**Results of Toxicity Tests and Chemical Analyses Conducted on
Sediments Collected from the TNX Outfall Delta Operable Unit,
July 1999**

by

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TNX OUTFALL DELTA OPERABLE UNIT, JULY 1999**

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TABLE OF CONTENTS

		Page
	EXECUTIVE SUMMARY	1
1.0	INTRODUCTION	1
2.0	SAMPLING LOCATIONS	4
3.0	METHODS	5
3.1	Sample Collection	5
3.2	Metal Analyses	5
3.3	Sediment Toxicity Tests	6
4.0	RESULTS	8
4.1	Sediment Chemistry/Characterization	8
4.1.1	Data	8
4.1.2	Comparison to Toxicity Reference Values	9
4.2	Sediment Toxicity Tests	11
5.0	SUMMARY/CONCLUSIONS	13
6.0	REFERENCES	14

Appendix Tables

Appendix 1	Sediment Toxicity Test Reports
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List of Tables

		Page
Table 1	Sampling Locations for Metal Analyses and Toxicity Testing	5
Table 2	Analytical Methods and Minimum Detection Limits for Sediment Samples	6
Table 3	Test Conditions for Conducting a 10-day Sediment Toxicity Test with <i>Hyalella azteca</i> , following U.S. EPA Testing Protocol	7
Table 4	Test Conditions for Conducting a 10-day Sediment Toxicity Test with <i>Chironomus tentans</i> , following U.S. EPA Testing Protocol	7
Table 5	Results of Metal Analyses Conducted on Sediments Collected from TNX Inner Swamp, Phase I and/or II, and 1999	8
Table 6	Particle Size Distribution of TNXOD OU Sediments Used for Toxicity Testing	9
Table 7	Total Organic Carbon Concentrations Distribution of TNXOD OU Sediments Used for Toxicity Testing	9
Table 8	Results of TNX Inner Swamp <i>Hyalella azteca</i> Sediment Toxicity Tests and Unit Specific Background Toxicity Tests	12
Table 9	Percent Survival in Definitive <i>Hyalella azteca</i> Toxicity Tests at Locations OFD-A5 and OFD-D7	12
Table 10	Results of <i>Chironomus tentans</i> Toxicity Tests	13

List of Figures

		Page
Figure 1	Location of TNX ODU	2
Figure 2	TNXOD OU / 1999 Sampling Locations	3
Figure 3	Mercury Concentrations in TNX Sediments	10
Figure 4	Uranium Concentrations in TNX Sediments	10
Figure 5	Percent Mortality in <i>Hyalella azteca</i> Toxicity Tests	10

EXECUTIVE SUMMARY

In order to provide unit specific toxicity data that will be used to address critical uncertainty in the ecological risk assessment (ERA) for the TNX Outfall Delta Operable Unit (TNXOD OU), sediments were collected from eight locations in the Inner Swamp portion of the operable unit and two unit specific background locations. These samples were analyzed for total mercury, total uranium, and sediment toxicity.

The results of the chemical analyses indicate that the locations that were sampled contained elevated levels of mercury and/or uranium, as compared to unit specific background locations. Background concentrations of mercury were ≤ 0.12 mg/kg, while concentrations in the Inner Swamp ranged from 0.2 to 18.4 mg/kg. Background concentrations of uranium were < 5 mg/kg, while concentrations in the Inner Swamp ranged from 62.6 to 254 mg/kg.

The results of toxicity tests conducted on sediments collected from the Inner Swamp and the background locations indicated that 9 of the 10 locations (including both of the background locations) were toxic to *Hyalella azteca*. The toxicity was not related to contaminant concentrations and does not appear to be due to soil type (high clay) and/or lack of organic matter in the sediment material. Additional tests were performed using a different species (*Chironomus tentans*) on sediment collected from the location expected to have the highest level of mercury and one of the background locations. The results of these tests also indicated that both sediments were toxic to the test organisms. However, the sediment sample that contained very high levels of mercury and uranium were less toxic than the background reference location, which suggests that the observed toxicity to benthic dwelling invertebrates is not directly attributable to concentrations of these constituents in sediments. Dilution series toxicity tests were also performed on sediment collected from two locations, but it was not possible to determine an LC50 (lethal concentration, 50%; the concentration that results in mortality to 50% of the test organisms) for mercury or uranium since toxicity was unaffected by dilution.

In summary, the results of these three versions of sediment toxicity tests at the TNXOD OU indicate that the toxicity observed in the Inner Swamp sediments is not related to mercury or uranium concentrations.

1.0 INTRODUCTION

The TNX area of the Savannah River Site is adjacent to the Savannah River flood plain at River Mile 156 (Figures 1 and 2). TNX served as a pilot-scale testing and evaluation facility in support of chemical process for fuel and target manufacturing areas and the Defense Waste Processing Facility. Prior to 1988, wastewater generated as result of these activities was discharged to unlined earthen basins through a network of process sewers. The old TNX seepage basin was an unlined earthen excavation designed to remove wastewater solids (in the inlet section) and contain wastewater (in the seepage section) until it could infiltrate into the underlying sediments that were believed to act as a natural ion exchange media. The basin was operated from 1958 to 1980. In the spring of 1980, the wastewater flow to the basin was stopped. As part of the basin closure, the west wall of the basin was breached to drain the standing free liquids into the adjacent wetlands. The breaching, along with the basin overflow throughout its 22-year operating history, resulted in a discharge gully and outfall delta in the adjacent swamp. Among

Figure 1. Location of TNX ODU

Figure 2. TNXOD OU / 1999 Sampling Locations

the significant wastes discharged to the basin (and subsequently to the swamp) were mercury and depleted uranium.

Stormwater continues to be discharged from the TNX area via a concrete culvert located in the discharge gully. This stormwater discharge deposits "clean" sand and debris onto the surface of the outfall delta and flows into the Inner Swamp (Figure 2). The Inner Swamp in turn drains into and/or mixes with water from the nearby Savannah River.

In the spring of 1998, the portion of the TNX Outfall Delta Operable Unit (TNXOD OU) was separated from the TNX Area Operable Unit. The TNXOD OU consists of the lower portion of the Discharge Gully, the Outfall Delta, Inner Swamp, High Ground, and Outer Swamp exposure groups.

Analytical data from both the Phase I (1995-1996) and Phase II (1998) Recovery Act Facility Investigation/Remedial Investigation (RFI/RI) sampling activities are currently being evaluated. Preliminary results of the ecological risk assessment (ERA) for the TNX Inner Swamp sediment exposure group suggest that mercury is the significant constituent of potential concern (COPC) with regard to the potential for toxic effects to sediment dwelling invertebrate communities in this wetlands area. Mercury was detected in 97 of 98 samples, with six of the detections being estimated values. The range of detections was wide (0.007 mg/kg to 30.8 mg/kg) compared to the unit specific background concentrations (0.007 mg/kg to 0.12 mg/kg). Mercury is known to be related to prior TNX processes; its distribution in the Inner Swamp indicates that it is unit related. Some areas of the Inner Swamp may also contain elevated concentrations of uranium. Although the activity levels reported for U-233/234, U-235 and U-238 (Phase I and II) are not high enough to be of ecological concern from a radiological standpoint, uranium may be present at concentrations that could produce a toxic response as a heavy metal. Therefore, even though uranium was not identified as a final COPC in the ERA, it was included as an analyte in this investigation.

In July 1999 sediment samples were collected from eight locations in the Inner Swamp and two unit specific reference locations. The samples were analyzed for total mercury and total uranium and sediment toxicity tests were performed to determine if there is an accumulation of these metals at toxic levels in the Inner Swamp wetlands area. This report summarizes the results of these tests. The results will be used to address critical uncertainty in the ecological risk assessment, particularly regarding the literature-based sediment toxicity reference value for mercury. The objective of the toxicity testing effort is to estimate an LC50 (lethal concentration, 50%; the concentration that results in mortality to 50% of the test organisms). It is assumed that there is a true threshold, or concentration below which there is no adverse effect on sediment dwelling biota, and above which there is an adverse effect. Interpretation of the results of the toxicity tests and chemical analyses should identify where that threshold lies.

2.0 SAMPLING LOCATIONS

Based on the Phase I and II results of mercury analyses and uranium activity levels conducted on sediments collected from locations in the TNXOD Inner Swamp, eight locations were selected for additional analyses (Table 1, Figure 2). Samples were selected that were expected to have elevated mercury levels, elevated uranium levels, and elevated levels of both mercury and uranium. Thus the locations selected should represent worst case conditions in the TNXOD Inner Swamp. Two uncontaminated reference locations were also selected. These locations are within the Savannah River floodplain, but are located approximately 50 m upriver from the TNXOD Inner Swamp and were not known to be exposed to contaminants from TNX discharges.

All of the sampling locations lie within the floodplain of the Savannah River and contain hydric soils. Although most of the locations contained some standing water at the time of sampling, two of the locations were not inundated. For consistency, and because mercury is more of a concern in aquatic ecosystems than in terrestrial ecosystems, it was conservatively decided that sediment toxicity tests would be performed on all of the samples, rather than performing a terrestrial toxicity test on soil from the drier locations. A wet and a dry unit specific reference location were chosen so that data from the Inner Swamp locations could be compared to a unit specific reference location that had similar hydrology. Based on existing data, sites were selected which had very low to very high

levels of mercury and also very low to high levels of uranium (Table 1). If toxicity is detected and is due to either metal or a combination of the two metals, this selection of sampling locations should allow for a determination of which metal or combination of metals was responsible for the observed toxicity.

Table 1. Sampling Locations for Metal Analyses and Toxicity Testing

Location	Wet/Dry	Toxicity Tests	Rationale for Selection^a
<u>TNXOD Inner Swamp</u>			
OFD-A4	wet	<i>Hyalella</i> P/F test	high Hg; low U
TNXOD-B8	wet	<i>Hyalella</i> P/F test	moderate Hg; high U
TNXOD-C10	wet	<i>Hyalella</i> P/F test	low Hg; high U
TNXOD-D28	wet	<i>Hyalella</i> P/F test	very low Hg; high U
TNXOD-I11	dry	<i>Hyalella</i> P/F test	very low Hg; low U
TNXSED-25	wet	<i>Hyalella</i> P/F test	low Hg; high U
OFD-A5	wet	<i>Hyalella</i> dilution series	high Hg; high U
OFD-D7	dry	<i>Hyalella</i> dilution series <i>Chironomus</i> P/F test	very high Hg; very low U
<u>Unit Specific Reference</u>			
BGCH-5	dry	<i>Hyalella</i> P/F test <i>Chironomus</i> P/F test	unit specific background
BGCH-7	wet	<i>Hyalella</i> P/F test	unit specific background

^aBased on chemical data collected as part of the Phase I and II sampling investigations

3.0 METHODS

3.1 Sample Collection

Sediment samples were collected in accordance with the protocols identified in the EPA Region IV Standard Operating Procedures Quality Assurance Manual (EPA 1996), WSRC Hydrogeologic Data Collection Procedures (U), Manual 3Q5 (WSRC 1997), and Standard Guide for Collection, Storage, Characterization, and Manipulation of Sediments for Toxicological Testing (ASTM 1991). Savannah River Technical Center personnel observed the collection of the samples.

Sediment samples were collected with a hand auger that sampled the top 12 inches (30 cm) of sediment. The sediment collected was placed on a clean sheet of polyethylene and mixed thoroughly with a stainless steel spoon. A subsample was then placed in a plastic bottle for chemical analyses and the remainder of the sample was placed in a plastic jar for toxicity testing. The samples were placed in a cooler, iced, and transported to certified laboratories for analysis.

3.2 Metal Analyses

Definitive level total mercury and total uranium analyses of the sediment samples were conducted by a certified laboratory (General Engineering Laboratory, Charleston, SC; SCDHEC Certification # 10120) using the U.S. EPA SW-846 methods specified in Table 2. In interpreting the results, if a result was less than the detection limit, 50% of the sample specific method detection limit (ssmdl) was reported.

Table 2. Analytical Methods and Minimum Detection Limits for Sediment Samples

Analyte	Digestion Method	Analytical Method	SSMDL*
Mercury	Aqua Regia**	EPA7471A	3.2 to 94.3 µg/kg
Uranium	EPA3050B	EPA6020	6.5 to 18.3 µg/kg

*Sample Specific Method Detection Limit. The SSMDL for sediment samples is related to sample mass and concentration, and therefore varies among samples

**As specified in EPA7471A

3.3 Sediment Toxicity Tests

Typical 10-day amphipod sediment toxicity tests (EPA 1994) are set as pass/fail (P/F) tests with a control treatment and sample treatment. However, the objective of this toxicity testing effort is to estimate an LC50, which is not calculable in individual Pass/Fail tests. It is assumed that there is a true threshold, or concentration below which there is no adverse effect on sediment dwelling biota, and above which there is an adverse effect. The American Society for Testing and Materials (ASTM 1994) describes a dilution series toxicity test that would allow for the calculation of a threshold concentration. This testing scheme provides a gradient of concentrations to allow for a comprehensive interpretation of all of the test results in an effort to estimate as closely as possible where that threshold lies. Based on data collected in the Phase I characterization effort, a location expected to have high concentrations of mercury and uranium (OFD-A5) and a location expected to have a high concentration of mercury and low concentration of uranium (OFD-D7) were selected for dilution series tests, the rationale being that the LC50 values derived from these tests would be able to differentiate between toxicity due to mercury and toxicity due to a combination of the two metals.

10-day survival toxicity tests were conducted on the sediment samples from the ten locations using the amphipod, *Hyaella azteca* as the test species. Toxicity tests were also performed on the TNX sediment expected to have the highest mercury concentration (OFD-D7; based on Phase I data) and on the corresponding reference sediment (BGCH-5) using a different species (*Chironomus tentans*). All tests were performed by a laboratory certified to perform biological testing (ETT Environmental, Greenville, SC; SCDHEC Certification #23104001); however, SCDHEC currently has no recommended protocols for sediment toxicity tests. The testing was performed following EPA Test Methods 100.1, *Hyaella azteca* 10-day Survival Test for Sediments and 100.2 *Chironomus tentans* 10-day Survival and Growth Test for Sediments (U.S. EPA, 1994). Test conditions for the *Hyaella azteca* and *Chironomus tentans* tests are summarized in Tables 3 and 4, respectively.

The reference sediment used for the toxicity tests was collected from Resurrection Creek, Greenville County, SC. ETT Environmental routinely uses sediment from this location as a control sediment and has demonstrated that it consistently meets the survival criterion for a control sediment.

