tested with a separate control treatment. As indicated above, test method summaries are given in Tables 2, 3 and 4. Routine water chemistry was performed at the beginning of each renewal. Overlying ammonia was measured at the beginning and end of each test while pore water ammonia was measured at test initiation.

The endpoints of the tests were survival and growth (dry wt. - mg/individual at test conclusion) for the 10-d tests and survival, growth rate (dry wt. – mg/individual/day) and offspring production (neonates/survivor) for the 28-d tests. At the end of the tests, all replicate test beakers were sieved through a 500 Φm sieve to collect surviving adult organisms. Adult dry

weight was determined by drying at 100EC for at least 24 h. For the 28-d day chronic tests, growth rate was calculated by subtracting the final dry weight from the initial amphipod dry weight and dividing by 28. In addition, the 28-d chronic test beakers were sieved through a 250 Φm sieve to collect offspring produced during the tests. The offspring were preserved in 70% ethanol with rose bengal for subsequent counting. Test acceptability criteria require ∃80% control survival and measurable growth and reproduction in surviving organisms in the control treatment of the 28-d chronic tests.

Data Analysis

Statistical procedures for the analysis of the test data are presented in U.S. EPA/ACE (2001). Survival data were Arc Sine Square Root transformed before analysis. Alpha was 0.05 for all statistical tests. Data were assessed for normality and homogeneity of variance using the Chi-Square Test and the Bartlett's Test, respectively. If the data met the assumptions of normality and homogeneity of variance they were analyzed by analysis of variance (ANOVA) followed by comparisons between test sediments and the control using Dunnett's Test. If the assumptions were not met, the data were analyzed using a Steel's Many-One Rank Test. If a sediment sample caused a reduction in survival, it was not included in the analyses of the sublethal endpoints of growth and reproduction. Differences between day-0 and end-of-test control amphipod dry weights were tested using a simple *t*-test.

RESULTS AND DISCUSSION

Water Quality

Measurements for water quality during the various tests are given in Table 5 through 8. Pore water ammonia was relatively low in all test beakers, with a highest recorded value of 23 mg/L for any test sediment and 4.0 mg/L for any control sediment. Overlying ammonia was also low, with a highest recorded value of 3.5 mg/L for any test sediment and 1.7 mg/L for any control sediment. These values are well below the level of 60 mg/L in pore water that would be

considered a problem by the U.S. EPA (U.S. EPA/ACE, 2001) for *L. plumulosus* and below levels thought to be toxic to *H. azteca* (U.S. EPA, 2000). None of the test or control sediments with the highest ammonia concentrations proved to be toxic. Values for pH, salinity and dissolved oxygen were acceptable for all test and control sediments.

Sediment Toxicity Tests – Spring/Summer 2005

Performance criteria of ∃80% amphipod survival in the *L. plumulosus* and *H. azteca* control treatments were obtained in all 10-d and 28-d toxicity tests (Appendices A-1 through A-5). In addition, there were statistically significant growth in all control treatments of all tests and measurable reproduction in all *L. plumulosus* control treatments in the 28-d chronic tests.

None of the sediments tested in 2005 were toxic. There were no significant reductions from control treatments in the Potomac/Wicomico River test sediments for any endpoints tested in the *H. azteca* and *L. plumulosus* 10-d tests or in the 28-d *L. plumulosus* chronic tests (Table 9). Individual replicate data and mean data for all control and Potomac/Wicomico River test endpoints in the spring/summer 2005 sediment tests are found in Appendices A-1 through A-5.

Sediment Toxicity Tests – Spring 2006

Performance criteria of ∃80% amphipod survival in the *L. plumulosus* and *H. azteca* control treatments were obtained in all 10-d and 28-d toxicity tests (Appendices A-6 through A-13). In addition, there was statistically significant growth in all control treatments of all tests and measurable reproduction in all *L. plumulosus* control treatments in the 28-d chronic tests.

For the *H. azteca* and *L. plumulosus* 10-d tests, there were no significant reductions from control treatments in the Potomac/Wicomico River test sediments for either survival or growth (Table 10). There was a significant reduction in the 2006 28-d *L. plumulosus* test for both growth rate and reproduction in sediment from MDE 11 in the Wicomico River (Table 10). *L. plumulosus* survival in this test was not significantly less than survival for the control amphipods (Table 10). As mentioned above, sediments from this same sample were not toxic to either *L. plumulosus* or *H. azteca* in the 10-d test. Individual replicate data and mean data for all

control and Potomac/Wicomico River test endpoints in the spring/summer 2006 sediment tests are found in Appendices A-6 through A-13.

It is not clear why toxicity occurred at MDE 11. Of the six tests conducted at this site (two 10-d *H. azteca* in 2005/2006, two10-d *L. plumulosus* in 2005/2006, and two 28-d *L. plumulosus* in 2005/2006) only one 28-d test showed toxicity, and that was only for the sublethal endpoints of growth rate and reproduction (Table 11).

Comparing sediment toxicity from year to year is difficult, especially in areas that do not elicit high levels of toxicity. Areas with very high contaminant levels, such as some in Baltimore Harbor, provide a more consistent toxic response over time to *L. plumulosus* than areas of moderate toxicity (McGee et al., 1999). Mearns et al. (1986) and Schlekat et al. (1995) reported that, in round-robin evaluations, there was concordance in the classification of highly toxic sediments, whereas characterizations of sediments with moderate to low levels of contamination was variable and inconsistent.

CONCLUSION

Performance criteria of ∃80% amphipod survival in the *H. azteca* and *L. plumulosus* control treatments were obtained from all toxicity tests. In addition, all control amphipods had significant growth over the test periods and all control amphipods in the 28-d *L. plumulosus* tests had measurable reproduction. Over the two years of testing only one station proved to be toxic, MDE 11 in the Wicomico River in the spring of 2006 in the 28-d *L. plumulosus* chronic test (Tables 10 and 11). The toxicity was based on reductions in both growth and reproduction but survival was not significantly different than control amphipod survival. This station was not chronically toxic in the summer of 2005 in any test, nor was it toxic in the *H. azteca* or *L. plumulosus* 10-d tests either year

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Table 1. Potomac/Wicomico River sample station locations (Upstream to Downstream) and dates of sediment collection and toxicity tests (*H.a.* = *Hyalella azteca*; *L.p.* = *Leptocheirus plumulosus*).

River System	Station Name	Latitude/Longitude (Decimal degrees)	Sample Collection Date		Test Start Dates					
					H.a.	*L.p.*		*H.a.*	*L.p.*	
					10 -d	10-d	28-d	10-d	10-d	28-d
			05	06	05	05	05	06	06	06
Potomac River	PR-13	38.89143 / 77.05630	4/28	2/28	5/18			3/14		
	PR-11	38.78543 / 77.03660	4/13	3/1	4/26			3/14		
	MDE-08	38.74678 / 77.03411	4/13	3/1	4/26			3/3		
	PR-10	38.70497 / 77.04777	4/13	3/1	4/26			3/14		
	PR-09	38.68972 / 77.11177	4/13	3/1	4/26			3/14		
	MDE-07	38.66293 / 77.13527	4/27	3/1	5/18			3/14		
	MDE-06	38.63491 / 77.12123	4/13	3/1	4/26			3/3		
	MDE-05	38.62347 / 77.21346	4/13	3/1	4/26			3/3		
	PR-08	38.60952 / 77.17285	4/13	3/1	4/26			3/3		
	MDE-04	38.56019 / 77.20400	4/13	2/28	4/26			3/3		
	PR-07	38.53145 / 77.26813	4/13	2/28	4/26			3/3		
	MDE-02	38.48787 / 77.30950	4/13	2/28	4/26			3/3		
	MDE-01	38.40675 / 77.28834	4/13	2/28	4/26			3/3		
	PR-05	38.35238 / 77.19775	8/4	3/1	4/26	8/16	8/12	3/3	3/14	3/10
	PR-04	38.38877 / 77.13192	8/4	3/1	4/26	8/16	8/12	3/3	3/14	3/10
	PR-03	38.41042 / 77.04427	8/4	2/28	4/26	8/16	8/12	3/3	3/14	3/10
	PR-02a	38.36505 / 76.98718	8/4	2/28	4/26	8/16	8/12	3/3	3/14	3/10
	PR-01	38.27330 / 76.94057	8/4	2/28	4/26	8/16	8/12	3/14	3/14	3/10
	MDE-10	38.26144 / 76.82597	8/4	2/28	5/18	8/16	8/12	3/14	3/14	3/10
Wicomico River	Allen's Fresh	38.41801 / 76.94625	4/26	4/6	5/18			4/21		
	Newport Run	38.41822 / 76.92412	4/26	4/6	5/18			4/21		
	MDE-12	38.40630 / 76.93738	4/26	4/6	5/18			4/21		
	MDE-13	38.40738 / 76.91802	4/26	4/6	5/18			4/21		
	MDE-11	38.34641 / 76.85143	8/4	4/6	5/18	8/16	8/12	4/21	4/21	4/21

Table 2. Test conditions for 10-d whole sediment survival and growth toxicity test with *Hyalella azteca*.

1. Test type	Whole sediment, static renewal of overlying water
2. Temperature	23 ± 1EC
3. Overlying water	95:5 well/filtered estuarine water mix to attain a conductivity of approximately 2,400 µmhos
4. Renewal of overlying water	2 volume additions/d
5. Light	Wide-spectrum fluorescent lights, 100 to 1000 lux
6. Photoperiod	16:8 (L/D)
7. Test chamber	300 mL lip-less beaker with screened hole for water renewal (Randomly assigned on test table)
8. Sediment volume	100 ml
9. Overlying water volume	175 ml
10. Size and life stage of amphipods	7- to 14-d old; size sorted on nested 710 and 500 µm mesh sieves
11. Number of organisms/replicate	10 (Randomly assigned to test replicates)
12. Number of replicates	8
13. Feeding	1.0 ml YCT daily
14. Aeration	none
15. Water quality	Alkalinity, hardness, and total ammonia at beginning and end of test. Temperature, D.O., and pH daily. Porewater ammonia in dummy beaker at test initiation.
16. Test duration	10 d
17. Endpoints	Survival and growth (mg/ind)
18. Performance criteria	Control survival $\geq$ 80% Measurable growth in control amphipods

Table 3. Test conditions for 28-d sediment toxicity test with *Leptocheirus plumulosus*.