Table 3. Test Conditions for Conducting a 10-day Sediment Toxicity Test with *Hyalella azteca*, following U.S. EPA Testing Protocol

Parameter	Conditions
Test type	Whole sediment toxicity test with renewal of overlying water
Temperature	23 ± 1°C
Light quality	Wide-spectrum fluorescent lights
Light intensity	500 to 1000 lux
Photoperiod	16L:8D
Test chamber	300 ml beaker
Sediment volume	100 ml
Overlying water volume	175 ml
Water renewal	2 volume additions/day
Age of organisms	7 to 14 days at start of test
Number of organisms/chamber	10
Number of replicates/treatment	8
Feeding	YCT food, 1.5 ml/day/test chamber
Aeration	None, unless DO drops below 40% of saturation
Overlying water	Surface water
Overlying water quality parameters	Hardness, alkalinity, conductivity, pH, and ammonia at beginning and end of test; temperature and DO daily
Test duration	10 days
Endpoint	Survival
Test acceptability	Control survival ≥ 80%

Table 4. Test Conditions for Conducting a 10-day Sediment Toxicity Test with *Chironomus tentans*, following U.S. EPA Testing Protocol

Parameter	Conditions
Test type	Whole sediment toxicity test with renewal of overlying water
Temperature	23 ± 1°C
Light quality	Wide-spectrum fluorescent lights
Light intensity	500 to 1000 lux
Photoperiod	16L:8D
Test chamber	High-form lipless 300 ml beaker
Sediment volume	100 ml
Overlying water volume	175 ml
Water renewal	2 volume additions/day
Age of organisms	3rd instar larvae
Number of organisms/chamber	10
Number of replicates/treatment	8
Feeding	Tetrafin goldfish food 1.5 ml daily/test chamber
Aeration	None, unless DO drops below 40% of saturation
Overlying water	Surface water
Overlying water quality parameters	Hardness, alkalinity, conductivity, pH, and ammonia at beginning and end of test; temperature and DO daily
Test duration	10 days
Endpoint	Survival
Test acceptability	Control survival ≥ 70% and mean weight per surviving control organism of 0.6 mg.

4.0 RESULTS

4.1 Sediment Chemistry/Characterization

4.1.1 Data

The sediment chemistry data are summarized in Table 5 and Figures 3 and 4. Sediment characterization data (particle size distribution, organic matter content, and percent moisture) are presented in Tables 6 and 7.

Mercury concentrations at the two TNXOD background locations were 0.05 and 0.12 mg/kg, which are within the range of values for uncontaminated soils in the U.S., as reported by Kabata-Pendias and Pendias, 1992 (range of 0.02 to 1.50 mg/kg; mean of 0.17 mg/kg) and uncontaminated wetland soils on the SRS and in South Carolina, as reported by Dixon et al. (1997). Dixon et al. reported that mercury concentrations in uncontaminated wetland soils collected from 50 locations on the SRS ranged from <0.055 to 0.3 mg/kg and averaged 0.052 mg/kg. At the 25 off-site locations that were sampled, mercury concentrations in wetland soils ranged from <0.023 to 0.74 mg/kg and averaged 0.043 mg/kg. Three of the eight locations that were sampled in the TNXOD Inner Swamp had relatively low concentrations of mercury in the sediments (<0.4 mg/kg), while five of the locations had mercury concentrations >2 mg/kg (Table 5; Figure 3). Location OFD-A4 had substantially more mercury than any of the other sampling locations (18.4 mg/kg).

Table 5. Results of Metal Analyses Conducted on Sediments Collected from TNXOD Inner Swamp, Phase I and/or II, and 1999

Location	1999 Mercury (mg/kg)	Phase I/II Mercury (mg/kg)	1999 Uranium (mg/kg)
BGCH-5 ^a	0.05	0.09	3.74
BGCH-7 ^a	0.12	0.12	4.80
OFD-A4	18.40	15.7	196.0
OFD-A5	3.62	17.7	62.60
TNXOD-B8	4.01	8.83	254.0
TNXOD-C10	4.14	2.28	87.70
TNXOD-D28	0.35	0.61	110.0
OFD-D7	3.17	30.8	197.0
OFD-D7 (duplicate)	2.30	33.8	104.0
TNXOD-I11	0.31	0.27	93.2
TNXSED-25	0.20	4.77	66.7
Lab Ref. Sediment ^b	-		

^aUnit specific background location

^bThe laboratory control sediment used for these tests was from Resurrection Creek, Greenville Co, SC.

A comparison of mercury concentrations measured in Phase I and/or Phase II and 1999 at the same locations indicates that the concentrations measured were generally similar. Notable exceptions were OFD-A5 and OFD-D7, both of which had much lower concentrations of mercury in 1999 than in 1996 (Table 5). It should be noted that the Phase I maximum result of 30.8 mg/kg from location OFD-D7 is flagged with a "V" analysis qualifier (WSRC 1996) indicating method blank contamination, potentially

resulting in an over-estimation of the actual concentration. Overall, these results suggest that the distribution of mercury in the TNX Inner Swamp may be very patchy.

Uranium concentrations in the TNXOD OU unit specific reference sediments were <5 mg/kg, which are within the range of values for uncontaminated soils in the U.S., as reported by Kabata-Pendias and Pendias, 1992 (range of 0.3 to 10.7 mg/kg; mean of 3.7 mg/kg). Uranium concentrations in the TNXOD Inner Swamp sediments ranged from 62.6 to 254 mg/kg (Table 5, Figure 4). Location TNXOD-B8 had the highest concentration of uranium, but locations OFD-A4 and OFD-D7 also had relatively high concentrations (~200 mg/kg).

The particle size distribution of the TNX sediments (Table 6) indicates that all of the sediments were composed primarily of sands (0.06 to 2 mm), with lesser amounts of clay and silt (<0.04 mm) and gravel (>2.0 mm). Total organic carbon concentrations in all of the TNX sediments (Table 7) were very low (<1 mg/kg).

Table 6. Particle Size Distribution of TNXOD OU Sediments Used for Toxicity Testing

Location	Particle Size Distribution by Percentage					
	<0.12 mm	0.12-0.27 mm	0.27-0.50 mm	0.5-0.8 mm	0.8-2.0 mm	>2.0 mm
BGCH-5 ^a	14.4	24.3	28.8	16.4	13.8	2.2
BGCH-7 ^a	9.5	11.2	14.2	16.2	31.2	17.7
OFD-A4	11.8	12.3	11.7	13.0	30.0	21.2
OFD-A5	10.9	9.9	10.3	6.4	60.0	2.5
TNXOD-B8	20.0	19.8	24.6	15.9	15.4	4.3
TNXOD-C10	19.7	31.8	22.8	12.4	9.6	3.7
TNXOD-D28	16.2	18.4	28.3	17.3	14.8	4.9
OFD-D7	13.0	13.5	24.5	23.6	21.4	4.0
TNXOD-I11	13.9	23.5	31.9	18.8	10.5	1.5
TNXSED-25	22.8	21.2	28.4	14.9	11.1	1.6

Table 7. Total Organic Carbon Concentrations of TNXOD OU Sediments Used for Toxicity Testing

Location	Total Organic Carbon (mg/kg)
BGCH-5 ^a	534
BGCH-7 ^a	155
OFD-A4	305
OFD-A5	298
TNXOD-B8	317
TNXOD-C10	160
TNXOD-D28	271
OFD-D7	331
TNXOD-I11	193
TNXSED-25	235

4.1.2 Comparison to Toxicity Reference Values

The toxicity reference value (TRV) used for mercury in the ERA document is an Effects Range- Low (ER-L) value of 0.15 mg/kg, as described in *Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Sediment Associated Biota* (Jones et al. 1997). The ER-L value may significantly over predict the likelihood of real effects. This is important because chemical concentrations may not be accurate predictors of biological and ecological effects. This is because the percentage of the

Figure 3. Mercury Concentrations in TNXOD OU Sediments

Figure 4. Uranium Concentrations in TNXOD OU Sediments

Figure 5. Percent Mortality in *Hyalella azteca* Toxicity Tests

chemical that is bioavailable may range from 0-100%. Benchmarks may be used to determine which chemicals present in the sediment are most likely causing toxicity. The use of site specific biological data, such as toxicity tests, enables a more accurate evaluation of potential for adverse ecological impact. All of the eight locations sampled in the TNX Inner Swamp exceeded the TRV for mercury. A TRV for uranium is not available.

4.2 Sediment Toxicity Tests

The results of the sediment toxicity tests conducted on *Hyaella azteca* are summarized in Table 8 and 9 and Figure 5; detailed results are presented in Appendix 1. The results of the pass/fail tests indicate that, with the exception of TNXSED-25, all of the sediments, including both of the unit specific background locations (BGCH-5 and BGCH-7), had significant mortality as compared to the control sediment. Of the 10 locations that were tested, the unit specific background locations were among the most toxic locations tested, even though these locations had very low levels of mercury and uranium. Correlation coefficients were calculated for mercury concentrations vs. percent mortality and uranium concentrations vs. percent mortality. The results of the analyses indicate a correlation coefficient of -0.06385 for mercury vs. mortality and 0.031224 for uranium vs. mortality. These very low correlation coefficients (a value of 1.0 indicates perfect positive correlation, a value of -1.0 indicates perfect inverse correlation, and a value of 0.0 indicates no correlation) indicate that there is no relationship between the concentrations of mercury and uranium in the TNXOD sediments and *Hyaella azteca* mortality. As part of the RFI/RI investigation for TNXOD analyses for TAL, TCL, pesticides, PCB's and radionuclides were performed on the unit specific background sediments, as well as the operable unit sediments. In all, analyses for 161 chemical constituents and 45 radiological constituents were measured (WSRC 1999). The results indicated that none of the analytes were present at the unit-specific background locations in concentrations that would be expected to produce toxicity. Therefore, it is likely that other factors are responsible for the observed toxicity.

As discussed in Section 3.3, definitive (dilution series) *Hyaella azteca* toxicity tests were performed on the location that was expected to have the highest concentration of mercury and the location expected to have the highest concentration of uranium (based on sediment chemistry data collected in Phase I and/or II). These locations were OFD-D7 (high mercury) and OFD-A5 (high uranium). The definitive tests were conducted with the intent of being able to determine LC50's for mercury and uranium. The results of the definitive tests showed no clear relationship between sediment concentration and toxicity (Table 9). For OFD-D7, the undiluted sediment was the most toxic concentration (22.5% survival). However, when OFD-D7 sediment was diluted with the laboratory reference sediment to a concentration of 12.5%, percent mortality was higher (55%) than was a dilution of 25%. For the sediment from OFD-A5, the most dilute test (12.5%) had the highest mortality (69%). There is no obvious explanation for these results. However, it was not possible to calculate LC50's for either mercury or uranium based on the results of the tests. Also, much lower levels of mercury were measured at both of these locations in 1999 than in Phase I and/or Phase II RFI/RI investigations.

Communication with the laboratory that performed the *Hyaella azteca* toxicity tests indicated that most of the sediments that were tested appeared to be clayey and had low organic matter. *Hyaella azteca* prefers sediments with more organic matter and less

clay. It was suggested that toxicity tests be conducted using *Chironomus tentans*, which is somewhat more tolerant of heavy soils (personal communication, Dr. Robert Kelley, ETT Environmental). Based on existing chemical data, the location that was expected to have the highest concentration of mercury (OFD-D7) was chosen for further testing. For comparison, a *C. tentans* test was also performed on the unit specific background location that was dry (BGCH-5). The results of these tests indicate that percent mortality of *C. tentans* from both sediments was significantly higher than that of the laboratory reference sediment (Table 10). Percent mortality in the reference sediment was 33%, as compared to 50% in OFD-D7 and 85% in BGCH-5. These results suggest that both sediments were unsuitable to *C. tentans*, but the very low recovery from BGCH-5 again suggests that the toxicity is not due to the presence of chemical contaminants, but is more likely due to unsuitable sediment characteristics. However, an examination of particle size distribution and percent organic matter in the sediments that were tested showed no clear relationship between either of these parameters and toxicity. TNXSED25 had the highest percentage of fine particles (<0.12 mm), and yet was the only sediment that was not toxic. Concentrations of total organic carbon in the TNX sediments ranged from 155 to 534 mg/kg. Organic carbon in the TNXSED 25 sediment was 235 mg/kg. Therefore, there is no obvious relationship between the sediment characteristics that were measured and sediment toxicity. However, as previously discussed, toxicity was not related to mercury or uranium concentrations, and no other chemical constituents were identified in the Phase I and/or Phase II RFI/RI investigations that were present in potentially toxic concentrations in the TNXOD sediments.

Table 8. Results of TNXOD Inner Swamp *Hyaella azteca* Sediment Toxicity Tests and Unit Specific Background Toxicity Tests

Location	Percent Mortality	Significant Mortality (p=0.05)
Reference Sediment ^a	16.0	- ^b
TNXOD Inner Swamp		
OFD-A4	42.5	Yes
OFD-A5	67.5	Yes
TNXOD-B8	51.2	Yes
TNXOD-C10	36.2	Yes
OFD-D7	77.5	Yes
TNXOD-D28	40.0	Yes
TNXOD-I11	38.7	Yes
TNXSED-25	26.2	No
Unit Specific Background		
BGCH-5	52.5	Yes
BGCH-7	68.7	Yes

^aReference sediment is from Resurrection Creek, Greenville Co., SC

^bSignificance cannot be calculated since the Reference Sediment is the sediment against which all test sediments are compared

Table 9. Percent Mortality in Definitive *Hyaella azteca* Toxicity Tests at Locations OFD-A5 and OFD-D7.

Location	Test Concentrations			
	12.5%	25%	50%	100%
OFD-A5	69%	50%	52%	67.5%
OFD-D7	55%	37.5%	70%	77.5%

Table 10. Results of *Chironomus tentans* Toxicity Tests

Location	Percent Mortality	Significant Mortality (p=0.05)
Reference Sediment ^a	33	- ^b
OFD-D7	50	Yes
BGCH-5	85	Yes

^aReference sediment is from Resurrection Creek, Greenville Co., SC

^bSignificance cannot be calculated since the Reference Sediment is the sediment against which all test sediments are compared

5.0 SUMMARY/CONCLUSIONS

The results of the chemical analyses indicate that the locations that were sampled contained elevated levels of mercury and/or uranium, as compared to unit specific background locations. Background concentrations of mercury were ≤ 0.12 mg/kg, while concentrations in the Inner Swamp ranged from 0.2 to 18.4 mg/kg. Background concentrations of uranium were < 5 mg/kg, while concentrations in the Inner Swamp ranged from 62.6 to 254 mg/kg.

The results of toxicity tests conducted on sediments collected from the Inner Swamp and the two unit specific background locations indicated that 9 of the 10 locations that were tested, including the two background locations, were toxic to *Hyaella azteca*. The toxicity was not related to contaminant concentrations and does not appear to be due to soil type (high clay) and/or lack of organic matter in the sediment material. Additional tests were performed on the location expected have the highest level of mercury and one of the background locations with a different species (*Chironomus tentans*). The results of these tests also indicated that both sediments were toxic to the test organisms. However, the sediment sample that contained very high levels of mercury and uranium were less toxic than the background reference location, which suggests that the observed toxicity to sediment dwelling invertebrates is not attributable to concentrations of these constituents in the sediment. It was not possible to determine LC50's for mercury or uranium since toxicity was unaffected by dilution. In summary, the results of these three versions of sediment toxicity tests at the TNXOD OU indicated that the toxicity observed in the Inner Swamp sediment is not related to mercury or uranium concentrations.

Even though mercury and uranium concentrations are elevated in the TNX ODU sediments, the metals do not appear to be toxic to sediment biota, as evidenced by the lack of correlation between metal concentrations and sediment toxicity. Mercury binds tightly to organic material and sulfides and in these forms, is not biologically available. Methylated mercury compounds, which are formed by sulfur-reducing bacteria under strongly anoxic conditions, are the most biologically available forms of mercury. The shallow depth of water present at the TNX ODU and periodic drying of the sediments that occurs during periods of low rainfall are not conducive to the formation of methyl mercury. Uranium is very insoluble, which should result in limited mobility and bioavailability in the TNX ODU sediments.

6.0 REFERENCES

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- WSRC. 1999. Westinghouse Savannah River Company. Data Summary Report for the RFI/RI Assessment of the TNX Outfall Delta. WSRC-TR-99-00034. Savannah River Site, Aiken, SC.

APPENDIX 1

P.O. Box 16414, Greenville, SC 29606

(864) 877-6942 • FAX (864) 877-6938

4 Craftsman Court, Greer, SC 29650

10 DAY AMPHIPOD SEDIMENT TOXICITY TEST

EPA/600/R-94/024 Method 100.1

Test Organism: Hyallela azteca

Client: WSRC
Sample Identification: A-4

Test Start Date: 8/4/99

10 DAY AMPHIPOD SEDIMENT TOXICITY TEST

Lab ID#	Client: WSRC	Start Date: 8/4/99
T12306	Sample Identification: A-4	End Date: 8/14/99

Test System

EPA/600/R-94/024 Method 100.1

The test was set as a Pass/Fail test with a control treatment and one sample treatment. Each treatment replicate consisted of 100 g of sediment and 175 mL of dilution water. There were eight replicates for each treatment. Ten test organisms were placed in each replicate. Sediment from a local stream was used in the control treatment. Test organisms were fed with YCT food. The test was conducted at a temperature of 23°C and a light cycle of 16 hr light/8 hr dark. Test vessels were 500 mL plastic beakers placed in a constant temperature incubator room.

<p align="center">Test Organisms</p> <p>Order: Amphipoda Species: <i>Hyallela azteca</i> Source: Aquatic Biosystems, Fort Collins, CO Life Stage: 7 to 14 days % Mortality During 48 Hr Prior to Test:: 0% Taxonomic Verification: RWK 8/4/99 Culturing: as received</p> <p>Observations: Cultures healthy Acclimation: None</p>	<p align="center">Dilution Water</p> <p>Type: Surface Water Collection Date 8/4/99 Initial:</p> <table> <tr> <td>Alkalinity</td> <td>10.4</td> <td>mg/L</td> </tr> <tr> <td>Hardness</td> <td>11.4</td> <td>mg/L</td> </tr> <tr> <td>Conductivity</td> <td>285</td> <td>umhos/cm</td> </tr> <tr> <td>pH:</td> <td>7.63</td> <td>units</td> </tr> </table> <p>Preparation Method: Grab sample</p>	Alkalinity	10.4	mg/L	Hardness	11.4	mg/L	Conductivity	285	umhos/cm	pH:	7.63	units
Alkalinity	10.4	mg/L											
Hardness	11.4	mg/L											
Conductivity	285	umhos/cm											
pH:	7.63	units											
<p align="center">Control Sediment</p> <p>Source: Resurrection Creek Collection Date: 8/4/99 Preservation: kept at 0-4°C in plastic Date/Time Added to Test Chambers: 8/3/99 Observations: silt, detritus Collection Method: grab Disposal</p>	<p align="center">Test Sediment</p> <p>Source: A-4 Collection Date 7/19/99 Homogenized?: yes Preservation: kept at 0-4°C in plastic Date/Time Added to Test Chambers: 8/3/99 Observations: Collection Method: grab Shipment: overnight</p>												
<p align="center">Food Preparation</p> <p>Source: YCT Purchase Date: Preparation Date: 8/4/99 Preservation: kept at 0-4°C Preparation Method: Trout Chow aerated 7 days Cerophyl, yeast aerated overnight Feeding Rate: 1.5 mL / day / replicate Hold Time: 5 days</p>	<p align="center">Test Chambers</p> <p>Type: Plastic 500 mL beakers Sediment Volume: 100 mL Sediment Dept 4 cm Overlying Water Volume: 175 mL Overlying Water Depth: 5 cm Aeration: Not needed</p>												

10 DAY AMPHIPOD SEDIMENT TOXICITY TEST

Lab ID#	Client: WSRC	Start Date: 8/4/99
T12306	Sample Identification: A-4	End Date: 8/14/99

WATER CHEMISTRY TEST METHODS

Temperature: SM 18th Ed. 2550	Alkalinity: SM 18th Ed. 2320
Dissolved Oxygen: SM 18th Ed. 4500-O	Hardness: SM 18th Ed. 2340
pH: SM 18th Ed. 4500-H+	Conductivity: SM 18th Ed. 2510

WATER CHEMISTRY TEST DATA - OVERLYING WATER

CONTROL TREATMENT

Test Day	Temp. C	pH units	D.O. mg/L	D.O. % sat.	Alkalinity	Ammonia
					Initial	Initial
Start	22.3	7.63	8.0	92%	10.4	<0.20
1	20.5		7.9	87%	Final	Final
2	22.6		7.6	87%	49.4	<0.1
3	22.0		7.5	86%	mg/L	mg/L
4	20.2		7.8	86%	Cond.	Hardness
5	21.5		7.0	79%	Initial	Initial
6	22.2		7.2	83%	285	11.4
7	21.2		6.8	76%	Final	Final
8	20.8		6.8	75%	175.0	49.4
9	20.2		8.0	88%	umhos/cm	mg/L
10	21.0	7.46	4.9	55%	Aeration: none	

SAMPLE TREATMENT

Test Day	Temp. C	pH units	D.O. mg/L	D.O. % sat.	Alkalinity	Ammonia
					Initial	Initial
Start	22.3	7.63	8.0		10.4	<0.20
1	20.6		8.0	88%	Final	Final
2	22.6		7.9	91%	7.2	<0.1
3	22.0		7.5	86%	mg/L	mg/L
4	20.2		7.7	85%	Cond.	Hardness
5	21.5		7.1	80%	Initial	Initial
6	22.2		7.3	84%	285	11.4
7	21.2		7.1	80%	Final	Final
8	20.8		6.8	75%	46.0	<0.1
9	19.8		8.0	86%	umhos/cm	mg/L
10	21.0	7.66	8.0	90%	Aeration: none	

SURVIVAL AND GROWTH RESULTS

CONTROL TREATMENT

	# Organisms				Mean Length (mm)	Standard Deviation
	Initial	Live at End	Dead at End	% Survival		
A	10	10	0	100%		
B	10	6	4	60%		
C	10	9	1	90%		
D	10	8	2	80%		
E	10	10	0	100%		
F	10	10	0	100%		
G	10	5	5	50%		
H	10	9	1	90%		
Mean	10.0			84%		

SAMPLE TREATMENT

	# Organisms				Mean Length (mm)	Standard Deviation
	Initial	Live at End	Dead at End	% Survival		
A	10	7	3	70%		
B	10	1	9	10%		
C	10	4	6	40%		
D	10	6	4	60%		
E	10	8	2	80%		
F	10	6	4	60%		
G	10	5	5	50%		
H	10	9	1	90%		
Mean	10.0			58%		

10 DAY AMPHIPOD SEDIMENT TOXICITY TEST

Lab ID#	Client: WSRC	Start Date: 8/4/99
T12306	Sample Identification: A-4	End Date: 8/14/99

RESULTS

SURVIVAL DATA		GROWTH DATA	
Mean of Eight Replicates		Mean Length (mm)	
	Mean %		Mean
Control	83.8%	Control	NA
Sample	57.5%	Sample	NA

STATISTICAL ANALYSES

SURVIVAL DATA	GROWTH DATA
Test for Normality: W= 0.94	Test for Normality: W= NA
Critical value: 0.84	Critical value: 0.84
Data are normal in distribution	NA
Test for Homogeneity of Variance:	Test for Homogeneity of Variance:
F= 1.03	F= NA
Critical value: 6.64	Critical value: 6.635
Data are homogeneous in variance	NA
Test for Differences in Survival: "t" Test	Test for Differences in Survival: "t" Test
t= 2.56	t= NA
Critical value: 1.75	Critical value: 1.94
The sediment significantly reduced survival of the test organisms.	

COMMENTS

None

Principal Analyst: Marsha Leitzel	Signature: <i>Marsha Leitzel</i>	Date: 10-19-99
Report Reviewed By: Robert W. Kelley, Ph.D.	Signature: <i>R. Kelley</i>	Date: 10-19-99

CONCLUSIONS

The sediment reduces the survival of the test organisms.

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4 Craftsman Court, Greer, SC 29650

10 Day Chronic Definitive Sediment Toxicity Test

Method: EPA/600/R-94/024 100.1

Test Organism: *Hyallela azteca*

**Facility: WSRC
Sample ID: A-5**

County: Aiken
NPDES#:
ETT#: T12305

Sample ID: August 4, 1999

CHRONIC DEFINITIVE SEDIMENT 10 DAY SURVIVAL TEST

Lab ID#	Client: WSRC	Start Date: 8/4/99
T12304	Sample Identification: D-7	End Date: 8/14/99

Test System

EPA/600/R-94/024 Method 100.1

The test was set as a Definitive test with a control treatment and four sample treatments. Each treatment replicate consisted of 100 g of sediment and 175 mL of dilution water. There were four replicates for each treatment. Ten test organisms were placed in each replicate. Sediment from a local stream was used in the control treatment. Test organisms were fed with YCT food. The test was conducted at a temperature of 23°C and a light cycle of 16 hr light/8 hr dark. Test vessels were 500 mL plastic beakers placed in a constant temperature incubator room.

<p align="center">Test Organisms</p> <p>Order: Amphipoda Species: <i>Hyallela azteca</i> Source: Aquatic Biosystems, Fort Collins, CO Life Stage: 7 to 14 days % Mortality During 48 Hr Prior to Test:: 0% Taxonomic Verification: RWK 8/4/99 Culturing: as received</p> <p>Observations: Cultures healthy Acclimation: None</p>	<p align="center">Dilution Water</p> <p>Type: Surface Water Collection Date: 8/4/99 Initial</p> <table> <tr> <td>Alkalinity</td> <td>10.4</td> <td>mg/L</td> </tr> <tr> <td>Hardness</td> <td>11.4</td> <td>mg/L</td> </tr> <tr> <td>Conductivity</td> <td>285</td> <td>umhos/cm</td> </tr> <tr> <td>pH:</td> <td>7.63</td> <td>units</td> </tr> </table> <p>Preparation Method: Grab sample</p>	Alkalinity	10.4	mg/L	Hardness	11.4	mg/L	Conductivity	285	umhos/cm	pH:	7.63	units
Alkalinity	10.4	mg/L											
Hardness	11.4	mg/L											
Conductivity	285	umhos/cm											
pH:	7.63	units											
<p align="center">Control Sediment</p> <p>Source: BGCH7 Collection Date: 7/19/99 Preservation: kept at 0-4°C in plastic Date/Time Added to Test Chambers: 8/3/99 Observations: Collection Method: grab Disposal:</p>	<p align="center">Test Sediment</p> <p>Source: A-5 Collection Date: 7/19/99 Homogenized?: yes Preservation: kept at 0-4°C in plastic Date/Time Added to Test Chambers: 8/3/99 Observations: Collection Method: grab Shipment: overnight</p>												
<p align="center">Food Preparation</p> <p>Source: YCT Purchase Date: Preparation Date: 8/4/99 Preservation: kept at 0-4°C Preparation Method: Trout Chow aerated 7 days Cerophyl, yeast aerated overnight Feeding Rate: 1.5 mL / day / replicate Hold Time: 5 days</p>	<p align="center">Test Chambers</p> <p>Type: Plastic 500 mL beakers Sediment Volume: 100 mL Sediment Depth: 4 cm Overlying Water Volume: 175 mL Overlying Water Depth: 5 cm Aeration: Not needed</p>												

CHRONIC DEFINITIVE SEDIMENT 10 DAY SURVIVAL TEST **Survival Results**

Client: **WSRC**
 Sample Identification: **A-5**
 Test Date: **August 4, 1999**

County: **Aiken**
 NPDES#:
 ETT #: **T12305**

Survival in Control sediment (BGCH7)						
Day	Rep. A	Rep B	Rep. C	Rep. D		Mean %
0	10	10	10	10		100%
10	1	1	4	6		30%
# Dead	9	9	6	4		70%
# Lost	0	0	0	0		0%

Survival at 12.5% sediment A-5 w/ 87.5% sediment BGCH7						
Day	Rep. A	Rep B	Rep. C	Rep. D		Mean %
0	10	10	10	10		100%
10	2	7	2	2		33%
# Dead	8	3	8	8		68%
# Lost	0	0	0	0		0%

Survival at 25% sediment A-5 w/ 75% sediment BGCH7						
Day	Rep. A	Rep B	Rep. C	Rep. D		Mean %
0	10	10	10	10		100%
10	3	6	2	9		50%
# Dead	7	4	8	1		50%
# Lost	0	0	0	0		0%

Survival at 50% sediment A-5 w/ 50% sediment BGCH7						
Day	Rep. A	Rep B	Rep. C	Rep. D		Mean %
0	10	10	10	10		100%
10	3	1	6	9		48%
# Dead	7	9	4	1		53%
# Lost	0	0	0	0		0%

Survival at 100% sediment A-5						
Day	Rep. A	Rep B	Rep. C	Rep. D		Mean %
0	10	10	10	10		100%
10	6	0	2	5		33%
# Dead	4	10	8	5		68%
# Lost	0	0	0	0		0%

Survival at						
Day	Rep. A	Rep B	Rep. C	Rep. D		Mean %
0						
1						
2						
3						
4						
5						
6						
7						
# Dead						
# Lost						

CHRONIC DEFINITIVE SEDIMENT 10 DAY SURVIVAL TEST **Statistical Analyses - Survival**

Client: WSRC
 Sample Identification: A-5
 Test Date: August 4, 1999

Test for Normality

Test Used: Shapiro-Wilks W= 0.953
 critical 0.884

The data are normal in distribution

Test for Homogeneity of Variance

Test Used: Bartlett's Test B= 0.56
 critical 15.086

The data are homogeneous in variance

Test for Differences in Survival

Test Type Used: t Test

t Test	Test Concentration				
	Control	12.5%	25.0%	50.0%	100%
t Value		-0.20	-1.17	-1.00	-0.10
critical		2.55	2.55	2.55	2.55
survival	30%	33%	50%	48%	33%

Wilcoxon's Test	Test Concentration				
	12.5%	25.0%	50.0%	100%	
Rank Sum	NA	NA	NA	NA	
critical	NA	NA	NA	NA	

NOEC (Survival): NA
 LOEC (Survival): NA
 Chronic Value: NA

Effluent Conc. vs. Survival

Summary

Both the control sediment and the test sediment reduced survival.
 Survival in 100% control sediment was not significantly less than in the control sediment.