1. Test type	Whole sediment, static renewal
2. Temperature	25°C
3. Overlying water	Filtered Wye River water diluted to 5 ppt
4. Light	Wide-spectrum fluorescent lights, 100 to 1000 lux
5. Photoperiod	16:8 (L/D)
6. Test chamber	1 L glass beaker covered with watch glass (Randomly assigned on test table)
7. Sediment volume	175 ml (2 cm)
8. Overlying water volume	800 ml
9. Water renewal	3 x /week, replace 400 ml
10. Size and life stage of amphipods	neonates; size sorted on nested 500 and 250 μm mesh sieves
11. Number of organisms/replicate	20 (Randomly assigned to test replicates)
12. Number of replicates	5
13. Feeding	3x/week TetraMin (ground and sieved to 250 :m)
14. Aeration	1-2 bubbles/sec with 1 ml pipette
15. Water quality	Salinity, pH and total ammonia at beginning and end of test. Temperature and D.O. daily. Pore water ammonia in dummy beaker at test initiation.
16. Test duration	28 d
17. Endpoints	Survival, growth rate (mg/ind/d), reproduction (offspring/survivor)
18. Performance criteria	Control survival $\geq$ 80% Measurable growth and reproduction

Table 4. Test conditions for 10-d whole sediment survival and growth toxicity test with *Leptocheirus plumulosus*.

1. Test type	Whole sediment, static renewal of overlying water
2. Temperature	25 ± 1EC
3. Overlying water	Filtered Wye River water diluted to 5 ppt
4. Renewal of overlying water	2 volume additions/d
5. Light	Wide-spectrum fluorescent lights, 100 to 1000 lux
6. Photoperiod	16:8 (L/D)
7. Test chamber	300 mL lip-less beaker with screened hole for water renewal (Randomly assigned on test table)
8. Sediment volume	100 ml
9. Overlying water volume	175 ml
10. Size and life stage of amphipods	neonates; size sorted on nested 750 and 500 :m mesh sieves
11. Number of organisms/replicate	10 (Randomly assigned to test replicates)
12. Number of replicates	8
13. Feeding	Daily - TetraMin (ground and sieved to 250 μm)
14. Aeration	none
15. Water quality	Salinity, pH and total ammonia at beginning and end of test. Temperature and D.O. daily. Pore water ammonia in dummy beaker at test initiation.
16. Test duration	10 d
17. Endpoints	Survival and growth (mg/ind)
18. Performance criteria	Control survival $\geq$ 80% Measurable growth in control amphipods

Table 5. Water chemistry summary for the 2005 Middle Potomac River 10-d amphipod *Hyalella azteca* sediment toxicity tests[1] [mean (S.D.) unless otherwise stated].

Station	DO mg/L	pH range	Temp °C	Conductivity µmhos	Alkalinity mg/L $CaCO_3$	Hardness mg/L $CaCO_3$	Ammonia (mg/L)		
							Overlying		Pore water
							day 0	day 10	day 0
Control 1	7.4 (0.61)	7.39-8.61	22.6 (0.38)	2550 (212)	108 (25)	360 (28)	0.2	<0.2	3.0
MDE 01	6.2 (0.44)	7.29-7.82	22.4 (0.41)	2300 (141)	105 (21)	350 (14)	0.5	<0.2	2.5
MDE 02	6.3 (0.89)	7.31-7.81	22.3 (0.43)	2300 (141)	110 (14)	345 (7)	<0.2	<0.2	1.4
MDE 04	6.1 (0.37)	7.07-7.57	22.6 (0.88)	2250 (212)	97.5 (25)	340 (14)	<0.2	<0.2	1.9
MDE 05	5.8 (0.30)	7.31-7.51	22.2 (0.31)	2300 (141)	123 (4)	345 (7)	1.2	<0.2	3.2
MDE 06	6.0 (0.36)	7.22-7.62	22.2 (0.26)	2300 (141)	130 (7)	345 (7)	1.5	<0.2	3.5
MDE 08	5.9 (0.49)	7.23-7.81	22.2 (0.26)	2300 (141)	113 (11)	335 (7)	2.3	<0.2	3.5
PR 01	7.4 (0.73)	7.63-7.96	23.7 (0.36)	2500 (0)	138 (4)	310 (42)	0.3	<0.2	3.0
PR 02a	7.1 (0.59)	7.43-7.89	22.3 (0.26)	2500 (141)	110 (7)	360 (28)	<0.2	<0.2	3.2
Control 2	7.4 (0.55)	7.62-8.23	22.5 (0.44)	2550 (212)	110 (14)	365 (21)	<0.2	<0.2	3.0
PR 03	6.8 (0.60)	7.32-7.82	22.1 (0.61)	2450 (71)	135 (7)	345 (21)	1.0	<0.2	3.5
PR 04	6.3 (0.63)	7.43-7.80	21.9 (0.65)	2350 (71)	123 (4)	360 (14)	0.4	<0.2	2.8
PR 05	5.9 (0.83)	7.10-7.84	22.4 (0.63)	2300 (141)	113 (18)	350 (14)	0.4	<0.2	2.3
PR 07	5.7 (0.25)	6.92-7.56	22.1 (0.32)	2250 (212)	133 (11)	350 (14)	0.8	<0.2	2.9
PR 08	5.2 (0.46)	7.13-7.34	22.0 (0.40)	2250 (212)	113 (18)	350 (14)	2.3	<0.2	3.5
PR 09	5.8 (0.25)	7.30-7.67	22.0 (0.25)	2300 (141)	143 (18)	360 (14)	1.0	<0.2	3.2
PR 10	5.8 (0.47)	7.39-7.69	22.0 (0.31)	2300 (141)	158 (39)	345 (7)	2.0	<0.2	3.8
PR 11	4.7 (0.98)	7.27-7.66	22.1 (0.22)	2300 (141)	155 (35)	355 (7)	2.4	0.4	10
Control 3	7.2 (0.53)	7.52-8.01	23.0 (0.53)	2450 (71)	135 (14)	365 (7)	0.3	<0.2	2.8
Allens Fresh	5.3 (0.90)	6.78-7.44	23.0 (0.44)	2300 (141)	125 (21)	350 (14)	1.7	<0.2	4.0
Newport Run	5.6 (0.75)	6.81-7.45	23.0 (0.48)	2300 (141)	123 (18)	360 (28)	0.9	<0.2	4.1
MDE 07	5.8 (0.51)	6.97-7.39	23.0 (0.39)	2200 (283)	120 (28)	335 (50)	1.1	<0.2	2.6
MDE 10	6.9 (0.60)	7.48-7.79	22.8 (0.42)	2250 (212)	120 (28)	350 (57)	<0.2	<0.2	[2]
MDE 11	6.7 (0.60)	7.55-7.88	22.8 (0.35)	2300 (141)	130 (7)	360 (28)	<0.2	<0.2	[2]
MDE 12	5.5 (1.00)	6.89-7.57	23.0 (0.45)	2300 (141)	120 (28)	350 (14)	1.3	<0.2	4.0
MDE 13	5.4 (0.98)	6.89-7.50	23.0 (0.37)	2250 (212)	133 (11)	350 (28)	1.0	<0.2	4.2
PR 13	5.6 (0.82)	7.12-7.73	22.9 (0.41)	2250 (212)	130 (21)	360 (28)	2.6	<0.2	[2]

[1]See Table 1 for start dates
[2]Not enough sample to analyze

Table 6. Water chemistry summary for the 2005 Middle Potomac River *Leptocheirus plumulosus* sediment toxicity tests[1] [mean (S.D.) unless otherwise stated].

Station	DO mg/L	pH range	Temp °C	Salinity (‰)	Ammonia (mg/L)		
					Overlying		Pore water
					day 0	day 10	day 0
Control 1 28-d	7.9 (0.33)	7.68-8.47	24.9 (0.48)	5.0 (0)	1.7	<0.2	4.0
MDE 10	7.9 (0.30)	7.76-8.42	24.7 (0.69)	5.0 (0)	1.4	<0.2	[2]
MDE 11	7.9 (0.27)	7.84-8.40	24.7 (0.77)	5.0 (0)	0.2	<0.2	[2]
PR 01	7.8 (0.44)	7.70-8.57	24.7 (0.66)	5.0 (0)	1.0	<0.2	3.0
PR 02a	7.9 (0.45)	7.94-8.87	24.7 (0.68)	5.0 (0)	0.2	<0.2	3.5
PR 03	8.1 (0.29)	7.95-8.30	24.7 (0.70)	5.0 (0)	0.5	<0.2	3.5
PR 04	7.9 (0.24)	7.83-8.34	24.7 (0.73)	5.0 (0)	0.8	<0.2	3.5
PR 05	7.8 (0.60)	7.65-8.21	24.7 (0.72)	5.0 (0)	0.6	<0.2	2.2
Control 1 10-d	6.2 (0.95)	7.45-8.12	25.0 (0.59)	5.0 (0)	1.5	<0.2	4.0
MDE 10	6.2 (0.96)	7.84-8.06	24.8 (0.71)	5.0 (0)	1.3	<0.2	[2]
MDE 11	6.2 (0.85)	7.72-7.97	24.7 (0.74)	5.0 (0)	0.3	<0.2	[2]
PR 01	5.9 (1.03)	7.68-8.30	24.7 (0.78)	5.0 (0)	0.9	<0.2	3.0
PR 02a	5.7 (1.00)	7.59-8.19	24.7 (0.79)	5.0 (0)	0.2	<0.2	3.5
PR 03	5.7 (0.92)	7.54-7.84	24.7 (0.78)	5.0 (0)	0.6	<0.2	3.5
PR 04	5.7 (0.88)	7.53-8.18	24.7 (0.67)	5.0 (0)	0.7	<0.2	3.5
PR 05	5.7 (0.78)	7.41-7.67	24.7 (0.68)	5.0 (0)	0.6	<0.2	2.2

[1]See Table 1 for start dates
[2]Not enough sample to analyze

Table 7. Water chemistry summary for the 2006 Middle Potomac River 10-d amphipod *Hyalella azteca* sediment toxicity tests[1] [mean (S.D.) unless otherwise stated].

Station	DO mg/L	pH range	Temp °C	Conductivity µmhos	Alkalinity mg/L $CaCO_3$	Hardness mg/L $CaCO_3$	Ammonia (mg/L)		
							Overlying		Pore water
							day 0	day 10	day 0
Control 1	7.0 (0.74)	7.40-8.23	22.8 (0.49)	3200 (990)	125 (35)	350 (71)	0.6	<0.2	3
MDE 01	6.4 (0.47)	7.12-7.85	22.5 (0.49)	2550 (71)	113 (4)	322 (26)	0.2	<0.2	3
MDE 02	6.5 (0.45)	7.28-7.82	22.5 (0.57)	2400 (0)	120 (7)	330 (14)	0.3	<0.2	3
MDE 04	6.1 (0.54)	7.11-7.68	22.4 (0.57)	2450 (71)	105 (7)	322 (3)	<0.2	<0.2	5
MDE 05	6.2 (0.78)	7.06-7.8	22.5 (0.46)	2400 (0)	115 (21)	360 (0)	0.3	<0.2	3
MDE 06	6.0 (0.35)	7.21-7.54	22.6 (0.43)	2400 (0)	130 (7)	360 (17)	1.3	<0.2	6
MDE 08	5.9 (0.32)	7.13-7.48	22.7 (0.45)	2400 (0)	130 (7)	342 (31)	1.2	<0.2	5
Control 2	6.8 (0.71)	7.40-7.97	22.6 (0.55)	3100 (849)	133 (57)	360 (57)	0.5	<0.2	3
PR 02a	6.0 (0.86)	7.18-7.60	22.6 (0.56)	3000 (707)	125 (7)	392 (96)	0.5	<0.2	5
PR 03	5.8 (0.90)	7.10-7.52	22.5 (0.62)	2950 (636)	113 (11)	370 (20)	0.2	<0.2	3
PR 04	6.4 (0.71)	7.40-7.74	22.6 (0.62)	2900 (566)	110 (7)	370 (59)	0.3	<0.2	3
PR 05	6.5 (0.57)	7.43-7.88	22.6 (0.60)	2750 (354)	130 (7)	368 (0)	0.8	<0.2	3
PR 07	6.0 (0.58)	7.25-7.68	22.7 (0.97)	2450 (71)	125 (0)	360 (0)	0.3	<0.2	20
PR 08	5.8 (0.67)	7.13-7.63	22.8 (0.97)	2450 (71)	118 (11)	364 (40)	3.5	<0.2	7
Control 3	6.6 (0.83)	7.58-8.24	23.1 (0.20)	2800 (283)	105 (7)	376 (34)	0.5	<0.2	3
MDE 07	5.5 (0.86)	7.31-7.77	22.9 (0.19)	2450 (71)	143 (18)	390 (20)	0.4	<0.2	4
MDE 10	6.2 (0.83)	7.44-7.97	22.9 (0.22)	2800 (283)	130 (0)	386 (3)	0.6	<0.2	8
PR 01	6.2 (0.91)	7.49-7.93	22.9 (0.13)	2650 (71)	123 (4)	370 (20)	0.2	<0.2	3
PR 09	5.6 (0.92)	7.23-7.86	23.0 (0.23)	2450 (71)	143 (18)	364 (28)	0.6	<0.2	5
PR 10	5.0 (0.71)	7.06-7.58	23.0 (0.23)	2400 (141)	135 (0)	362 (3)	0.7	<0.2	5
PR 11	5.3 (0.81)	7.00-7.69	23.0 (0.25)	2300 (141)	133 (4)	382 (3)	0.9	<0.2	10
PR 13	4.8 (0.96)	7.10-7.67	23.0 (0.22)	2350 (212)	135 (0)	384 (6)	0.5	<0.2	5
Control 4	7.2 (0.67)	7.66-8.22	23.5 (0.30)	3100 (707)	113 (18)	346 (48)	0.5	<0.2	3
Allens Fresh	6.2 (0.81)	7.30-7.90	23.3 (0.23)	3000 (849)	105 (0)	342 (76)	0.2	<0.2	23
Newport Run	5.4 (0.96)	7.06-7.59	23.4 (0.20)	2800 (566)	98 (4)	316 (28)	0.9	<0.2	16
MDE 11	6.5 (0.93)	7.45-7.85	23.3 (0.26)	3100 (849)	128 (25)	382 (88)	1.5	<0.2	13
MDE 12	5.9 (0.70)	6.98-7.63	23.4 (0.30)	2350 (71)	168 (74)	326 (20)	1.8	<0.2	6.6
MDE 13	5.9 (0.75)	6.92-7.76	23.3 (0.24)	2350 (71)	105 (0)	318 (14)	2.2	<0.2	<0.4

[1]See Table 1 for start dates

Table 8. Water chemistry summary for the 2006 Middle Potomac River *Leptocheirus plumulosus* sediment toxicity test conducted[1] [mean (S.D.) unless otherwise stated].

Station	DO mg/L	pH range	Temp °C	Salinity (‰)	Ammonia (mg/L)		
					Overlying		Pore water
					day 0	day 10	day 0
Control 4 28-d	7.8 (0.45)	7.46-8.47	24.1 (0.62)	5.0 (0)	0.7	<0.2	2.5
MDE 10	7.2 (0.85)	7.30-8.33	24.2 (0.55)	5.0 (0)	1.5	<0.2	8
PR 01	7.7 (0.45)	7.48-8.27	24.1 (0.55)	5.0 (0)	0.6	<0.2	3
PR 02a	7.6 (0.43)	7.44-8.43	24.3 (0.53)	5.0 (0)	1.2	<0.2	5
PR 03	7.7 (0.34)	7.62-8.00	24.2 (0.63)	5.0 (0)	0.5	<0.2	3
PR04	7.8 (0.35)	7.71-8.07	25.3 (0.58)	5.0 (0)	0.2	<0.2	2.5
PR 05	7.5 (0.57)	7.53-8.06	24.2 (0.53)	5.0 (0)	0.9	<0.2	3
Control 4 MDE 11	7.6 (0.41)	7.53-8.55	24.8 (0.33)	5.3 (0.46)	0.6	<0.2	3
MDE 11 28-d	7.8 (0.27)	7.69-8.21	24.8 (0.39)	5.3 (0.46)	0.3	<0.2	2.1
Control 4 10-d	5.7 (0.80)	7.07-8.15	23.9 (0.52)	5.1 (0.29)	<0.2	<0.2	2.5
MDE 10	5.1 (1.01)	7.21-7.97	24.0 (0.46)	5.1 (0.46)	<0.2	<0.2	8
PR 01	5.1 (0.97)	7.41-7.91	24.0 (0.44)	5.1 (0.29)	<0.2	<0.2	3
PR 02a	4.9 (1.05)	7.25-7.95	24.1 (0.42)	5.1 (0.29)	<0.2	<0.2	5
PR 03	5.5 (0.67)	7.15-7.55	23.9 (0.50)	5.1 (0.29)	<0.2	<0.2	3
PR04	5.6 (0.66)	7.23-7.75	23.9 (0.60)	5.1 (0.29)	<0.2	<0.2	2.5
PR 05	5.5 (0.69)	7.30-7.77	24.0 (0.51)	5.1 (0.29)	<0.2	<0.2	3
Control 4 MDE 11	6.6 (0.47)	7.48-8.63	24.6 (0.40)	5.0 (0)	0.5	<0.2	3
MDE 11 10-d	6.5 (0.49)	7.49-7.97	24.7 (0.36)	5.0 (0.0)	0.2	<0.2	2.1

[1]See Table 1 for start dates

Table 9. Summary of results from the MDE 2005 Potomac River toxicity testing effort. Shaded areas are endpoint values that were significantly less than control values for that specific test ($\alpha = 0.05$). Blank cells are freshwater sites only tested with *H. azteca*.

	2005						
	H. azteca 10-d		*L. plumulosus* 10-d		*L. plumulosus* 28-d		
	Survival	Growth	Survival	Growth	Survival	Growth Rate	Reproduction
Station	%	(mg)	%	(mg)	%	mg/Lepto/day	young/Lepto
Control 1*	95.0	0.18	88.8	0.26	86.0	0.054	4.0
MDE 01	91.3	0.23					
MDE 02	96.3	0.21					
MDE 04	97.5	0.21					
MDE 05	100.0	0.24					
MDE 06	95.0	0.26					
MDE 08	98.8	0.23					
PR 01	97.5	0.23	87.5	0.30	80.0	0.053	2.8
PR 02a	96.3	0.20	93.8	0.29	94.0	0.059	4.7
Control 2	92.5	0.19					
PR 03	97.5	0.25	93.8	0.29	89.0	0.041	1.8
PR 04	96.3	0.22	88.8	0.31	77.0	0.039	1.4
PR 05	96.3	0.22	95.0	0.29	79.0	0.037	1.4
PR 07	98.8	0.25					
PR 08	95.0	0.23					
PR 09	95.0	0.25					
PR 10	96.3	0.25					
PR 11	96.3	0.26					
Control 3	88.8	0.13					
Allen's Fresh	92.5	0.14					
Newport Run	88.8	0.15					
MDE 07	92.5	0.15					
MDE 10	90.0	0.14	92.5	0.28	89.0	0.068	5.6
MDE 11	93.8	0.13	92.5	0.25	84.0	0.042	3.7
MDE 12	83.8	0.17					
MDE 13	78.8	0.17					
PR 13	93.8	0.17					

* Stations were tested in groups with different control treatments (e.g., *H. azteca* MDE 01, 02, 04, 05, 06, 08, PR 01, 02a were compared statistically to Control 1). All of the saltwater tests were conducted at the same time and were compared to one control treatment.