CHRONIC DEFINITIVE SEDIMENT 10 DAY SURVIVAL TEST **Water Chemistry**

Client: **WSRC**
 Sample Identification: **A-5**
 Test Date: **August 4, 1999**

Control Sediment

	Alkal.	Hard.	Cond.	NH3		
	mg/L	mg/L	umhos	mg/L		
Initial	10.4	11.4	285	<0.1		
Day 10	88.2	49.4	175	<0.2		

Test Sediment

	Alkal.	Hard.	Cond.	NH3		
	mg/L	mg/L	umhos	mg/L		
Initial	10.4	11.4	285	<0.1		
Day 10	10.7	3.8	41	0.13		

Temperature

	Test Concentration				
	Control	12.50%	25.00%	50.00%	100%
Initial	22.3		22.3		22.3
Day 1	20.2		20.5		20.5
Day 2	22.6		22.2		22.6
Day 3	21.1		22.0		22.0
Day 4	20.2		20.2		20.2
Day 5	21.5		21.5		21.5
Day 6	22.2		22.2		22.2
Day 7	21.2		21.2		20.8
Day 8	20.8		20.8		19.8
Day 9	19.7		19.8		21.0
Day 10	21.0		21.0		21.0

Dissolved Oxygen

	Test Concentration				
	Control	12.50%	25.00%	50.00%	100%
Initial	8.0		8.0		8.0
Day 1	8.0		7.6		7.7
Day 2	7.2		8.0		8.0
Day 3	7.5		8.0		8.0
Day 4	7.2		7.4		7.4
Day 5	7.2		7.7		7.8
Day 6	7.5		7.4		7.4
Day 7	7.1		7.2		7.2
Day 8	7.0		7.3		7.3
Day 9	7.8		7.8		7.7
Day 10	7.7				8.1

Test Results Reviewed and Approved By: _____

R. V. [Signature]

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4 Craftsman Court, Greer, SC 29650

10 DAY AMPHIPOD SEDIMENT TOXICITY TEST

EPA/600/R-94/024 Method 100.1

Test Organism: *Hyallela azteca*

Client: WSRC
Sample Identification: A-11

Test Start Date: 8/4/99

10 DAY AMPHIPOD SEDIMENT TOXICITY TEST

Lab ID#	Client: WSRC	Start Date: 8/4/99
T12309	Sample Identification: A-11	End Date: 8/14/99

Test System

EPA/600/R-94/024 Method 100.1

The test was set as a Pass/Fail test with a control treatment and one sample treatment. Each treatment replicate consisted of 100 g of sediment and 175 mL of dilution water. There were eight replicates for each treatment. Ten test organisms were placed in each replicate. Sediment from a local stream was used in the control treatment. Test organisms were fed with YCT food. The test was conducted at a temperature of 23°C and a light cycle of 16 hr light/8 hr dark. Test vessels were 500 mL plastic beakers placed in a constant temperature incubator room.

<p style="text-align: center;">Test Organisms</p> <p>Order: Amphipoda Species: <i>Hyallela azteca</i> Source: Aquatic Biosystems, Fort Collins, CO Life Stage: 7 to 14 days % Mortality During 48 Hr Prior to Test:: 0% Taxonomic Verification: RWK 8/4/99 Culturing: as received</p> <p>Observations: Cultures healthy Acclimation: None</p>	<p style="text-align: center;">Dilution Water</p> <p>Type: Surface Water Collection Date 8/4/99</p> <table> <tr> <td>Initial</td><td></td></tr> <tr> <td>Alkalinity</td><td>10.4 mg/L</td></tr> <tr> <td>Hardness</td><td>11.4 mg/L</td></tr> <tr> <td>Conductivity</td><td>285 umhos/cm</td></tr> <tr> <td>pH:</td><td>7.63 units</td></tr> </table> <p>Preparation Method: Grab sample</p>	Initial		Alkalinity	10.4 mg/L	Hardness	11.4 mg/L	Conductivity	285 umhos/cm	pH:	7.63 units
Initial											
Alkalinity	10.4 mg/L										
Hardness	11.4 mg/L										
Conductivity	285 umhos/cm										
pH:	7.63 units										
<p style="text-align: center;">Control Sediment</p> <p>Source: Resurrection Creek Collection Date: 8/4/99 Preservation: kept at 0-4°C in plastic Date/Time Added to Test Chambers: 8/3/99 Observations: silt and organic Collection Method: grab Disposal</p>	<p style="text-align: center;">Test Sediment</p> <p>Source: I-11 Collection Date 7/16/99 Homogenized?: yes Preservation: kept at 0-4°C in plastic Date/Time Added to Test Chambers: 8/3/99 Observations: Collection Method: grab Shipment: overnight</p>										
<p style="text-align: center;">Food Preparation</p> <p>Source: YCT Purchase Date: Preparation Date: 8/4/99 Preservation: kept at 0-4°C Preparation Method: Trout Chow aerated 7 days Cerophyl, yeast aerated overnight Feeding Rate: 1.5 mL / day / replicate Hold Time: 5 days</p>	<p style="text-align: center;">Test Chambers</p> <p>Type: Plastic 500 mL beakers Sediment Volume: 100 mL Sediment Depth 4 cm Overlying Water Volume: 175 mL Overlying Water Depth: 5 cm Aeration: Not needed</p>										

10 DAY AMPHIPOD SEDIMENT TOXICITY TEST

Lab ID#	Client: WSRC	Start Date: 8/4/99
T12309	Sample Identification: A-11	End Date: 8/14/99

WATER CHEMISTRY TEST METHODS

Temperature: SM 18th Ed. 2550	Alkalinity: SM 18th Ed. 2320
Dissolved Oxygen: SM 18th Ed. 4500-O	Hardness: SM 18th Ed. 2340
pH: SM 18th Ed. 4500-H+	Conductivity: SM 18th Ed. 2510

WATER CHEMISTRY TEST DATA - OVERLYING WATER

CONTROL TREATMENT

Test Day	Temp. C	pH units	D.O. mg/L	D.O. % sat.	Alkalinity	Ammonia
					Initial	Initial
Start	22.3	7.63	8.0	92%	10.4	<0.20
1	20.5		7.9	87%	Final	Final
2	22.6		7.6	87%	88.2	<0.1
3	22.0		7.5	86%	mg/L	mg/L
4	20.2		7.8	86%	Cond.	Hardness
5	21.5		7.0	79%	Initial	Initial
6	22.2		7.2	83%	285	11.4
7	21.2		6.8	76%	Final	Final
8	20.8		6.8	75%	175.0	49.4
9	20.2		8.0	88%	umhos/cm	mg/L
10	21.0	7.46	4.9	55%	Aeration: none	

SAMPLE TREATMENT

Test Day	Temp. C	pH units	D.O. mg/L	D.O. % sat.	Alkalinity	Ammonia
					Initial	Initial
Start	22.3	7.63	8.0		10.4	<0.20
1	20.1		8.0	88%	Final	Final
2	22.6		8.0	92%	7.6	<0.1
3	21.2		7.7	87%	mg/L	mg/L
4	20.2		7.5	82%	Cond.	Hardness
5	21.5		7.2	81%	Initial	Initial
6	22.2		7.6	87%	285	11.4
7	21.2		7.3	82%	Final	Final
8	20.8		7.2	79%	44.0	9.5
9	20.3		7.7	85%	umhos/cm	mg/L
10	21.0	7.07	7.8	88%	Aeration: none	

SURVIVAL AND GROWTH RESULTS

CONTROL TREATMENT

	# Organisms			% Survival	Mean Length (mm)	Standard Deviation
	Initial	Live at End	Dead at End			
A	10	10	0	100%		
B	10	6	4	60%		
C	10	9	1	90%		
D	10	8	2	80%		
E	10	10	0	100%		
F	10	10	0	100%		
G	10	5	5	50%		
H	10	9	1	90%		
Mean	10.0			84%		

SAMPLE TREATMENT

	# Organisms			% Survival	Mean Length (mm)	Standard Deviation
	Initial	Live at End	Dead at End			
A	10	6	4	60%		
B	10	6	4	60%		
C	10	8	2	80%		
D	10	4	6	40%		
E	10	9	1	90%		
F	10	5	5	50%		
G	10	7	3	70%		
H	10	4	6	40%		
Mean	10.0			61%		

10 DAY AMPHIPOD SEDIMENT TOXICITY TEST

Lab ID#	Client: WSRC	Start Date: 8/4/99
T12309	Sample Identification: A-11	End Date: 8/14/99

RESULTS

SURVIVAL DATA		GROWTH DATA	
Mean of Eight Replicates		Mean Length (mm)	
	Mean %		Mean
Control	83.8%	Control	NA
Sample	61.3%	Sample	NA

STATISTICAL ANALYSES

SURVIVAL DATA	GROWTH DATA
Test for Normality: W= 0.95 Critical value: 0.84 Data are normal in distribution	Test for Normality: W= NA Critical value: 0.84 NA
Test for Homogeneity of Variance: F= 2.06 Critical value: 6.64 Data are homogeneous in variance	Test for Homogeneity of Variance: F= NA Critical value: 6.635 NA
Test for Differences in Survival: "t" Test t= 2.58 Critical value: 1.75 The sediment significantly reduced survival of the test organisms.	Test for Differences in Survival: "t" Test t= NA Critical value: 1.94

COMMENTS

None

Principal Analyst: Marsha Leitzel
 Report Reviewed By: Robert W. Kelley, Ph.D.

Signature: *Marsha Leitzel* Date: 10-19-99
 Signature: *R. Kelley* Date: 10-19-99

CONCLUSIONS

The sediment reduces survival of the test organisms.

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10 DAY AMPHIPOD SEDIMENT TOXICITY TEST

EPA/600/R-94/024 Method 100.1

Test Organism: *Hyallela azteca*

Client: WSRC
Sample Identification: B-8

Test Start Date: 8/4/99

10 DAY AMPHIPOD SEDIMENT TOXICITY TEST

Lab ID#	Client: WSRC	Start Date: 8/4/99
T12313	Sample Identification: B-8	End Date: 8/14/99

Test System

EPA/600/R-94/024 Method 100.1

The test was set as a Pass/Fail test with a control treatment and one sample treatment. Each treatment replicate consisted of 100 g of sediment and 175 mL of dilution water. There were eight replicates for each treatment. Ten test organisms were placed in each replicate. Sediment from a local stream was used in the control treatment. Test organisms were fed with YCT food. The test was conducted at a temperature of 23°C and a light cycle of 16 hr light/8 hr dark. Test vessels were 500 mL plastic beakers placed in a constant temperature incubator room.

Test Organisms		Dilution Water	
Order: Amphipoda		Type: Surface Water	
Species: <i>Hyallela azteca</i>		Collection Date 8/4/99	Initial
Source: Aquatic Biosystems, Fort Collins, CO		Alkalinity	10.4 mg/L
Life Stage: 7-14 days		Hardness	11.4 mg/L
% Mortality During 48 Hr Prior to Test:: 0%		Conductivity	285 umhos/cm
Taxonomic Verification: RWK 8/4/99		pH:	7.63 units
Culturing: as received		Preparation Method:	
Observations: Cultures healthy		Grab sample	
Acclimation: None			

Control Sediment		Test Sediment	
Source: Resurrection Creek		Source: B-8	
Collection Date: 8/4/99		Collection Date 7/16/99	Homogenized?: yes
Preservation: kept at 0-4°C in plastic		Preservation: kept at 0-4°C in plastic	
Date/Time Added to Test Chambers: 8/3/99		Date/Time Added to Test Chambers: 8/3/99	
Observations: silt and organic		Observations:	
Collection Method: grab		Collection Method: grab	
Disposal		Shipment: overnight	

Food Preparation		Test Chambers	
Source: YCT		Type: Plastic 500 mL beakers	
Purchase Date:	Preparation Date: 8/4/99	Sediment Volume: 100 mL	
Preservation: kept at 0-4°C		Sediment Dept 4 cm	
Preparation Method: Trout Chow aerated 7 days		Overlying Water Volume: 175 mL	
	Cerophyl, yeast aerated overnight	Overlying Water Depth: 5 cm	
Feeding Rate: 1.5 mL / day / replicate		Aeration: Not needed	
Hold Time: 5 days			

10 DAY AMPHIPOD SEDIMENT TOXICITY TEST

Lab ID#	Client: WSRC	Start Date: 8/4/99
T12313	Sample Identification: B-8	End Date: 8/14/99

WATER CHEMISTRY TEST METHODS

Temperature: SM 18th Ed. 2550	Alkalinity: SM 18th Ed. 2320
Dissolved Oxygen: SM 18th Ed. 4500-O	Hardness: SM 18th Ed. 2340
pH: SM 18th Ed. 4500-H+	Conductivity: SM 18th Ed. 2510

WATER CHEMISTRY TEST DATA - OVERLYING WATER

CONTROL TREATMENT

Test Day	Temp. C	pH units	D.O. mg/L	D.O. % sat.	Alkalinity	Ammonia
Start	22.3	7.63	8.0	92%	Initial	Initial
1	20.5		7.9	87%	10.4	<0.20
2	22.6		7.6	87%	Final	Final
3	22.0		7.5	86%	88.2	<0.1
4	20.2		7.8	86%	mg/L	mg/L
5	21.5		7.0	79%	Cond.	Hardness
6	22.2		7.2	83%	Initial	Initial
7	21.2		6.8	76%	285	11.4
8	20.8		6.8	75%	Final	Final
9	20.2		8.0	88%	175.0	49.4
10	21.0	7.46	4.9	55%	umhos/cm	mg/L
Aeration: none						

SAMPLE TREATMENT

Test Day	Temp. C	pH units	D.O. mg/L	D.O. % sat.	Alkalinity	Ammonia
Start	22.3	7.63	8.0		Initial	Initial
1	20.6		8.0	88%	10.4	<0.20
2	22.6		7.9	91%	Final	Final
3	22.0		7.5	86%	7.2	<0.1
4	20.2		7.4	81%	mg/L	mg/L
5	21.5		7.2	81%	Cond.	Hardness
6	22.2		7.3	84%	Initial	Initial
7	21.2		7.5	84%	285	11.4
8	20.8		7.1	78%	Final	Final
9	20.3		8.1	89%	43.0	3.8
10	21.0	6.98	8.1	91%	umhos/cm	mg/L
Aeration: none						

SURVIVAL AND GROWTH RESULTS

CONTROL TREATMENT

	# Organisms				Mean Length (mm)	Standard Deviation
	Initial	Live at End	Dead at End	% Survival		
A	10	10	0	100%		
B	10	6	4	60%		
C	10	9	1	90%		
D	10	8	2	80%		
E	10	10	0	100%		
F	10	10	0	100%		
G	10	5	5	50%		
H	10	9	1	90%		
Mean	10.0			84%		

SAMPLE TREATMENT

	# Organisms				Mean Length (mm)	Standard Deviation
	Initial	Live at End	Dead at End	% Survival		
A	10	6	4	60%		
B	10	7	3	70%		
C	10	3	7	30%		
D	10	5	5	50%		
E	10	3	7	30%		
F	10	3	7	30%		
G	10	6	4	60%		
H	10	6	4	60%		
Mean	10.0			49%		

10 DAY AMPHIPOD SEDIMENT TOXICITY TEST

Lab ID#	Client: WSRC	Start Date: 8/4/99
T12313	Sample Identification: B-8	End Date: 8/14/99

RESULTS

SURVIVAL DATA		GROWTH DATA	
Mean of Eight Replicates		Mean Length (mm)	
	Mean %		Mean
Control	83.8%	Control	NA
Sample	48.7%	Sample	NA

STATISTICAL ANALYSES

SURVIVAL DATA	GROWTH DATA
Test for Normality: W= 0.93 Critical value: 0.84 Data are normal in distribution	Test for Normality: W= NA Critical value: 0.84 NA
Test for Homogeneity of Variance: F= 2.90 Critical value: 6.64 Data are homogeneous in variance	Test for Homogeneity of Variance: F= NA Critical value: 6.635 NA
Test for Differences in Survival: "t" Test t= 3.88 Critical value: 1.75 The sediment significantly reduced survival of the test organisms.	Test for Differences in Survival: "t" Test t= NA Critical value: 1.94

COMMENTS

None

Principal Analyst: Marsha Leitzel	Signature: <i>Marsha Leitzel</i>	Date: 10-19-99
Report Reviewed By: Robert W. Kelley, Ph.D.	Signature: <i>R. Kelley</i>	Date: 10-19-99

CONCLUSIONS

The sediment reduces survival of the test organisms.

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10 DAY AMPHIPOD SEDIMENT TOXICITY TEST

EPA/600/R-94/024 Method 100.1

Test Organism: *Hyallela azteca*

Client: WSRC
Sample Identification: BGCH5

Test Start Date: 8/4/99

10 DAY AMPHIPOD SEDIMENT TOXICITY TEST

Lab ID#	Client: WSRC	Start Date: 8/4/99
T12308	Sample Identification: BGCH5	End Date: 8/14/99

Test System

EPA/600/R-94/024 Method 100.1

The test was set as a Pass/Fail test with a control treatment and one sample treatment. Each treatment replicate consisted of 100 g of sediment and 175 mL of dilution water. There were eight replicates for each treatment. Ten test organisms were placed in each replicate. Sediment from a local stream was used in the control treatment. Test organisms were fed with YCT food. The test was conducted at a temperature of 23°C and a light cycle of 16 hr light/8 hr dark. Test vessels were 500 mL plastic beakers placed in a constant temperature incubator room.

Test Organisms Order: Amphipoda Species: <i>Hyallela azteca</i> Source: Aquatic Biosystems, Fort Collins, CO Life Stage: 7-14 days % Mortality During 48 Hr Prior to Test:: 0% Taxonomic Verification: RWK 8/4/99 Culturing: as received Observations: Cultures healthy Acclimation: None	Dilution Water Type: Surface Water Collection Date 8/4/99 Initial <i>Alkalinity</i> 10.4 mg/L <i>Hardness</i> 11.4 mg/L <i>Conductivity</i> 285 umhos/cm <i>pH:</i> 7.63 units Preparation Method: Grab sample
Control Sediment Source: Resurrection Creek Collection Date: 8/4/99 Preservation: kept at 0-4°C in plastic Date/Time Added to Test Chambers: 8/3/99 Observations: silt and organic Collection Method: grab Disposal	Test Sediment Source: BGCH5 Collection Date 7/19/99 Homogenized?: yes Preservation: kept at 0-4°C in plastic Date/Time Added to Test Chambers: 8/3/99 Observations: Collection Method: grab Shipment: overnight
Food Preparation Source: YCT Purchase Date: Preparation Date: 8/4/99 Preservation: kept at 0-4°C Preparation Method: Trout Chow aerated 7 days Cerophyl, yeast aerated overnight Feeding Rate: 1.5 mL / day / replicate Hold Time: 5 days	Test Chambers Type: Plastic 500 mL beakers Sediment Volume: 100 mL Sediment Depth 4 cm Overlying Water Volume: 175 mL Overlying Water Depth: 5 cm Aeration: Not needed

10 DAY AMPHIPOD SEDIMENT TOXICITY TEST

Lab ID#	Client: WSRC	Start Date: 8/4/99
T12308	Sample Identification: BGCH5	End Date: 8/14/99

WATER CHEMISTRY TEST METHODS

Temperature: SM 18th Ed. 2550	Alkalinity: SM 18th Ed. 2320
Dissolved Oxygen: SM 18th Ed. 4500-O	Hardness: SM 18th Ed. 2340
pH: SM 18th Ed. 4500-H+	Conductivity: SM 18th Ed. 2510

WATER CHEMISTRY TEST DATA - OVERLYING WATER

CONTROL TREATMENT

Test Day	Temp. C	pH units	D.O. mg/L	D.O. % sat.	Alkalinity	Ammonia
					Initial	Initial
Start	22.3	7.63	8.0	92%	10.4	<0.20
1	20.5		7.9	87%	Final	Final
2	22.6		7.6	87%	88.2	<0.1
3	22.0		7.5	86%	mg/L	mg/L
4	20.2		7.8	86%	Cond.	Hardness
5	21.5		7.0	79%	Initial	Initial
6	22.2		7.2	83%	285	11.4
7	21.2		6.8	76%	Final	Final
8	20.8		6.8	75%	175.0	49.4
9	20.2		8.0	88%	umhos/cm	mg/L
10	21.0	7.46	4.9	55%	Aeration: none	

SAMPLE TREATMENT

Test Day	Temp. C	pH units	D.O. mg/L	D.O. % sat.	Alkalinity	Ammonia
					Initial	Initial
Start	22.3	7.63	8.0	92%	10.4	<0.20
1	20.3		8.1	89%	Final	Final
2	22.6		7.8	90%	6.1	<0.1
3	22.2		7.6	87%	mg/L	mg/L
4	20.2		7.4	81%	Cond.	Hardness
5	21.5		7.1	80%	Initial	Initial
6	22.2		7.4	85%	285	11.4
7	21.2		7.2	81%	Final	Final
8	20.8		7.1	78%	3.8	43.0
9	22.0		7.8	90%	umhos/cm	mg/L
10	21.0	7.49	8.1	91%	Aeration: none	

SURVIVAL AND GROWTH RESULTS

CONTROL TREATMENT

	# Organisms			% Survival	Mean Length (mm)	Standard Deviation
	Initial	Live at End	Dead at End			
A	10	10	0	100%		
B	10	6	4	60%		
C	10	9	1	90%		
D	10	8	2	80%		
E	10	10	0	100%		
F	10	10	0	100%		
G	10	5	5	50%		
H	10	9	1	90%		
Mean	10.0			84%		

SAMPLE TREATMENT

	# Organisms			% Survival	Mean Length (mm)	Standard Deviation
	Initial	Live at End	Dead at End			
A	10	1	9	10%		
B	10	4	6	40%		
C	10	3	7	30%		
D	10	3	7	30%		
E	10	8	2	80%		
F	10	4	6	40%		
G	10	9	1	90%		
H	10	6	4	60%		
Mean	10.0			48%		

10 DAY AMPHIPOD SEDIMENT TOXICITY TEST

Lab ID#	Client: WSRC	Start Date: 8/4/99
T12308	Sample Identification: BGCH5	End Date: 8/14/99

RESULTS

SURVIVAL DATA Mean of Eight Replicates		GROWTH DATA Mean Length (mm)	
	Mean %		Mean
Control	83.8%	Control	NA
Sample	47.5%	Sample	NA

STATISTICAL ANALYSES

SURVIVAL DATA	GROWTH DATA
Test for Normality: W= 0.95 Critical value: 0.84 Data are normal in distribution	Test for Normality: W= NA Critical value: 0.84 NA
Test for Homogeneity of Variance: F= 1.12 Critical value: 6.64 Data are homogeneous in variance	Test for Homogeneity of Variance: F= NA Critical value: 6.635 NA
Test for Differences in Survival: "t" Test t= 3.16 Critical value: 1.75 The sediment significantly reduced survival of the test organisms.	Test for Differences in Survival: "t" Test t= NA Critical value: 1.94

COMMENTS

None

Principal Analyst: Marsha Leitzel
 Report Reviewed By: Robert W. Kelley, Ph.D.

Signature: *Marsha Leitzel* Date: 10-19-99
 Signature: *R. Kelley* Date: 10-17-99

CONCLUSIONS

The sediment reduces survival of the test organisms.

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10 DAY AMPHIPOD SEDIMENT TOXICITY TEST

EPA/600/R-94/024 Method 100.1

Test Organism: *Hyallela azteca*

Client: WSRC
Sample Identification: BGCH7

Test Start Date: 8/4/99

10 DAY AMPHIPOD SEDIMENT TOXICITY TEST

Lab ID#	Client: WSRC	Start Date: 8/4/99
T12307	Sample Identification: BGCH7	End Date: 8/14/99

Test System

EPA/600/R-94/024 Method 100.1

The test was set as a Pass/Fail test with a control treatment and one sample treatment. Each treatment replicate consisted of 100 g of sediment and 175 mL of dilution water. There were eight replicates for each treatment. Ten test organisms were placed in each replicate. Sediment from a local stream was used in the control treatment. Test organisms were fed with YCT food. The test was conducted at a temperature of 23°C and a light cycle of 16 hr light/8 hr dark. Test vessels were 500 mL plastic beakers placed in a constant temperature incubator room.

<p align="center">Test Organisms</p> <p>Order: Amphipoda Species: <i>Hyalella azteca</i> Source: Aquatic Biosystems, Fort Collins, CO Life Stage: 7 to 14 days % Mortality During 48 Hr Prior to Test:: 0% Taxonomic Verification: RWK 8/4/99 Culturing: as received</p> <p>Observations: Cultures healthy Acclimation: None</p>	<p align="center">Dilution Water</p> <p>Type: Surface Water Collection Date 8/4/99 Initial <i>Alkalinity</i> 10.4 mg/L <i>Hardness</i> 11.4 mg/L <i>Conductivity</i> 285 umhos/cm <i>pH:</i> 7.63 units</p> <p>Preparation Method: Grab sample</p>
<p align="center">Control Sediment</p> <p>Source: Resurrection Creek Collection Date: 8/4/99 Preservation: kept at 0-4°C in plastic Date/Time Added to Test Chambers: 8/3/99 Observations: silt and organic Collection Method: grab Disposal</p>	<p align="center">Test Sediment</p> <p>Source: BGCH7 Collection Date 7/19/99 Homogenized?: yes Preservation: kept at 0-4°C in plastic Date/Time Added to Test Chambers: 8/3/99 Observations: Collection Method: grab Shipment: overnight</p>
<p align="center">Food Preparation</p> <p>Source: YCT Purchase Date: Preparation Date: 8/4/99 Preservation: kept at 0-4°C Preparation Method: Trout Chow acrated 7 days Cerophyl, yeast acrated overnight Feeding Rate: 1.5 mL / day / replicate Hold Time: 5 days</p>	<p align="center">Test Chambers</p> <p>Type: Plastic 500 mL beakers Sediment Volume: 100 mL Sediment Dept 4 cm Overlying Water Volume: 175 mL Overlying Water Depth: 5 cm Aeration: Not needed</p>

10 DAY AMPHIPOD SEDIMENT TOXICITY TEST

Lab ID#	Client: WSRC	Start Date: 8/4/99
T12307	Sample Identification: BGCH7	End Date: 8/14/99

WATER CHEMISTRY TEST METHODS

Temperature: SM 18th Ed. 2550	Alkalinity: SM 18th Ed. 2320
Dissolved Oxygen: SM 18th Ed. 4500-O	Hardness: SM 18th Ed. 2340
pH: SM 18th Ed. 4500-H+	Conductivity: SM 18th Ed. 2510

WATER CHEMISTRY TEST DATA - OVERLYING WATER

CONTROL TREATMENT

Test Day	Temp. C	pH units	D.O. mg/L	D.O. % sat.	Alkalinity Initial	Ammonia Initial
Start	22.3	7.63	8.0	92%	10.4	<0.20
1	20.5		7.9	87%	Final	Final
2	22.6		7.6	87%	88.2	<0.1
3	22.0		7.5	86%	mg/L	mg/L
4	20.2		7.8	86%	Cond.	Hardness
5	21.5		7.0	79%	Initial	Initial
6	22.2		7.2	83%	285	11.4
7	21.2		6.8	76%	Final	Final
8	20.8		6.8	75%	175.0	49.4
9	20.2		8.0	88%	umhos/cm	mg/L
10	21.0	7.46	4.9	55%	Aeration: none	