Table 10. Summary of results from the MDE 2006 Potomac River toxicity testing effort. Shaded areas are endpoint values that were significantly less than control values for that specific test (α = 0.05). Blank cells are freshwater sites only tested with *H. azteca*.

	2006						
	H. azteca 10-d		*L. plumulosus* 10-d		*L. plumulosus* 28-d		
	Survival	Growth	Survival	Growth	Survival	Growth Rate	Reproduction
Station	%	(mg)	%	(mg)	%	mg/Lepto/day	young/Lepto
Control 1*	95.0	0.17					
MDE 01	76.3	0.17					
MDE 02	95.0	0.18					
MDE 04	93.8	0.18					
MDE 05	91.3	0.20					
MDE 06	90.0	0.18					
MDE 08	77.5	0.15					
Control 2	97.5	0.17	91.3	0.33	80.0	0.061	4.9
PR 02a	96.3	0.15	97.5	0.39	81.0	0.065	5.9
PR 03	88.8	0.15	95.0	0.34	81.0	0.046	2.7
PR 04	82.5	0.19	92.5	0.29	85.0	0.045	3.2
PR 05	88.8	0.19	95.0	0.35	87.0	0.053	3.4
PR 07	85.0	0.20					
PR 08	97.5	0.19					
Control 3	95.0	0.19					
MDE 07	93.8	0.21					
MDE 10	85.0	0.19	92.5	0.48	84.0	0.081	8.4
PR 01	97.5	0.19	97.5	0.42	82.0	0.063	5.2
PR 09	97.5	0.23					
PR 10	91.3	0.24					
PR 11	100.0	0.23					
PR 13	93.8	0.24					
Control 4	90.0	0.17	80.0	0.16	80.0	0.061	5.2
MDE 11	87.5	0.15	86.3	0.19	66.0	0.027	0.5
MDE 12	91.3	0.19					
MDE 13	100.0	0.24					
Allen's Fresh	98.6	0.23					
Newport Run	98.8	0.23					

* Stations were tested in groups with different control treatments (e.g., *H. azteca* tests for MDE 01, 02, 04, 05, 06, and 08 were compared statistically to Control 1).

Table 11. Summary of results from the MDE 2005/2006 Potomac River toxicity testing effort. Shaded areas are endpoint values that were significantly less than control values for that specific test (α = 0.05). Blank cells are freshwater sites only tested with *H. azteca*.

	2005							2006						
	H. azteca 10-d		*L. plumulosus* 10d		*L. plumulosus* 28-d			*H. azteca* 10-d		*L. plumulosus* 10d		*L. plumulosus* 28-d		
	Survival	Growth	Survival	Growth	Survival	Growth Rate	Reproduction	Survival	Growth	Survival	Growth	Survival	Growth Rate	Reproduction
Station	%	(mg)	%	(mg)	%	mg Lepto/day	Young/Lepto	%	(mg)	%	(mg)	%	mg Lepto/day	Young/Lepto
MDE 01	91.3	0.23						76.3	0.17					
MDE 02	96.3	0.21						95.0	0.18					
MDE 04	97.5	0.21						93.8	0.18					
MDE 05	100.0	0.24						91.3	0.20					
MDE 06	95.0	0.26						90.0	0.18					
MDE 07	92.5	0.15						93.8	0.21					
MDE 08	98.8	0.23						77.5	0.15					
MDE 10	90.0	0.14	92.5	0.28	89.0	0.068	5.6	85.0	0.19	92.5	0.48	84.0	0.081	8.4
MDE 11	93.8	0.13	92.5	0.25	84.0	0.042	3.7	87.5	0.15	86.3	0.19	66.0	0.027	0.5
MDE 12	83.8	0.17						91.3	0.19					
MDE 13	78.8	0.17						100.0	0.24					
PR 01	97.5	0.23	87.5	0.30	80.0	0.053	2.8	97.5	0.19	97.5	0.42	82.0	0.063	5.2
PR 02a	96.3	0.20	93.8	0.29	94.0	0.059	4.7	96.3	0.15	97.5	0.39	81.0	0.065	5.9
PR 03	97.5	0.25	93.8	0.29	89.0	0.041	1.8	88.8	0.15	95.0	0.34	81.0	0.046	2.7
PR 04	96.3	0.22	88.8	0.31	77.0	0.039	1.4	82.5	0.19	92.5	0.29	85.0	0.045	3.2
PR 05	96.3	0.22	95.0	0.29	79.0	0.037	1.4	88.8	0.19	95.0	0.35	87.0	0.053	3.4
PR 07	98.8	0.25						85.0	0.20					
PR 08	95.0	0.23						97.5	0.19					
PR 09	95.0	0.25						97.5	0.23					
PR 10	96.3	0.25						91.3	0.24					
PR 11	96.3	0.26						100.0	0.23					
PR 13	93.8	0.17						93.8	0.24					
Allen's Fresh	92.5	0.14						98.6	0.23					
Newport Run	88.8	0.15						98.8	0.23					

APPENDICES TO SEDIMENT TOXICITY REPORT

A-1. Lower Potomac River amphipod *Hyalella azteca* 10 day survival and growth sediment toxicity test results (4/26-5/6/05). An * indicates a treatment significantly < the control (% = 0.05).

Treatment REP	# Surviving amphipods	0 Rep. dry wt. (mg)	0 Treatment % Survival (SD)	0 Treatment mg. dry wt. (SD)
Control A	10	0.201	95.0 (5.35)	0.18 (0.018)
Control B	9	0.165		
Control C	10	0.154		
Control D	9	0.203		
Control E	10	0.183		
Control F	9	0.178		
Control G	10	0.196		
Control H	9	0.170		
MDE 01 A	8	0.246	91.3 (9.91)	0.23 (0.016)
MDE 01 B	10	0.219		
MDE 01 C	10	0.210		
MDE 01 D	10	0.217		
MDE 01 E	8	0.230		
MDE 01 F	9	0.209		
MDE 01 G	8	0.252		
MDE 01 H	10	0.228		
MDE 02 A	10	0.234	96.3 (7.44)	0.21 (0.011)
MDE 02 B	10	0.204		
MDE 02 C	8	0.212		
MDE 02 D	10	0.210		
MDE 02 E	9	0.199		
MDE 02 F	10	0.208		
MDE 02 G	11	0.222		
MDE 02 H	10	0.220		
MDE 04 A	10	0.216	97.5 (4.63)	0.21 (0.021)
MDE 04 B	10	0.201		
MDE 04 C	10	0.202		
MDE 04 D	10	0.193		
MDE 04 E	9	0.237		
MDE 04 F	10	0.227		
MDE 04 G	9	0.185		
MDE 04 H	10	0.243		

A-1. Continued

Treatment REP	# Surviving amphipods	0 Rep. dry wt. (mg)	0 Treatment % Survival (SD)	0 Treatment mg. dry wt. (SD)
MDE 05 A	10	0.247	100.0 (0.00)	0.24 (0.015)
MDE 05 B	10	0.242		
MDE 05 C	10	0.205		
MDE 05 D	10	0.251		
MDE 05 E	10	0.245		
MDE 05 F	10	0.234		
MDE 05 G	10	0.237		
MDE 05 H	11	0.228		
MDE 06 A	10	0.257	95.0 (5.35)	0.26 (0.034)
MDE 06 B	10	0.250		
MDE 06 C	9	0.308		
MDE 06 D	10	0.257		
MDE 06 E	9	0.288		
MDE 06 F	9	0.221		
MDE 06 G	12	0.206		
MDE 06 H	9	0.284		
MDE 08 A	9	0.224	98.8 (3.54)	0.23 (0.019)
MDE 08 B	10	0.239		
MDE 08 C	10	0.267		
MDE 08 D	10	0.207		
MDE 08 E	10	0.219		
MDE 08 F	10	0.211		
MDE 08 G	10	0.222		
MDE 08 H	10	0.240		
PR 01 A	9	0.233	97.5 (4.63)	0.23 (0.017)
PR 01 B	10	0.209		
PR 01 C	10	0.222		
PR 01 D	10	0.251		
PR 01 E	10	0.246		
PR 01 F	9	0.217		
PR 01 G	10	0.255		
PR 01 H	10	0.233		

A-1. Continued

Treatment REP	# Surviving amphipods	0 Rep. dry wt. (mg)	0 Treatment % Survival (SD)	0 Treatment mg. dry wt. (SD)
PR 02a A	10	0.207	96.3 (10.61)	0.20 (0.017)
PR 02a B	10	0.221		
PR 02a C	7	0.207		
PR 02a D	10	0.179		
PR 02a E	10	0.198		
PR 02a F	10	0.187		
PR 02a G	10	0.180		
PR 02a H	10	0.221		
Day 0 amphipod A[1]	10	0.089		0.11 (0.016)
Day 0 amphipod B	10	0.103		
Day 0 amphipod C	10	0.123		
Day 0 amphipod D	10	0.086		
Day 0 amphipod E	10	0.123		
Day 0 amphipod F	10	0.097		
Day 0 amphipod G	10	0.124		
Day 0 amphipod H	10	0.100		

[1]These are the dry weights of the amphipods at day 0 used to determine if there was measurable growth in the control amphipods as compared to the control amphipod weights at day 10.