SAMPLE TREATMENT

Test Day	Temp. C	pH units	D.O. mg/L	D.O. % sat.	Alkalinity Initial	Ammonia Initial
Start	22.3	7.63	8.0	92%	10.4	<0.20
1	20.2		8.0	88%	Final	Final
2	22.6		7.2	83%	21.0	<0.1
3	21.1		7.5	84%	mg/L	mg/L
4	20.2		7.2	79%	Cond.	Hardness
5	21.5		7.2	81%	Initial	Initial
6	22.2		7.5	86%	285	11.4
7	21.2		7.1	80%	Final	Final
8	20.8		7.0	77%	39.0	3.8
9	19.7		7.8	84%	umhos/cm	mg/L
10	21.0	7.97	7.3	82%	Aeration: none	

SURVIVAL AND GROWTH RESULTS

CONTROL TREATMENT

	# Organisms				Mean Length (mm)	Standard Deviation
	Initial	Live at End	Dead at End	% Survival		
A	10	10	0	100%		
B	10	6	4	60%		
C	10	9	1	90%		
D	10	8	2	80%		
E	10	10	0	100%		
F	10	10	0	100%		
G	10	5	5	50%		
H	10	9	1	90%		
Mean	10.0			84%		

SAMPLE TREATMENT

	# Organisms				Mean Length (mm)	Standard Deviation
	Initial	Live at End	Dead at End	% Survival		
A	10	1	9	10%		
B	10	1	9	10%		
C	10	4	6	40%		
D	10	6	4	60%		
E	10	4	6	40%		
F	10	1	9	10%		
G	10	1	9	10%		
H	10	7	3	70%		
Mean	10.0			31%		

10 DAY AMPHIPOD SEDIMENT TOXICITY TEST

Lab ID#	Client: WSRC	Start Date: 8/4/99
T12307	Sample Identification: BGCH7	End Date: 8/14/99

RESULTS

SURVIVAL DATA Mean of Eight Replicates		GROWTH DATA Mean Length (mm)	
	Mean %		Mean
Control	83.8%	Control	NA
Sample	31.3%	Sample	NA

STATISTICAL ANALYSES

SURVIVAL DATA	GROWTH DATA
Test for Normality: W= 0.93 Critical value: 0.84 Data are normal in distribution	Test for Normality: W= NA Critical value: 0.84 NA
Test for Homogeneity of Variance: F= 1.05 Critical value: 6.64 Data are homogeneous in variance	Test for Homogeneity of Variance: F= NA Critical value: 6.635 NA
Test for Differences in Survival: "t" Test t= 4.66 Critical value: 1.75 The sediment significantly reduced survival of the test organisms.	Test for Differences in Survival: "t" Test t= NA Critical value: 1.94

COMMENTS

None

Principal Analyst:	Marsha Leitzel	Signature: <i>Marsha Leitzel</i>	Date: 10-19-99
Report Reviewed By:	Robert W. Kelley, Ph.D.	Signature: <i>R. Kelley</i>	Date: 10-19-99

CONCLUSIONS

The sediment reduces survival of the test organisms.

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10 DAY AMPHIPOD SEDIMENT TOXICITY TEST

EPA/600/R-94/024 Method 100.1

Test Organism: *Hyallela azteca*

Client: WSRC
Sample Identification: C-10

Test Start Date: 8/4/99

10 DAY AMPHIPOD SEDIMENT TOXICITY TEST

Lab ID#	Client: WSRC	Start Date: 8/4/99
T12311	Sample Identification: C-10	End Date: 8/14/99

Test System

EPA/600/R-94/024 Method 100.1

The test was set as a Pass/Fail test with a control treatment and one sample treatment. Each treatment replicate consisted of 100 g of sediment and 175 mL of dilution water. There were eight replicates for each treatment. Ten test organisms were placed in each replicate. Sediment from a local stream was used in the control treatment. Test organisms were fed with YCT food. The test was conducted at a temperature of 23°C and a light cycle of 16 hr light/8 hr dark. Test vessels were 500 mL plastic beakers placed in a constant temperature incubator room.

Test Organisms Order: Amphipoda Species: <i>Hyallela azteca</i> Source: Aquatic Biosystems, Fort Collins, CO Life Stage: 7 to 14 days % Mortality During 48 Hr Prior to Test:: 0% Taxonomic Verification: RWK 8/4/99 Culturing: as received Observations: Cultures healthy Acclimation: None	Dilution Water Type: Surface Water Collection Date 8/4/99 Initial Alkalinity 10.4 mg/L Hardness 11.4 mg/L Conductivity 285 umhos/cm pH: 7.63 units Preparation Method: Grab sample
Control Sediment Source: Resurrection Creek Collection Date: 8/4/99 Preservation: kept at 0-4°C in plastic Date/Time Added to Test Chambers: 8/3/99 Observations: silt and organic Collection Method: grab Disposal	Test Sediment Source: C-10 Collection Date 7/16/99 Homogenized?: yes Preservation: kept at 0-4°C in plastic Date/Time Added to Test Chambers: 8/3/99 Observations: Collection Method: grab Shipment: overnight
Food Preparation Source: YCT Purchase Date: Preparation Date: 8/4/99 Preservation: kept at 0-4°C Preparation Method: Trout Chow aerated 7 days Cerophyl, yeast aerated overnight Feeding Rate: 1.5 mL / day / replicate Hold Time: 5 days	Test Chambers Type: Plastic 500 mL beakers Sediment Volume: 100 mL Sediment Dept 4 cm Overlying Water Volume: 175 mL Overlying Water Depth: 5 cm Aeration: Not needed

10 DAY AMPHIPOD SEDIMENT TOXICITY TEST

Lab ID#	Client: WSRC	Start Date: 8/4/99
T12311	Sample Identification: C-10	End Date: 8/14/99

WATER CHEMISTRY TEST METHODS

Temperature: SM 18th Ed. 2550	Alkalinity: SM 18th Ed. 2320
Dissolved Oxygen: SM 18th Ed. 4500-O	Hardness: SM 18th Ed. 2340
pH: SM 18th Ed. 4500-H+	Conductivity: SM 18th Ed. 2510

WATER CHEMISTRY TEST DATA - OVERLYING WATER

CONTROL TREATMENT

Test Day	Temp. C	pH units	D.O. mg/L	D.O. % sat.	Alkalinity	Ammonia
Start	22.3	7.63	8.0	92%	Initial 10.4	Initial <0.20
1	20.5		7.9	87%	Final	Final
2	22.6		7.6	87%	88.2	<0.1
3	22.0		7.5	86%	mg/L	mg/L
4	20.2		7.8	86%	Cond.	Hardness
5	21.5		7.0	79%	Initial 285	Initial 11.4
6	22.2		7.2	83%	Final	Final
7	21.2		6.8	76%	175.0	49.4
8	20.8		6.8	75%	umhos/cm	mg/L
9	20.2		8.0	88%		
10	21.0	7.46	4.9	55%	Aeration: none	

SAMPLE TREATMENT

Test Day	Temp. C	pH units	D.O. mg/L	D.O. % sat.	Alkalinity	Ammonia
Start	22.3	7.63	8.0	92%	Initial 10.4	Initial <0.20
1	20.3		7.6	84%	Final	Final
2	22.6		8.0	92%	10.1	<0.1
3	21.0		7.1	80%	mg/L	mg/L
4	20.2		7.4	81%	Cond.	Hardness
5	21.5		7.2	81%	Initial 285	Initial 11.4
6	22.2		7.5	86%	Final	Final
7	21.2		7.8	88%	43.0	5.7
8	20.8		7.6	84%	umhos/cm	mg/L
9	20.1		8.1	89%		
10	21.0	7.71	8.0	90%	Aeration: none	

SURVIVAL AND GROWTH RESULTS

CONTROL TREATMENT

	# Organisms				Mean Length (mm)	Standard Deviation
	Initial	Live at End	Dead at End	% Survival		
A	10	10	0	100%		
B	10	6	4	60%		
C	10	9	1	90%		
D	10	8	2	80%		
E	10	10	0	100%		
F	10	10	0	100%		
G	10	5	5	50%		
H	10	9	1	90%		
Mean	10.0			84%		

SAMPLE TREATMENT

	# Organisms				Mean Length (mm)	Standard Deviation
	Initial	Live at End	Dead at End	% Survival		
A	10	7	3	70%		
B	10	7	3	70%		
C	10	8	2	80%		
D	10	6	4	60%		
E	10	8	2	80%		
F	10	5	5	50%		
G	10	5	5	50%		
H	10	5	5	50%		
Mean	10.0			64%		

10 DAY AMPHIPOD SEDIMENT TOXICITY TEST

Lab ID#	Client: WSRC	Start Date: 8/4/99
T12311	Sample Identification: C-10	End Date: 8/14/99

RESULTS

SURVIVAL DATA		GROWTH DATA	
Mean of Eight Replicates		Mean Length (mm)	
	Mean %		Mean
Control	83.8%	Control	NA
Sample	63.8%	Sample	NA

STATISTICAL ANALYSES

SURVIVAL DATA	GROWTH DATA
<p>Test for Normality: W= 0.94 Critical value: 0.84 Data are normal in distribution</p> <p>Test for Homogeneity of Variance: F= 4.26 Critical value: 6.64 Data are homogeneous in variance</p> <p>Test for Differences in Survival: "t" Test t= 2.64 Critical value: 1.75 The sediment significantly reduced survival of the test organisms.</p>	<p>Test for Normality: W= NA Critical value: 0.84 NA</p> <p>Test for Homogeneity of Variance: F= NA Critical value: 6.635 NA</p> <p>Test for Differences in Survival: "t" Test t= NA Critical value: 1.94</p>

COMMENTS

The sediment reduces the survival of the test organisms.

Principal Analyst: Marsha Leitzel	Signature: <i>Marsha Leitzel</i>	Date: 10-19-99
Report Reviewed By: Robert W. Kelley, Ph.D.	Signature: <i>R. Kelley</i>	Date: 10-19-99

CONCLUSIONS

The sediment does not adversely affect the survival and but does adversely effect the growth of freshwater amphipods.

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4 Craftsman Court, Greer, SC 29650

**10 Day Chronic Definitive
Sediment Toxicity Test**
Method: EPA/600/R-94/024 100.1

Test Organism: *Hyallela azteca*

Facility: WSRC
Sample ID: D-7

County: Aiken
NPDES#:
ETT#: T12304

Sample ID: August 4, 1999

CHRONIC DEFINITIVE SEDIMENT 10 DAY SURVIVAL TEST

Lab ID#	Client: WSRC	Start Date: 8/4/99
T12304	Sample Identification: D-7	End Date: 8/14/99

Test System

EPA/600/R-94/024 Method 100.1

The test was set as a Definitive test with a control treatment and four sample treatments. Each treatment replicate consisted of 100 g of sediment and 175 mL of dilution water. There were four replicates for each treatment. Ten test organisms were placed in each replicate. Sediment from a local stream was used in the control treatment. Test organisms were fed with YCT food. The test was conducted at a temperature of 23°C and a light cycle of 16 hr light/8 hr dark. Test vessels were 500 mL plastic beakers placed in a constant temperature incubator room.

Test Organisms

Order: Amphipoda
 Species: *Hyalella azteca*
 Source: Aquatic Biosystems, Fort Collins, CO
 Life Stage: 7 to 14 days
 % Mortality During 48 Hr Prior to Test:: 0%
 Taxonomic Verification: RWK 8/4/99
 Culturing: as received

Observations: Cultures healthy
 Acclimation: None

Dilution Water

Type: Surface Water
 Collection Date: 8/4/99 Initial

Alkalinity	10.4	mg/L
Hardness	11.4	mg/L
Conductivity	285	umhos/cm
pH:	7.63	units

Preparation Method:
 Grab sample

Control Sediment

Source: BGCH5
 Collection Date: 7/19/99
 Preservation: kept at 0-4°C in plastic
 Date/Time Added to Test Chambers: 8/3/99
 Observations:
 Collection Method: grab
 Disposal:

Test Sediment

Source: D-7
 Collection Date: 7/19/99 Homogenized?: yes
 Preservation: kept at 0-4°C in plastic
 Date/Time Added to Test Chambers: 8/3/99
 Observations:
 Collection Method: grab
 Shipment: overnight

Food Preparation

Source: YCT
 Purchase Date: Preparation Date: 8/4/99
 Preservation: kept at 0-4°C
 Preparation Method: Trout Chow aerated 7 days
 Cerophyl, yeast aerated overnight
 Feeding Rate: 1.5 mL / day / replicate
 Hold Time: 5 days

Test Chambers

Type: Plastic 500 mL beakers
 Sediment Volume: 100 mL
 Sediment Depth: 4 cm
 Overlying Water Volume: 175 mL
 Overlying Water Depth: 5 cm
 Aeration: Not needed

CHRONIC DEFINITIVE SEDIMENT 10 DAY SURVIVAL TEST **Survival Results**

Client: **WSRC**
 Sample Identification: **D-7**
 Test Date: **August 4, 1999**

County: **Aiken**
 NPDES#:
 ETT #: **T12304**

Survival in Control sediment (BGCH5)						
Day	Rep. A	Rep B	Rep. C	Rep. D		Mean %
0	10	10	10	10		100%
10	3	3	8	4		45%
# Dead	7	7	2	6		55%
# Lost	0	0	0	0		0%

Survival at 12.5% sediment D-7 w/ 87.5% sediment BGCH5						
Day	Rep. A	Rep B	Rep. C	Rep. D		Mean %
0	10	10	10	10		100%
10	4	6	8	0		45%
# Dead	6	4	2	10		55%
# Lost	0	0	0	0		0%

Survival at 25% sediment D-7 w/ 75% sediment BGCH5						
Day	Rep. A	Rep B	Rep. C	Rep. D		Mean %
0	10	10	10	10		100%
10	4	6	5	10		63%
# Dead	6	4	5	0		38%
# Lost	0	0	0	0		0%

Survival at 50% sediment D-7 w/ 50% sediment BGCH5						
Day	Rep. A	Rep B	Rep. C	Rep. D		Mean %
0	10	10	10	10		100%
10	4	5	2	1		30%
# Dead	6	5	8	9		70%
# Lost	0	0	0	0		0%

Survival at 100% sediment D-7						
Day	Rep. A	Rep B	Rep. C	Rep. D		Mean %
0	10	10	10	10		100%
10	0	4	2	3		23%
# Dead	10	6	8	7		78%
# Lost	0	0	0	0		0%

Survival at						
Day	Rep. A	Rep B	Rep. C	Rep. D		Mean %
0						
1						
2						
3						
4						
5						
6						
7						
# Dead						
# Lost						

CHRONIC DEFINITIVE SEDIMENT 10 DAY SURVIVAL TEST

Statistical Analyses - Survival

Client: WSRC
 Sample Identification: D-7
 Test Date: August 4, 1999

Test for Normality

Test Used: Shapiro-Wilks W= 0.971
 critical 0.884

The data are normal in distribution

Test for Homogeneity of Variance

Test Used: Bartlett's Test B= 1.52
 critical 15.086

The data are homogeneous in variance

Test for Differences in Survival

Test Type Used: t Test

t Test	Test Concentration				
	Control	12.5%	25.0%	50.0%	100%
t Value		0.16	-1.11	0.95	1.45
critical		2.55	2.55	2.55	2.55
survival	45%	45%	63%	30%	23%

Wilcoxon's Test	Test Concentration			
	12.5%	25.0%	50.0%	100%
Rank Sum	NA	NA	NA	NA
critical	NA	NA	NA	NA

NOEC (Survival): NA
 LOEC (Survival): NA
 Chronic Value: NA

Effluent Conc. vs. Survival

Summary

Both the control sediment and the test sediment reduced survival.
 Survival in 100% control sediment was not significantly less than in the control sediment.