A-2. Lower Potomac River amphipod *Hyalella azteca* 10 day survival and growth sediment toxicity test results (4/26-5/6/05). An * indicates a treatment significantly < the control (% = 0.05).

Treatment REP	# Surviving amphipods	0 Rep. dry wt. (mg)	0 Treatment % Survival (SD)	0 Treatment mg. dry wt. (SD)
Control A	9	0.194	92.5 (7.07)	0.19 (0.018)
Control B	10	0.175		
Control C	11	0.170		
Control D	9	0.201		
Control E	9	0.227		
Control F	9	0.200		
Control G	8	0.201		
Control H	11	0.184		
PR 03 A	10	0.314	97.5 (4.63)	0.25 (0.043)
PR 03 B	10	0.265		
PR 03 C	10	0.191		
PR 03 D	10	0.268		
PR 03 E	10	0.222		
PR 03 F	9	0.272		
PR 03 G	10	0.188		
PR 03 H	9	0.242		
PR 04 A	8	0.219	96.3 (7.44)	0.22 (0.011)
PR 04 B	10	0.225		
PR 04 C	10	0.235		
PR 04 D	10	0.215		
PR 04 E	10	0.231		
PR 04 F	10	0.213		
PR 04 G	10	0.217		
PR 04 H	9	0.242		
PR 05 A	10	0.219	96.3 (5.18)	0.22 (0.018)
PR 05 B	9	0.232		
PR 05 C	10	0.215		
PR 05 D	10	0.213		
PR 05 E	9	0.224		
PR 05 F	9	0.225		
PR 05 G	10	0.261		
PR 05 H	10	0.202		

A-2. Continued

Treatment REP	# Surviving amphipods	0 Rep. dry wt. (mg)	0 Treatment % Survival (SD)	0 Treatment mg. dry wt. (SD)
PR 07 A	10	0.255	98.8 (3.54)	0.25 (0.007)
PR 07 B	10	0.245		
PR 07 C	10	0.260		
PR 07 D	9	0.242		
PR 07 E	10	0.254		
PR 07 F	10	0.260		
PR 07 G	10	0.255		
PR 07 H	10	0.251		
PR 08 A	10	0.229	95.0 (10.69)	0.23 (0.016)
PR 08 B	10	0.257		
PR 08 C	7	0.210		
PR 08 D	10	0.228		
PR 08 E	9	0.208		
PR 08 F	10	0.228		
PR 08 G	10	0.234		
PR 08 H	10	0.246		
PR 09 A	10	0.245	95.0 (5.35)	0.25 (0.017)
PR 09 B	9	0.257		
PR 09 C	9	0.238		
PR 09 D	10	0.231		
PR 09 E	11	0.232		
PR 09 F	10	0.274		
PR 09 G	9	0.261		
PR 09 H	9	0.268		
PR 10 A	10	0.217	96.3 (5.18)	0.25 (0.030)
PR 10 B	9	0.241		
PR 10 C	10	0.273		
PR 10 D	10	0.281		
PR 10 E	10	0.232		
PR 10 F	9	0.212		
PR 10 G	10	0.290		
PR 10 H	9	0.240		

A-2. Continued

Treatment REP	# Surviving amphipods	0 Rep. dry wt. (mg)	0 Treatment % Survival (SD)	0 Treatment mg. dry wt. (SD)
PR 11 A	10	0.237	96.3 (5.18)	0.26 (0.037)
PR 11 B	9	0.229		
PR 11 C	10	0.263		
PR 11 D	10	0.232		
PR 11 E	10	0.333		
PR 11 F	9	0.305		
PR 11 G	9	0.254		
PR 11 H	11	0.258		
Day 0 amphipod A[1]	10	0.089		0.11 (0.016)
Day 0 amphipod B	10	0.103		
Day 0 amphipod C	10	0.123		
Day 0 amphipod D	10	0.086		
Day 0 amphipod E	10	0.123		
Day 0 amphipod F	10	0.097		
Day 0 amphipod G	10	0.124		
Day 0 amphipod H	10	0.100		

[1]These are the dry weights of the amphipods at day 0 used to determine if there was measurable growth in the control amphipods as compared to the control amphipod weights at day 10.

A-3. Lower Potomac River amphipod *Hyalella azteca* 10 day survival and growth sediment toxicity test results (5/18-5/28/05). An * indicates a treatment significantly < the control (% = 0.05).

Treatment REP	# Surviving amphipods	0 Rep. dry wt. (mg)	0 Treatment % Survival (SD)	0 Treatment mg. dry wt. (SD)
Control A	9	0.129	88.8 (9.91)	0.13 (0.006)
Control B	7	0.133		
Control C	9	0.138		
Control D	10	0.126		
Control E	8	0.130		
Control F	10	0.129		
Control G	9	0.122		
Control H	9	0.118		
ALLEN'S FRESH A	9	0.125	92.5 (8.86)	0.14 (0.016)
ALLEN'S FRESH B	9	0.144		
ALLEN'S FRESH C	10	0.161		
ALLEN'S FRESH D	8	0.140		
ALLEN'S FRESH E	10	0.143		
ALLEN'S FRESH F	10	0.156		
ALLEN'S FRESH G	10	0.157		
ALLEN'S FRESH H	8	0.116		
NEWPORT RUN A	9	0.128	88.8 (11.26)	0.15 (0.020)
NEWPORT RUN B	8	0.143		
NEWPORT RUN C	8	0.161		
NEWPORT RUN D	10	0.157		
NEWPORT RUN E	10	0.173		
NEWPORT RUN F	10	0.178		
NEWPORT RUN G	9	0.124		
NEWPORT RUN H	7	0.143		
MDE 07 A	9	0.161	92.5 (7.07)	0.15 (0.014)
MDE 07 B	10	0.166		
MDE 07 C	11	0.177		
MDE 07 D	9	0.151		
MDE 07 E	9	0.155		
MDE 07 F	9	0.174		
MDE 07 G	10	0.131		
MDE 07 H	8	0.168		

A-3. Continued

Treatment REP	# Surviving amphipods	0 Rep. dry wt. (mg)	0 Treatment % Survival (SD)	0 Treatment mg. dry wt. (SD)
MDE 10 A	9	0.150	90.0 (5.35)	0.14 (0.017)
MDE 10 B	9	0.129		
MDE 10 C	9	0.137		
MDE 10 D	11	0.130		
MDE 10 E	9	0.113		
MDE 10 F	9	0.161		
MDE 10 G	8	0.117		
MDE 10 H	9	0.151		
MDE 11 A	10	0.126	93.8 (9.16)	0.13 (0.006)
MDE 11 B	10	0.120		
MDE 11 C	8	0.124		
MDE 11 D	10	0.120		
MDE 11 E	10	0.121		
MDE 11 F	8	0.136		
MDE 11 G	9	0.131		
MDE 11 H	10	0.121		
MDE 12 A	13	0.144	83.8 (11.88)	0.17 (0.028)
MDE 12 B	8	0.169		
MDE 12 C	8	0.202		
MDE 12 D	7	0.154		
MDE 12 E	10	0.136		
MDE 12 F	7	0.161		
MDE 12 G	9	0.192		
MDE 12 H	8	0.211		
MDE 13 A	7	0.131	78.8 (14.58)	0.17 (0.025)
MDE 13 B	10	0.175		
MDE 13 C	8	0.156		
MDE 13 D	9	0.192		
MDE 13 E	6	0.168		
MDE 13 F	8	0.211		
MDE 13 G	6	0.160		
MDE 13 H	9	0.190		

A-3. Continued

Treatment REP	# Surviving amphipods	0 Rep. dry wt. (mg)	0 Treatment % Survival (SD)	0 Treatment mg. dry wt. (SD)
PR 13 A	10	0.150	93.8 (7.44)	0.17 (0.016)
PR 13 B	8	0.182		
PR 13 C	10	0.152		
PR 13 D	9	0.187		
PR 13 E	9	0.172		
PR 13 F	10	0.190		
PR 13 G	10	0.158		
PR 13 H	9	0.165		
Day 0 amphipod A[1]	10	0.045		0.05 (0.003)
Day 0 amphipod B	10	0.049		
Day 0 amphipod C	10	0.052		
Day 0 amphipod D	10	0.052		
Day 0 amphipod E	10	0.051		
Day 0 amphipod F	10	0.055		
Day 0 amphipod G	10	0.055		
Day 0 amphipod H	10	0.054		

[1]These are the dry weights of the amphipods at day 0 used to determine if there was measurable growth in the control amphipods as compared to the control amphipod weights at day 10.

A-4. Lower Potomac River amphipod *Leptocheirus plumulosus* 10 day survival and growth sediment toxicity test results (8/16–8/26/05). An * indicates a treatment significantly < the control (% = 0.05).

Treatment REP	# Surviving amphipods	0 Rep. dry wt. (mg)	0 Treatment % Survival (SD)	0 Treatment mg. dry wt. (SD)
Control A	10	0.23	88.8 (9.91)	0.26 (0.030)
Control B	8	0.24		
Control C	8	0.24		
Control D	10	0.27		
Control E	8	0.30		
Control F	10	0.25		
Control G	8	0.31		
Control H	9	0.26		
MDE 10 A	10	0.22	92.5 (10.35)	0.28 (0.045)
MDE 10 B	8	0.35		
MDE 10 C	10	0.30		
MDE 10 D	8	0.22		
MDE 10 E	10	0.26		
MDE 10 F	10	0.32		
MDE 10 G	8	0.30		
MDE 10 H	10	0.26		
MDE 11 A	10	0.28	92.5 (8.86)	0.25 (0.045)
MDE 11 B	8	0.31		
MDE 11 C	10	0.24		
MDE 11 D	12	0.17		
MDE 11 E	8	0.24		
MDE 11 F	10	0.30		
MDE 11 G	9	0.22		
MDE 11 H	9	0.24		
PR 01 A	9	0.29	87.5 (8.86)	0.30 (0.031)
PR 01 B	9	0.31		
PR 01 C	10	0.32		
PR 01 D	9	0.27		
PR 01 E	7	0.26		
PR 01 F	9	0.35		
PR 01 G	9	0.27		
PR 01 H	8	0.32		

A-4. Continued

Treatment REP	# Surviving amphipods	0 Rep. dry wt. (mg)	0 Treatment % Survival (SD)	0 Treatment mg. dry wt. (SD)
PR 02a A	9	0.30	93.8 (5.18)	0.29 (0.051)
PR 02a B	13	0.31		
PR 02a C	10	0.35		
PR 02a D	9	0.23		
PR 02a E	9	0.20		
PR 02a F	9	0.32		
PR 02a G	9	0.32		
PR 02a H	10	0.33		
PR 03 A	10	0.38	93.8 (7.44)	0.29 (0.051)
PR 03 B	9	0.25		
PR 03 C	10	0.32		
PR 03 D	8	0.24		
PR 03 E	10	0.30		
PR 03 F	9	0.29		
PR 03 G	9	0.28		
PR 03 H	10	0.22		
PR 04 A	10	0.33	88.8 (8.35)	0.31 (0.048)
PR 04 B	8	0.31		
PR 04 C	8	0.31		
PR 04 D	10	0.28		
PR 04 E	8	0.41		
PR 04 F	9	0.27		
PR 04 G	9	0.28		
PR 04 H	9	0.26		
PR 05 A	9	0.28	95.0 (5.35)	0.29 (0.037)
PR 05 B	10	0.28		
PR 05 C	10	0.28		
PR 05 D	10	0.29		
PR 05 E	9	0.25		
PR 05 F	10	0.28		
PR 05 G	9	0.37		
PR 05 H	9	0.30		

A-4. Continued

Treatment REP	# Surviving amphipods	0 Rep. dry wt. (mg)	0 Treatment % Survival (SD)	0 Treatment mg. dry wt. (SD)
Day 0 amphipod A[1]		0.07		
Day 0 amphipod B		0.07		
Day 0 amphipod C		0.05		
Day 0 amphipod D		0.04		0.05 (0.014)
Day 0 amphipod E		0.04		
Day 0 amphipod F		0.03		
Day 0 amphipod G		0.05		
Day 0 amphipod H		0.05		

[1]These are the dry weights of the amphipods at day 0 used to determine if there was measurable growth in the control amphipods as compared to the control amphipod weights at day 10.

A-5. Lower Potomac River amphipod *Leptocheirus plumulosus* 28 day survival and growth sediment toxicity test results (8/12-9/9/05). An * indicates a treatment significantly < the control (% = 0.05).

Treatment REP	# Surviving Leptos	0 Rep. Growth rate[1] (mg/ Lepto/d)	Neonates/ Lepto	0 Treatment % Survival (SD)	0 Treatment Growth rate (mg/Lepto/d) (SD)	0 Treatment Neonates/ Lepto (SD)
Control A	17	0.066	3.9	86.0 (8.22)	0.054 (0.009)	4.0 (1.75)
Control B	17	0.058	4.1			
Control C	20	0.049	1.8			
Control D	16	0.055	6.7			
Control E	16	0.043	3.6			
MDE 10 A	18	0.075	2.3	89.0 (7.42)	0.068 (0.004)	5.6 (2.65)
MDE 10 B	20	0.066	6.2			
MDE 10 C	17	0.070	9.6			
MDE 10 D	16	0.065	5.3			
MDE 10 E	18	0.066	4.7			
MDE 11 A	18	0.043	1.2	84.0 (5.48)	0.042 (0.008)	3.7 (1.93)
MDE 11 B	16	0.030	2.7			
MDE 11 C	18	0.049	4.3			
MDE 11 D	16	0.041	3.9			
MDE 11 E	16	0.048	6.4			
PR 01 A	16	0.080	1.1	80.0 (3.54)	0.053 (0.020)	2.8 (1.98)
PR 01 B	16	0.055	3.4			
PR 01 C	16	0.051	5.4			
PR 01 D	15	0.057	3.7			
PR 01 E	17	0.023	0.6			
PR 02a A	17	0.061	7.1	94.0 (5.48)	0.059 (0.007)	4.7 (1.65)
PR 02a B	19	0.066	4.4			
PR 02a C	19	0.053	5.6			
PR 02a D	19	0.049	3.2			
PR 02a E	21	0.064	3.3			
PR 03 A	17	0.034	0.6	89.0 (8.22)	0.041 (0.008)	1.82 (1.50)
PR 03 B	17	0.033	0.6			
PR 03 C	19	0.048	3.9			
PR 03 D	20	0.038	1.1			
PR 03 E	16	0.051	2.9			

A-5. Continued

Treatment REP	# Surviving Leptos	0 Rep. Growth rate[1] (mg/ Lepto/d)	Rep Neonates/ Lepto	0 Treatment % Survival (SD)	0 Treatment Growth rate (mg/Lepto/d) (SD)	0 Treatment Neonates/ Lepto (SD)
PR 04 A	14	0.045	1.4	77.0 (9.08)	0.039 (0.008)	1.36 (1.23)
PR 04 B	17	0.028	0.3			
PR 04 C	17	0.042	1.2			
PR 04 D	13	0.033	0.5			
PR 04 E	16	0.045	3.4			
PR 05 A	14	0.039	0.6	79.0 (10.84)	0.037 (0.016)	1.42 (1.39)
PR 05 B	15	0.021	0.7			
PR 05 C	19	0.029	0.5			
PR 05 D	14	0.032	1.5			
PR 05 E	17	0.064	3.8			
Day 0 amphipod A[2]		0.04			0.04 (0.006) 0 dry wt. day 0	
Day 0 amphipod B		0.03				
Day 0 amphipod C		0.04				

[1]Growth rate = Day 28 dry weight – Day 0 dry weight/28

[2]These are the dry weights of the amphipods at day 0 used to determine if there was measurable growth in the control amphipods as compared to the control amphipod weights at day 28 and to use in the growth rate calculations.

A-6. Lower Potomac River amphipod *Hyalella azteca* 10 day survival and growth sediment toxicity test results (3/3-3/13/06). An * indicates a treatment significantly < the control (% = 0.05).

Treatment REP	# Surviving amphipods	0 Rep. dry wt. (mg)	0 Treatment % Survival (SD)	0 Treatment mg. dry wt. (SD)
Control A	10	0.18	95.0 (7.56)	0.17 (0.021)
Control B	10	0.13		
Control C	9	0.20		
Control D	10	0.16		
Control E	10	0.19		
Control F	8	0.16		
Control G	11	0.17		
Control H	9	0.17		
MDE 01 A	2	0.22	76.3 (32.49)	0.17 (0.027)
MDE 01 B	8	0.16		
MDE 01 C	10	0.14		
MDE 01 D	9	0.15		
MDE 01 E	3	0.19		
MDE 01 F	9	0.16		
MDE 01 G	10	0.14		
MDE 01 H	11	0.17		
MDE 02 A	8	0.20	95.0 (7.56)	0.18 (0.015)
MDE 02 B	10	0.18		
MDE 02 C	10	0.19		
MDE 02 D	9	0.19		
MDE 02 E	9	0.19		
MDE 02 F	10	0.19		
MDE 02 G	10	0.15		
MDE 02 H	10	0.18		
MDE 04 A	7	0.20	93.8 (10.61)	0.18 (0.017)
MDE 04 B	11	0.19		
MDE 04 C	9	0.19		
MDE 04 D	10	0.17		
MDE 04 E	10	0.15		
MDE 04 F	9	0.20		
MDE 04 G	10	0.18		
MDE 04 H	10	0.18		

A-6. Continued

Treatment REP	# Surviving amphipods	0 Rep. dry wt. (mg)	0 Treatment % Survival (SD)	0 Treatment mg. dry wt. (SD)
MDE 05 A	9	0.21	91.3 (9.91)	0.20 (0.033)
MDE 05 B	9	0.20		
MDE 05 C	9	0.19		
MDE 05 D	10	0.17		
MDE 05 E	9	0.16		
MDE 05 F	7	0.26		
MDE 05 G	10	0.21		
MDE 05 H	10	0.16		
MDE 06 A	10	0.17	90.0 (9.26)	0.18 (0.011)
MDE 06 B	10	0.17		
MDE 06 C	10	0.17		
MDE 06 D	9	0.20		
MDE 06 E	8	0.18		
MDE 06 F	9	0.18		
MDE 06 G	8	0.19		
MDE 06 H	8	0.19		
MDE 08 A	10	0.14	77.5 (33.70)	0.15 (0.065)
MDE 08 B	9	0.20		
MDE 08 C	10	0.18		
MDE 08 D	6	0.18		
MDE 08 E	0	0		
MDE 08 F	9	0.19		
MDE 08 G	9	0.17		
MDE 08 H	9	0.17		
Day 0 amphipod A[1]		0.06		0.05 (0.007)
Day 0 amphipod B		0.05		
Day 0 amphipod C		0.05		
Day 0 amphipod D		0.05		
Day 0 amphipod E		0.05		
Day 0 amphipod F		0.04		
Day 0 amphipod G		0.03		
Day 0 amphipod H		0.05		

[1]These are the dry weights of the amphipods at day 0 used to determine if there was measurable growth in the control amphipods as compared to the control amphipod weights at day 10.

A-7. Lower Potomac River amphipod *Hyalella azteca* 10 day survival and growth sediment toxicity test results (3/3-3/13/06). An * indicates a treatment significantly < the control (% = 0.05).