CHRONIC DEFINITIVE SEDIMENT 10 DAY SURVIVAL TEST **Water Chemistry**

Client: **WSRC**
 Sample Identification: **D-7**
 Test Date: **August 4, 1999**

Control Sediment

	Alkal.	Hard.	Cond.	NH3		
	mg/L	mg/L	umhos	mg/L		
Initial	10.4	11.4	285	<0.1		
Day 10	88.2	49.4	175	<0.2		

Test Sediment

	Alkal.	Hard.	Cond.	NH3		
	mg/L	mg/L	umhos	mg/L		
Initial	10.4	11.4	285	<0.1		
Day 10	10.9	5.7	78	<0.1		

Temperature

	Test Concentration				
	Control	12.50%	25.00%	50.00%	100%
Initial	22.3		22.3		22.3
Day 1	20.3		20.5		20.5
Day 2	22.6		22.0		22.0
Day 3	22.2		21.8		22.0
Day 4	20.2		20.2		20.2
Day 5	21.6		21.5		21.5
Day 6	22.2		22.2		22.2
Day 7	21.2		21.2		21.2
Day 8	20.8		20.8		20.8
Day 9	22.0		21.6		21.6
Day 10	21.0		21.0		21.0

Dissolved Oxygen

	Test Concentration				
	Control	12.50%	25.00%	50.00%	100%
Initial	8.0		8.0		8.0
Day 1	8.1		7.6		7.9
Day 2	7.8		8.0		8.0
Day 3	7.6		7.8		7.9
Day 4	7.4		7.6		7.4
Day 5	7.1		7.4		7.4
Day 6	7.4		7.3		7.4
Day 7	7.2		7.0		7.0
Day 8	7.1		7.4		7.2
Day 9	7.8		7.5		7.7
Day 10	7.7				7.7

Test Results Reviewed and Approved By:

R. Kelly

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10 DAY AMPHIPOD SEDIMENT TOXICITY TEST

EPA/600/R-94/024 Method 100.1

Test Organism: Hyallela azteca

Client: WSRC
Sample Identification: D-28

Test Start Date: 8/4/99

10 DAY AMPHIPOD SEDIMENT TOXICITY TEST

Lab ID#	Client: WSRC	Start Date: 8/4/99
T12312	Sample Identification: D-28	End Date: 8/14/99

Test System

EPA/600/R-94/024 Method 100.1

The test was set as a Pass/Fail test with a control treatment and one sample treatment. Each treatment replicate consisted of 100 g of sediment and 175 mL of dilution water. There were eight replicates for each treatment. Ten test organisms were placed in each replicate. Sediment from a local stream was used in the control treatment. Test organisms were fed with YCT food. The test was conducted at a temperature of 23°C and a light cycle of 16 hr light/8 hr dark. Test vessels were 500 mL plastic beakers placed in a constant temperature incubator room.

Test Organisms Order: Amphipoda Species: <i>Hyallela azteca</i> Source: Aquatic Biosystems, Fort Collins, CO Life Stage: 7 to 14 days % Mortality During 48 Hr Prior to Test:: 0% Taxonomic Verification: RWK 8/4/99 Culturing: as received Observations: Cultures healthy Acclimation: None	Dilution Water Type: Surface Water Collection Date 8/4/99 Initial Alkalinity 10.4 mg/L Hardness 11.4 mg/L Conductivity 285 umhos/cm pH: 7.63 units Preparation Method: Grab sample
Control Sediment Source: Resurrection Creek Collection Date: 8/4/99 Preservation: kept at 0-4°C in plastic Date/Time Added to Test Chambers: 8/3/99 Observations: silt and organic Collection Method: grab Disposal	Test Sediment Source: D-28 Collection Date 7/16/99 Homogenized?: yes Preservation: kept at 0-4°C in plastic Date/Time Added to Test Chambers: 8/3/99 Observations: Collection Method: grab Shipment: overnight
Food Preparation Source: YCT Purchase Date: Preparation Date: 8/4/99 Preservation: kept at 0-4°C Preparation Method: Trout Chow aerated 7 days Cerophyl, yeast aerated overnight Feeding Rate: 1.5 mL / day / replicate Hold Time: 5 days	Test Chambers Type: Plastic 500 mL beakers Sediment Volume: 100 mL Sediment Depth 4 cm Overlying Water Volume: 175 mL Overlying Water Depth: 5 cm Aeration: Not needed

10 DAY AMPHIPOD SEDIMENT TOXICITY TEST

Lab ID#	Client: WSRC	Start Date: 8/4/99
T12312	Sample Identification: D-28	End Date: 8/14/99

WATER CHEMISTRY TEST METHODS

Temperature: SM 18th Ed. 2550	Alkalinity: SM 18th Ed. 2320
Dissolved Oxygen: SM 18th Ed. 4500-O	Hardness: SM 18th Ed. 2340
pH: SM 18th Ed. 4500-H+	Conductivity: SM 18th Ed. 2510

WATER CHEMISTRY TEST DATA - OVERLYING WATER

CONTROL TREATMENT

Test Day	Temp. C	pH units	D.O. mg/L	D.O. % sat.	Alkalinity	Ammonia
					Initial	Initial
Start	22.3	7.63	8.0	92%	10.4	<0.20
1	20.5		7.9	87%	Final	Final
2	22.6		7.6	87%	88.2	<0.1
3	22.0		7.5	86%	mg/L	mg/L
4	20.2		7.8	86%	Cond.	Hardness
5	21.5		7.0	79%	Initial	Initial
6	22.2		7.2	83%	285	11.4
7	21.2		6.8	76%	Final	Final
8	20.8		6.8	75%	175.0	49.4
9	20.2		8.0	88%	umhos/cm	mg/L
10	21.0	7.46	4.9	55%	Aeration: none	

SAMPLE TREATMENT

Test Day	Temp. C	pH units	D.O. mg/L	D.O. % sat.	Alkalinity	Ammonia
					Initial	Initial
Start	22.3	7.63	8.0	92%	10.4	<0.20
1	20.5		7.7	85%	Final	Final
2	22.6		7.8	90%	52.6	<0.1
3	22.0		7.3	84%	mg/L	mg/L
4	20.2		7.4	81%	Cond.	Hardness
5	21.5		7.1	80%	Initial	Initial
6	22.2		7.3	84%	285	11.4
7	21.2		7.6	85%	Final	Final
8	20.8		7.2	79%	42.0	15.2
9	20.2		8.4	92%	umhos/cm	mg/L
10	21.0	7.18	8.4	94%	Aeration: none	

SURVIVAL AND GROWTH RESULTS

CONTROL TREATMENT

	# Organisms			% Survival	Mean Length (mm)	Standard Deviation
	Initial	Live at End	Dead at End			
A	10	10	0	100%		
B	10	6	4	60%		
C	10	9	1	90%		
D	10	8	2	80%		
E	10	10	0	100%		
F	10	10	0	100%		
G	10	5	5	50%		
H	10	9	1	90%		
Mean	10.0			84%		

SAMPLE TREATMENT

	# Organisms			% Survival	Mean Length (mm)	Standard Deviation
	Initial	Live at End	Dead at End			
A	10	4	6	40%		
B	10	8	2	80%		
C	10	10	0	100%		
D	10	5	5	50%		
E	10	5	5	50%		
F	10	5	5	50%		
G	10	8	2	80%		
H	10	3	7	30%		
Mean	10.0			60%		

10 DAY AMPHIPOD SEDIMENT TOXICITY TEST

Lab ID#	Client: WSRC	Start Date: 8/4/99
T12312	Sample Identification: D-28	End Date: 8/14/99

RESULTS

SURVIVAL DATA Mean of Eight Replicates		GROWTH DATA Mean Length (mm)	
	Mean %		Mean
Control	83.8%	Control	NA
Sample	60.0%	Sample	NA

STATISTICAL ANALYSES

SURVIVAL DATA	GROWTH DATA
<p>Test for Normality: W= 0.96 Critical value: 0.84 Data are normal in distribution</p> <p>Test for Homogeneity of Variance: F= 1.13 Critical value: 6.64 Data are homogeneous in variance</p> <p>Test for Differences in Survival: "t" Test t= 2.09 Critical value: 1.75 The sediment significantly reduced survival of the test organisms.</p>	<p>Test for Normality: W= NA Critical value: 0.84 NA</p> <p>Test for Homogeneity of Variance: F= NA Critical value: 6.635 NA</p> <p>Test for Differences in Survival: "t" Test t= NA Critical value: 1.94</p>

COMMENTS

None

Principal Analyst: Marsha Leitzel	Signature: <i>Marsha Leitzel</i>	Date: 10-19-99
Report Reviewed By: Robert W. Kelley, Ph.D.	Signature: <i>R. Kelley</i>	Date: 10-19-99

CONCLUSIONS

The sediment reduces the survival of the test organisms.

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10 DAY AMPHIPOD SEDIMENT TOXICITY TEST

EPA/600/R-94/024 Method 100.1

Test Organism: Hyallela azteca

Client: WSRC
Sample Identification: TNSD25

Test Start Date: 8/4/99

10 DAY AMPHIPOD SEDIMENT TOXICITY TEST

Lab ID#	Client: WSRC	Start Date: 8/4/99
T12310	Sample Identification: TNSD25	End Date: 8/14/99

Test System

EPA/600/R-94/024 Method 100.1

The test was set as a Pass/Fail test with a control treatment and one sample treatment. Each treatment replicate consisted of 100 g of sediment and 175 mL of dilution water. There were eight replicates for each treatment. Ten test organisms were placed in each replicate. Sediment from a local stream was used in the control treatment. Test organisms were fed with YCT food. The test was conducted at a temperature of 23°C and a light cycle of 16 hr light/8 hr dark. Test vessels were 500 mL plastic beakers placed in a constant temperature incubator room.

Test Organisms

Order: Amphipoda
 Species: *Hyalella azteca*
 Source: Aquatic Biosystems, Fort Collins, CO
 Life Stage: 7 to 14 days
 % Mortality During 48 Hr Prior to Test:: 0%
 Taxonomic Verification: RWK 8/4/99
 Culturing: as received

Observations: Cultures healthy
 Acclimation: None

Dilution Water

Type: Surface Water
 Collection Date 8/4/99 Initial
 Alkalinity 10.4 mg/L
 Hardness 11.4 mg/L
 Conductivity 285 umhos/cm
 pH: 7.63 units

Preparation Method:
 Grab sample

Control Sediment

Source: Resurrection Creek
 Collection Date: 8/4/99
 Preservation: kept at 0-4°C in plastic
 Date/Time Added to Test Chambers: 8/3/99
 Observations: silt and organic
 Collection Method: grab
 Disposal

Test Sediment

Source: TNSD25
 Collection Date 7/16/99 Homogenized?: yes
 Preservation: kept at 0-4°C in plastic
 Date/Time Added to Test Chambers: 8/3/99
 Observations:
 Collection Method: grab
 Shipment: overnight

Food Preparation

Source: YCT
 Purchase Date: Preparation Date: 8/4/99
 Preservation: kept at 0-4°C
 Preparation Method: Trout Chow aerated 7 days
 Cerophyl, yeast aerated overnight
 Feeding Rate: 1.5 mL / day / replicate
 Hold Time: 5 days

Test Chambers

Type: Plastic 500 mL beakers
 Sediment Volume: 100 mL
 Sediment Depth 4 cm
 Overlying Water Volume: 175 mL
 Overlying Water Depth: 5 cm
 Aeration: Not needed

10 DAY AMPHIPOD SEDIMENT TOXICITY TEST

Lab ID#	Client: WSRC	Start Date: 8/4/99
T12310	Sample Identification: TNSD25	End Date: 8/14/99

WATER CHEMISTRY TEST METHODS

Temperature: SM 18th Ed. 2550	Alkalinity: SM 18th Ed. 2320
Dissolved Oxygen: SM 18th Ed. 4500-O	Hardness: SM 18th Ed. 2340
pH: SM 18th Ed. 4500-H+	Conductivity: SM 18th Ed. 2510

WATER CHEMISTRY TEST DATA - OVERLYING WATER

CONTROL TREATMENT

Test Day	Temp. C	pH units	D.O. mg/L	D.O. % sat.	Alkalinity	Ammonia
					Initial	Initial
Start	22.3	7.63	8.0	92%	10.4	<0.20
1	20.5		7.9	87%	Final	Final
2	22.6		7.6	87%	88.2	<0.1
3	22.0		7.5	86%	mg/L	mg/L
4	20.2		7.8	86%	Cond.	Hardness
5	21.5		7.0	79%	Initial	Initial
6	22.2		7.2	83%	285	11.4
7	21.2		6.8	76%	Final	Final
8	20.8		6.8	75%	175.0	49.4
9	20.2		8.0	88%	umhos/cm	mg/L
10	21.0	7.46	4.9	55%	Aeration: none	

SAMPLE TREATMENT

Test Day	Temp. C	pH units	D.O. mg/L	D.O. % sat.	Alkalinity	Ammonia
					Initial	Initial
Start	22.3	7.63	8.0	92%	10.4	<0.20
1	20.2		7.9	87%	Final	Final
2	22.6		8.0	92%	9.6	0.27
3	22.0		7.7	89%	mg/L	mg/L
4	20.2		7.4	81%	Cond.	Hardness
5	21.5		7.3	82%	Initial	Initial
6	22.2		7.4	85%	285	11.4
7	21.2		7.7	87%	Final	Final
8	20.8		7.6	84%	45.0	1.9
9	20.1		7.7	85%	umhos/cm	mg/L
10	21.0	7.17	8.1	91%	Aeration: none	

SURVIVAL AND GROWTH RESULTS

CONTROL TREATMENT

	# Organisms			% Survival	Mean Length (mm)	Standard Deviation
	Initial	Live at End	Dead at End			
A	10	10	0	100%		
B	10	6	4	60%		
C	10	9	1	90%		
D	10	8	2	80%		
E	10	10	0	100%		
F	10	10	0	100%		
G	10	5	5	50%		
H	10	9	1	90%		
Mean	10.0			84%		

SAMPLE TREATMENT

	# Organisms			% Survival	Mean Length (mm)	Standard Deviation
	Initial	Live at End	Dead at End			
A	10	7	3	70%		
B	10	10	0	100%		
C	10	7	3	70%		
D	10	3	7	30%		
E	10	9	1	90%		
F	10	10	0	100%		
G	10	5	5	50%		
H	10	8	2	80%		
Mean	10.0			74%		

10 DAY AMPHIPOD SEDIMENT TOXICITY TEST

Lab ID#	Client: WSRC	Start Date: 8/4/99
T12310	Sample Identification: TNSD25	End Date: 8/14/99

RESULTS

SURVIVAL DATA Mean of Eight Replicates		GROWTH DATA Mean Length (mm)	
	Mean %		Mean
Control	83.8%	Control	NA
Sample	73.8%	Sample	NA

STATISTICAL ANALYSES

SURVIVAL DATA	GROWTH DATA
<p>Test for Normality: W= 0.95 Critical value: 0.84 Data are normal in distribution</p> <p>Test for Homogeneity of Variance: F= 1.32 Critical value: 6.64 Data are homogeneous in variance</p> <p>Test for Differences in Survival: "t" Test t= 0.88 Critical value: 1.75 The sediment did not significantly reduce survival of the test organisms.</p>	<p>Test for Normality: W= NA Critical value: 0.84 NA</p> <p>Test for Homogeneity of Variance: F= NA Critical value: 6.635 NA</p> <p>Test for Differences in Survival: "t" Test t= NA Critical value: 1.94</p>

COMMENTS

None

Principal Analyst: Marsha Leitzel Signature: *Marsha Leitzel* Date: 10-19-99
Report Reviewed By: Robert W. Kelley, Ph.D. Signature: *R Kelley* Date: 10-17-99

CONCLUSIONS

The sediment does not reduce survival of the test organisms.