Treatment REP	# Surviving amphipods	0 Rep. dry wt. (mg)	0 Treatment % Survival (SD)	0 Treatment mg. dry wt. (SD)
Control A	10	0.17	97.5 (4.63)	0.17 (0.021)
Control B	10	0.17		
Control C	9	0.19		
Control D	11	0.17		
Control E	9	0.17		
Control F	10	0.12		
Control G	11	0.18		
Control H	10	0.17		
PR 02A A	10	0.16	96.3 (5.18)	0.15 (0.014)
PR 02A B	9	0.13		
PR 02A C	10	0.14		
PR 02A D	9	0.16		
PR 02A E	10	0.17		
PR 02A F	9	0.14		
PR 02A G	10	0.15		
PR 02A H	10	0.14		
PR 03 A	9	0.17	88.8 (9.91)	0.15 (0.024)
PR 03 B	8	0.18		
PR 03 C	8	0.12		
PR 03 D	8	0.17		
PR 03 E	8	0.12		
PR 03 F	10	0.14		
PR 03 G	19	0.13		
PR 03 H	10	0.14		
PR 04 A	6	0.19	82.5 (21.88)	0.19 (0.022)
PR 04 B	10	0.19		
PR 04 C	9	0.16		
PR 04 D	8	0.18		
PR 04 E	11	0.19		
PR 04 F	10	0.15		
PR 04 G	4	0.22		
PR 04 H	9	0.20		

A-7. Continued

Treatment REP	# Surviving amphipods	0 Rep. dry wt. (mg)	0 Treatment % Survival (SD)	0 Treatment mg. dry wt. (SD)
PR 05 A	10	0.18	88.8 (11.26)	0.19 (0.014)
PR 05 B	8	0.20		
PR 05 C	9	0.20		
PR 05 D	9	0.19		
PR 05 E	10	0.16		
PR 05 F	12	0.18		
PR 05 G	7	0.20		
PR 05 H	8	0.18		
PR 07 A	10	0.17	85.0 (17.73)	0.20 (0.034)
PR 07 B	5	0.21		
PR 07 C	8	0.22		
PR 07 D	9	0.22		
PR 07 E	10	0.16		
PR 07 F	11	0.17		
PR 07 G	7	0.26		
PR 07 H	9	0.20		
PR 08 A	9	0.17	97.5 (4.63)	0.19 (0.017)
PR 08 B	10	0.20		
PR 08 C	10	0.16		
PR 08 D	9	0.17		
PR 08 E	10	0.20		
PR 08 F	10	0.20		
PR 08 G	10	0.18		
PR 08 H	10	0.20		
Day 0 amphipod A[1]		0.06		0.05 (0.007)
Day 0 amphipod B		0.05		
Day 0 amphipod C		0.05		
Day 0 amphipod D		0.05		
Day 0 amphipod E		0.05		
Day 0 amphipod F		0.04		
Day 0 amphipod G		0.03		
Day 0 amphipod H		0.05		

[1]These are the dry weights of the amphipods at day 0 used to determine if there was measurable growth in the control amphipods as compared to the control amphipod weights at day 10.

A-8. Lower Potomac River amphipod *Hyalella azteca* 10 day survival and growth sediment toxicity test results (3/14-3/24/06). An * indicates a treatment significantly < the control (% = 0.05).

Treatment REP	# Surviving amphipods	0 Rep. dry wt. (mg)	0 Treatment % Survival (SD)	0 Treatment mg. dry wt. (SD)
Control A	10	0.20	95.0 (7.56)	0.19 (0.017)
Control B	9	0.19		
Control C	10	0.19		
Control D	10	0.17		
Control E	10	0.17		
Control F	10	0.21		
Control G	8	0.17		
Control H	9	0.21		
MDE 07 A	10	0.16	93.8 (5.18)	0.21 (0.028)
MDE 07 B	9	0.20		
MDE 07 C	10	0.23		
MDE 07 D	9	0.20		
MDE 07 E	9	0.19		
MDE 07 F	10	0.22		
MDE 07 G	9	0.23		
MDE 07 H	9	0.25		
MDE 10 A	8	0.17	85.0 (15.12)	0.19 (0.012)
MDE 10 B	8	0.19		
MDE 10 C	9	0.19		
MDE 10 D	11	0.19		
MDE 10 E	10	0.20		
MDE 10 F	10	0.17		
MDE 10 G	7	0.19		
MDE 10 H	6	0.20		
PR 01 A	11	0.18	97.5 (4.63)	0.19 (0.019)
PR 01 B	9	0.18		
PR 01 C	10	0.18		
PR 01 D	10	0.17		
PR 01 E	10	0.23		
PR 01 F	10	0.20		
PR 01 G	10	0.19		
PR 01 H	9	0.19		

A-8. Continued

Treatment REP	# Surviving amphipods	0 Rep. dry wt. (mg)	0 Treatment % Survival (SD)	0 Treatment mg. dry wt. (SD)
PR 09 A	10	0.19	97.5 (4.63)	0.23 (0.027)
PR 09 B	9	0.22		
PR 09 C	10	0.27		
PR 09 D	10	0.22		
PR 09 E	10	0.24		
PR 09 F	9	0.25		
PR 09 G	10	0.26		
PR 09 H	10	0.21		
PR 10 A	7	0.25	91.3 (11.26)	0.24 (0.011)
PR 10 B	11	0.24		
PR 10 C	9	0.23		
PR 10 D	10	0.23		
PR 10 E	10	0.24		
PR 10 F	8	0.25		
PR 10 G	9	0.22		
PR 10 H	10	0.25		
PR 11 A	10	0.22	100.0 (0.00)	0.23 (0.020)
PR 11 B	10	0.23		
PR 11 C	10	0.25		
PR 11 D	10	0.20		
PR 11 E	10	0.22		
PR 11 F	10	0.25		
PR 11 G	10	0.21		
PR 11 H	10	0.25		
PR 13 A	10	0.20	93.8 (5.18)	0.24 (0.025)
PR 13 B	9	0.22		
PR 13 C	10	0.22		
PR 13 D	10	0.27		
PR 13 E	9	0.23		
PR 13 F	9	0.25		
PR 13 G	9	0.23		
PR 13 H	9	0.27		

A-8. Continued

Treatment REP	# Surviving amphipods	0 Rep. dry wt. (mg)	0 Treatment % Survival (SD)	0 Treatment mg. dry wt. (SD)
Day 0 amphipod A[1]		0.05		
Day 0 amphipod B		0.05		
Day 0 amphipod C		0.06		
Day 0 amphipod D		0.05		0.05 (0.005)
Day 0 amphipod E		0.06		
Day 0 amphipod F		0.05		
Day 0 amphipod G		Lost		
Day 0 amphipod H		0.06		

[1]These are the dry weights of the amphipods at day 0 used to determine if there was measurable growth in the control amphipods as compared to the control amphipod weights at day 10.

A-9. Lower Potomac River amphipod *Hyalella azteca* 10 day survival and growth sediment toxicity test results (4/21-5/1/06). An * indicates a treatment significantly < the control (% = 0.05).

Treatment REP	# Surviving amphipods	0 Rep. dry wt. (mg)	0 Treatment % Survival (SD)	0 Treatment mg. dry wt. (SD)
Control A	10	0.16	90.0 (24.49)	0.17 (0.015)
Control B	10	0.15		
Control C	10	0.16		
Control D	10	0.17		
Control E	3	0.19		
Control F	10	0.18		
Control G	9	0.19		
Control H	10	0.17		
MDE 11 A	10	0.14	87.5 (21.88)	0.15 (0.016)
MDE 11 B	7	0.16		
MDE 11 C	10	0.16		
MDE 11 D	10	0.13		
MDE 11 E	10	0.15		
MDE 11 F	10	0.14		
MDE 11 G	9	0.18		
MDE 11 H	4	0.16		
MDE 12 A	9	0.16	91.3 (6.41)	0.19 (0.024)
MDE 12 B	8	0.16		
MDE 12 C	9	0.18		
MDE 12 D	9	0.22		
MDE 12 E	10	0.18		
MDE 12 F	10	0.17		
MDE 12 G	9	0.19		
MDE 12 H	9	0.22		
MDE 13 A	10	0.21	100.0 (0.00)	0.24 (0.025)
MDE 13 B	10	0.29		
MDE 13 C	10	0.23		
MDE 13 D	10	0.26		
MDE 13 E	10	0.23		
MDE 13 F	10	0.23		
MDE 13 G	11	0.26		
MDE 13 H	10	0.24		

A-9. Continued

Treatment REP	# Surviving amphipods	0 Rep. dry wt. (mg)	0 Treatment % Survival (SD)	0 Treatment mg. dry wt. (SD)
Allen's Fresh A	10	0.22	98.6 (3.78)	0.23 (0.031)
Allen's Fresh B	10	0.20		
Allen's Fresh C	10	0.25		
Allen's Fresh D	9	0.20		
Allen's Fresh E	10	0.27		
Allen's Fresh F	10	0.25		
Allen's Fresh G	10	0.19		
Allen's Fresh H	Bad[2]	Bad[2]		
Newport Run A	10	0.24	98.8 (3.54)	0.23 (0.031)
Newport Run B	10	0.23		
Newport Run C	10	0.17		
Newport Run D	9	0.28		
Newport Run E	10	0.22		
Newport Run F	10	0.24		
Newport Run G	10	0.22		
Newport Run H	10	0.25		
Day 0 amphipod A[1]		0.06		0.05 (0.008)
Day 0 amphipod B		0.06		
Day 0 amphipod C		0.04		
Day 0 amphipod D		0.04		
Day 0 amphipod E		0.05		
Day 0 amphipod F		0.05		
Day 0 amphipod G		0.04		
Day 0 amphipod H		0.04		

[1]These are the dry weights of the amphipods at day 0 used to determine if there was measurable growth in the control amphipods as compared to the control amphipod weights at day 10.

[2]One large amphipod (not *H. azteca*) at end of test that was probably predatory. Samples were not sieved. This replicate was eliminated from statistical analyses.

A-10. Lower Potomac River amphipod *Leptocheirus plumulosus* 10 day survival and growth sediment toxicity test results (3/14-3/24/06). An * indicates a treatment significantly < the control (% = 0.05).

Treatment REP	# Surviving amphipods	0 Rep. dry wt. (mg)	0 Treatment % Survival (SD)	0 Treatment mg. dry wt. (SD)
Control A	9	0.31	91.3 (8.35)	0.33 (0.061)
Control B	9	0.23		
Control C	8	0.29		
Control D	9	0.40		
Control E	10	0.34		
Control F	10	0.30		
Control G	8	0.37		
Control H	10	0.41		
MDE 10 A	9	0.52	92.5 (7.07)	0.48 (0.063)
MDE 10 B	9	0.53		
MDE 10 C	10	0.36		
MDE 10 D	9	0.47		
MDE 10 E	10	0.44		
MDE 10 F	10	0.47		
MDE 10 G	9	0.53		
MDE 10 H	8	0.55		
PR 01 A	9	0.44	97.5 (4.63)	0.42 (0.038)
PR 01 B	10	0.44		
PR 01 C	9	0.45		
PR 01 D	10	0.34		
PR 01 E	10	0.44		
PR 01 F	10	0.38		
PR 01 G	10	0.43		
PR 01 H	10	0.42		
PR 02a A	10	0.35	97.5 (4.63)	0.39 (0.038)
PR 02a B	10	0.33		
PR 02a C	10	0.41		
PR 02a D	10	0.37		
PR 02a E	9	0.37		
PR 02a F	10	0.40		
PR 02a G	10	0.40		
PR 02a H	9	0.45		

A-10. Continued

Treatment REP	# Surviving amphipods	0 Rep. dry wt. (mg)	0 Treatment % Survival (SD)	0 Treatment mg. dry wt. (SD)
PR 03 A	10	0.35	95.0 (5.35)	0.34 (0.051)
PR 03 B	9	0.24		
PR 03 C	9	0.34		
PR 03 D	10	0.29		
PR 03 E	10	0.36		
PR 03 F	10	0.34		
PR 03 G	9	0.36		
PR 03 H	9	0.41		
PR 04 A	9	0.23	92.5 (8.86)	0.29 (0.055)
PR 04 B	8	0.31		
PR 04 C	10	0.23		
PR 04 D	8	0.37		
PR 04 E	10	0.26		
PR 04 F	10	0.34		
PR 04 G	10	0.24		
PR 04 H	9	0.33		
PR 05 A	10	0.39	95.0 (14.14)	0.35 (0.058)
PR 05 B	10	0.47		
PR 05 C	10	0.31		
PR 05 D	6	0.34		
PR 05 E	11	0.33		
PR 05 F	10	0.28		
PR 05 G	10	0.33		
PR 05 H	10	0.35		
Day 0 amphipod A[1]		0.08		0.08 (0.010)
Day 0 amphipod B		0.08		
Day 0 amphipod C		0.09		
Day 0 amphipod D		0.09		
Day 0 amphipod E		0.07		
Day 0 amphipod F		0.08		
Day 0 amphipod G		0.08		
Day 0 amphipod H		0.10		

[1]These are the dry weights of the amphipods at day 0 used to determine if there was measurable growth in the control amphipods as compared to the control amphipod weights at day 10.

A-11. Lower Potomac River amphipod *Leptocheirus plumulosus* 10 day survival and growth sediment toxicity test results (4/21-5/1/06). An * indicates a treatment significantly < the control (% = 0.05).

Treatment REP	# Surviving amphipods	0 Rep. dry wt. (mg)	0 Treatment % Survival (SD)	0 Treatment mg. dry wt. (SD)
Control A	9	0.25	80.0 (14.14)	0.16 (0.044)
Control B	8	0.11		
Control C	8	0.15		
Control D	6	0.18		
Control E	6	0.11		
Control F	8	0.17		
Control G	10	0.17		
Control H	9	0.17		
MDE 11 A	10	0.19	86.3 (9.16)	0.19 (0.051)
MDE 11 B	8	0.18		
MDE 11 C	8	0.25		
MDE 11 D	9	0.16		
MDE 11 E	9	0.28		
MDE 11 F	9	0.12		
MDE 11 G	7	0.17		
MDE 11 H	9	0.20		
Day 0 amphipod A[1]		0.03		0.03 (0.013)
Day 0 amphipod B		0.03		
Day 0 amphipod C		0.02		
Day 0 amphipod D		0.06		
Day 0 amphipod E		0.02		
Day 0 amphipod F		0.02		
Day 0 amphipod G		0.03		
Day 0 amphipod H		0.04		

[1]These are the dry weights of the amphipods at day 0 used to determine if there was measurable growth in the control amphipods as compared to the control amphipod weights at day 10.

A-12. Lower Potomac River amphipod *Leptocheirus plumulosus* 28 day survival and growth sediment toxicity test results (3/10-4/7/06). An * indicates a treatment significantly < the control (% = 0.05).

Treatment REP	# Surviving Leptos	0 Rep. Growth rate[1] (mg/ Lepto/d)	Neonates/ Lepto	0 Treatment % Survival (SD)	0 Treatment Growth rate (mg/Lepto/d) (SD)	0 Treatment Neonates/ Lepto (SD)
Control A	17	0.050	2.6	80.0 (10.00)	0.061 (0.009)	4.9 (1.82)
Control B	17	0.067	5.1			
Control C	15	0.057	3.9			
Control D	13	0.057	7.4			
Control E	18	0.073	5. 7			
MDE 10 A	15	0.086	11.0	84.0 (7.42)	0.081 (0.005)	8.4 (3.07)
MDE 10 B	17	0.076	11.7			
MDE 10 C	16	0.084	4.3			
MDE 10 D	17	0.084	6.7			
MDE 10 E	19	0.075	8.3			
PR 01 A	15	0.073	7.1	82.0 (8.37)	0.063 (0.011)	5.2 (2.73)
PR 01 B	19	0.074	8.5			
PR 01 C	16	0.054	2.5			
PR 01 D	17	0.049	2.5			
PR 01 E	15	0.067	5.6			
PR 02a A	16	0.071	3.6	81.0 (2.24)	0.065 (0.008)	5.9 (1.71)
PR 02a B	17	0.061	6.7			
PR 02a C	16	0.062	5.1			
PR 02a D	16	0.056	8.1			
PR 02a E	16	0.077	6.1			
PR 03 A	17	0.058	3.4	81.0 (9.62)	0.046 (0.011)	2.7 (0.83)
PR 03 B	17	0.041	3.1			
PR 03 C	13	0.050	1.5			
PR 03 D	16	0.033	2.2			
PR 03 E	18	lost	3.3			
PR 04 A	17	0.044	2.8	85.0 (7.07)	0.045 (0.016)	3.2 (2.13)
PR 04 B	19	0.050	6.4			
PR 04 C	15	0.061	3.1			
PR 04 D	17	0.019	0.4			
PR 04 E	17	0.051	3.5			

A-12 Continued

Treatment REP	# Surviving Leptos	0 Rep. Growth rate[1] (mg/ Lepto/d)	Rep Neonates/ Lepto	0 Treatment % Survival (SD)	Treatment Growth rate (mg/Lepto/d) (SD)	0 Treatment Neonates/ Lepto (SD)
PR 05 A	20	0.047	2.7			
PR 05 B	17	0.046	3.7			
PR 05 C	19	0.053	4.4	87.0 (11.51)	0.053 (0.007)	3.4 (0.72)
PR 05 D	14	0.064	3.6			
PR 05 E	17	0.056	2.8			
Day 0 amphipod A[2]		0.241				
Day 0 amphipod B		0.051				
Day 0 amphipod C		0.108			0.10 (0.083) 0 dry wt. day 0	
Day 0 amphipod D		0.027				
Day 0 amphipod E		0.090				

[1]Growth rate = Day 28 dry weight – Day 0 dry weight/28

[2]These are the dry weights of the amphipods at day 0 used to determine if there was measurable growth in the control amphipods as compared to the control amphipod weights at day 28 and to use in the growth rate calculations.

A-13 Lower Potomac River amphipod *Leptocheirus plumulosus* 28 day survival and growth sediment test results (4/21-5/19/06). An * indicates a treatment significantly < the control (% = 0.05).

Treatment REP	# Surviving Leptos	0 Rep. Growth rate[1] (mg / Lepto/d)	Neonates/ Lepto	0 Treatment % Survival (SD)	0 Treatment Growth rate (mg/Lepto/d) (SD)	0 Treatment Neonates/ Lepto (SD)
Control A	20	0.061	5.20			
Control B	15	0.050	2.73			
Control C	17	0.061	8.06	80.0 (14.58)	0.061 (0.009)	5.2 (1.91)
Control D	12	0.074	4.75			
Control E	16	0.058	5.50			
MDE 11 A	15	0.032	0.07			
MDE 11 B	11	0.029	0.64			
MDE 11 C	9	0.027	0	66.0 (21.91)	0.027 (0.009)*	0.5 (0.74)*
MDE 11 D	20	0.012	0			
MDE 11 E	11	0.037	1.73			
Day 0 amphipod A[2]		0.015				
Day 0 amphipod B		0.009			0.01 (0.003)	
Day 0 amphipod C		0.014			0 dry wt.	
Day 0 amphipod D		0.014			day 0	

[1]Growth rate = Day 28 dry weight – Day 0 dry weight/28

[2]These are the dry weights of the amphipods at day 0 used to determine if there was measurable growth in the control amphipods as compared to the control amphipod weights at day 28 and to use in the growth rate calculations.