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10 DAY CHIRONOMUS SEDIMENT TOXICITY TEST

EPA/600/R-94/024

Test Organism: *Chironomus tentans*

Client: WSRC
Sample Identification: BGCH5

Test Start Date: 8/24/99

10 DAY CHIRONOMUS SEDIMENT TOXICITY TEST

Lab ID#	Client: WSRC	Start Date: 8/24/99
T12308	Sample Identification: BGCH5	End Date: 9/3/99

Test System

EPA/600/R-94/024

The test was set as a Pass/Fail test with a control treatment and one sample treatment. Each treatment replicate consisted of 100 g of sediment and 175 mL of dilution water. There were eight replicates for each treatment. Ten test organisms were placed in each replicate. Sediment from a local stream was used in the control treatment. Test organisms were fed with YCT food. The test was conducted at a temperature of 23°C and a light cycle of 16 hr light/8 hr dark. Test vessels were 500 mL plastic beakers placed in a constant temperature incubator room.

Test Organisms		Dilution Water	
Order: Diptera	Family: Chironomidae	Type: Surface Water	
Species: <i>Chironomus tentans</i>		Collection Date 8/23/99	Initial
Source: Aquatic Biosystems, Fort Collins, CO		Alkalinity	10.4 mg/L
Life Stage: 2nd instar		Hardness	11.4 mg/L
% Mortality During 48 Hr Prior to Test:: 0%		Conductivity	285 umhos/cm
Taxonomic Verification: RWK 8/24/99		pH:	7.63 units
Culturing: as received		Preparation Method:	
Observations: Cultures healthy		Grab sample	
Acclimation: None			

Control Sediment	Test Sediment
Source: Resurrection Creek	Source: BGCH5
Collection Date: 8/4/99	Collection Date 7/19/99 Homogenized?: yes
Preservation: kept at 0-4°C in plastic	Preservation: kept at 0-4°C in plastic
Date/Time Added to Test Chambers: 8/23/99	Date/Time Added to Test Chambers: 8/3/99
Observations: silt, detritus	Observations:
Collection Method: grab	Collection Method: grab
Disposal	Shipment: overnight

Food Preparation	Test Chambers
Source: Tetramin Fish Flakes	Type: Plastic 500 mL beakers
Purchase Date: Preparation Date: 8/24/99	Sediment Volume: 100 mL
Preservation: kept at 0-4°C	Sediment Depth 4 cm
Preparation Method: 4g flakes / 1500 mL DI water	Overlying Water Volume: 175 mL
Feeding Rate: 1.5 mL / day / replicate	Overlying Water Depth: 5 cm
Hold Time: 10 days	Aeration: Not needed

10 DAY CHIRONOMUS SEDIMENT TOXICITY TEST

Lab ID#	Client: WSRC	Start Date: 8/24/99
T12308	Sample Identification: BGCH5	End Date: 9/3/99

WATER CHEMISTRY TEST METHODS

Temperature: SM 18th Ed. 2550	Alkalinity: SM 18th Ed. 2320
Dissolved Oxygen: SM 18th Ed. 4500-O	Hardness: SM 18th Ed. 2340
pH: SM 18th Ed. 4500-H+	Conductivity: SM 18th Ed. 2510

WATER CHEMISTRY TEST DATA - OVERLYING WATER

CONTROL TREATMENT

Test Day	Temp. C	pH units	D.O. mg/L	D.O. % sat.	Alkalinity	Ammonia
					Initial	Initial
Start	19.4	7.22	8.6	92%	10.4	1.7
1	19.3		7.2	77%	Final	Final
2	19.3		6.9	74%	14.0	<0.1
3	19.1		8.1	87%	mg/L	mg/L
4	19.0		6.8	73%	Cond.	Hardness
5	21.2		7.4	83%	Initial	Initial
6	19.4		6.0	65%	58.7	9.5
7	18.9		6.2	65%	Final	Final
8	19.1		6.3	68%	175.0	9.5
9	22.9		5.9	68%	umhos/cm	mg/L
10	22.9	6.80	6.2	71%	Aeration: none	

SAMPLE TREATMENT

Test Day	Temp. C	pH units	D.O. mg/L	D.O. % sat.	Alkalinity	Ammonia
					Initial	Initial
Start	19.4	7.22	8.6	92%	10.4	1.7
1	19.3		7.8	84%	Final	Final
2	19.3		7.0	75%	6.0	<0.1
3	19.1		7.0	75%	mg/L	mg/L
4	19.0		7.4	80%	Cond.	Hardness
5	21.6		7.0	79%	Initial	Initial
6	19.4		7.0	75%	58.7	9.5
7	18.9		7.5	79%	Final	Final
8	19.1		7.6	82%	61.3	3.80
9	22.9		7.1	82%	umhos/cm	mg/L
10	22.9	7.17	7.2	83%	Aeration: none	

SURVIVAL AND GROWTH RESULTS

CONTROL TREATMENT

	# Organisms			% Survival	Mean Length (mm)	Standard Deviation
	Initial	Live at End	Dead at End			
A	10	2	8	20%		
B	10	8	2	80%		
C	10	5	5	50%		
D	10	10	0	100%		
E	10	7	3	70%		
F	10	8	2	80%		
G	10	7	3	70%		
H	10	spilled	0	NA		
Mean	10.0			67%		

SAMPLE TREATMENT

	# Organisms			% Survival	Mean Length (mm)	Standard Deviation
	Initial	Live at End	Dead at End			
A	10	0	10	0%		
B	10	2	8	20%		
C	10	2	8	20%		
D	10	3	7	30%		
E	10	1	9	10%		
F	10	2	8	20%		
G	10	2	8	20%		
H	10	0	10	0%		
Mean	10.0			15%		

10 DAY CHIRONOMUS SEDIMENT TOXICITY TEST

Lab ID#	Client: WSRC	Start Date: 8/24/99
T12308	Sample Identification: BGCH5	End Date: 9/3/99

RESULTS

SURVIVAL DATA		GROWTH DATA	
Mean of Eight Replicates		Mean Length (mm)	
	Mean %		Mean
Control	67.1%	Control	NA
Sample	15.0%	Sample	NA

STATISTICAL ANALYSES

SURVIVAL DATA	GROWTH DATA
<p>Test for Normality: W= 0.92 Critical value: 0.84 Data are normal in distribution</p> <p>Test for Homogeneity of Variance: F= 2.61 Critical value: 6.64 Data are homogeneous in variance</p> <p>Test for Differences in Survival: "t" Test t= 4.67 Critical value: 1.75 The sediment significantly reduced survival of the test organisms.</p>	<p>Test for Normality: W= NA Critical value: 0.84 NA</p> <p>Test for Homogeneity of Variance: F= NA Critical value: 6.635 NA</p> <p>Test for Differences in Survival: "t" Test t= NA Critical value: 1.94</p>

COMMENTS

Control survival was less than recommended minimum of 80%; this is believed to be due to high coarse silt content of the sediment. Tubificid worms were also noted in several control replicates.

Principal Analyst: Marsha Leitzel	Signature: <i>Marsha Leitzel</i>	Date: 10-19-99
Report Reviewed By: Robert W. Kelley, Ph.D.	Signature: <i>R. Kelley</i>	Date: 10-19-99

CONCLUSIONS

The sediment reduces the survival of the test organisms.

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10 DAY CHIRONOMUS SEDIMENT TOXICITY TEST

EPA/600/R-94/024

Test Organism: Chironomus tentans

Client:	WSRC
Sample Identification:	D-7
Test Start Date:	8/24/99

10 DAY CHIRONOMUS SEDIMENT TOXICITY TEST

Lab ID#	Client: WSRC	Start Date: 8/24/99
T12304	Sample Identification: D-7	End Date: 9/3/99

Test System

EPA/600/R-94/024

The test was set as a Pass/Fail test with a control treatment and one sample treatment. Each treatment replicate consisted of 100 g of sediment and 175 mL of dilution water. There were eight replicates for each treatment. Ten test organisms were placed in each replicate. Sediment from a local stream was used in the control treatment. Test organisms were fed with YCT food. The test was conducted at a temperature of 23°C and a light cycle of 16 hr light/8 hr dark. Test vessels were 500 mL plastic beakers placed in a constant temperature incubator room.

Test Organisms	Dilution Water
Order: Diptera Family: Chironomidae	Type: Surface Water
Species: <i>Chironomus tentans</i>	Collection Date 8/23/99 Initial
Source: Aquatic Biosystems, Fort Collins, CO	Alkalinity 10.4 mg/L
Life Stage: 2nd instar	Hardness 11.4 mg/L
% Mortality During 48 Hr Prior to Test:: 0%	Conductivity 285 umhos/cm
Taxonomic Verification: RWK 8/24/99	pH: 7.63 units
Culturing: as received	Preparation Method:
Observations: Cultures healthy	Grab sample
Acclimation: None	

Control Sediment	Test Sediment
Source: Resurrection Creek	Source: D-7
Collection Date: 8/4/99	Collection Date 7/19/99 Homogenized?: yes
Preservation: kept at 0-4°C in plastic	Preservation: kept at 0-4°C in plastic
Date/Time Added to Test Chambers: 8/23/99	Date/Time Added to Test Chambers: 8/23/99
Observations: silt, detritus	Observations:
Collection Method: grab	Collection Method: grab
Disposal	Shipment: overnight

Food Preparation	Test Chambers
Source: Tetramin Fish Flakes	Type: Plastic 500 mL beakers
Purchase Date: Preparation Date: 8/24/99	Sediment Volume: 100 mL
Preservation: kept at 0-4°C	Sediment Depth 4 cm
Preparation Method: 4g flakes / 1500 mL DI water	Overlying Water Volume: 175 mL
Feeding Rate: 1.5 mL / day / replicate	Overlying Water Depth: 5 cm
Hold Time: 10 days	Aeration: Not needed

10 DAY CHIRONOMUS SEDIMENT TOXICITY TEST

Lab ID#	Client: WSRC	Start Date: 8/24/99
T12304	Sample Identification: D-7	End Date: 9/3/99

WATER CHEMISTRY TEST METHODS

Temperature: SM 18th Ed. 2550	Alkalinity: SM 18th Ed. 2320
Dissolved Oxygen: SM 18th Ed. 4500-O	Hardness: SM 18th Ed. 2340
pH: SM 18th Ed. 4500-H+	Conductivity: SM 18th Ed. 2510

WATER CHEMISTRY TEST DATA - OVERLYING WATER

CONTROL TREATMENT

Test Day	Temp. C	pH units	D.O. mg/L	D.O. % sat.	Alkalinity	Ammonia
					Initial	Initial
Start	19.4	7.22	8.6	92%	10.4	1.7
1	19.3		7.2	77%	Final	Final
2	19.3		6.9	74%	14.0	<0.1
3	19.1		8.1	87%	mg/L	mg/L
4	19.0		6.8	73%	Cond.	Hardness
5	21.2		7.4	83%	Initial	Initial
6	19.4		6.0	65%	58.7	9.5
7	18.9		6.2	65%	Final	Final
8	19.1		6.3	68%	175.0	9.5
9	22.9		5.9	68%	umhos/cm	mg/L
10	22.9	6.80	6.2	71%	Aeration: none	

SAMPLE TREATMENT

Test Day	Temp. C	pH units	D.O. mg/L	D.O. % sat.	Alkalinity	Ammonia
					Initial	Initial
Start	19.4	7.22	8.6	92%	10.4	1.7
1	19.3		8.0	86%	Final	Final
2	19.3		7.4	80%	10.9	<0.1
3	19.1		7.3	78%	mg/L	mg/L
4	19.0		7.6	82%	Cond.	Hardness
5	21.6		7.0	79%	Initial	Initial
6	19.4		7.3	78%	58.7	9.5
7	18.9		7.6	80%	Final	Final
8	19.1		7.6	82%	182.0	5.70
9	22.9		7.1	82%	umhos/cm	mg/L
10	22.9	7.17	7.2	83%	Aeration: none	

SURVIVAL AND GROWTH RESULTS

CONTROL TREATMENT

	# Organisms				Mean Length (mm)	Standard Deviation
	Initial	Live at End	Dead at End	% Survival		
A	10	2	8	20%		
B	10	8	2	80%		
C	10	5	5	50%		
D	10	10	0	100%		
E	10	7	3	70%		
F	10	8	2	80%		
G	10	7	3	70%		
H	10	spilled	0	NA		
Mean	10.0			67%		

SAMPLE TREATMENT

	# Organisms				Mean Length (mm)	Standard Deviation
	Initial	Live at End	Dead at End	% Survival		
A	10	4	6	40%		
B	10	5	5	50%		
C	10	6	4	60%		
D	10	3	7	30%		
E	10	9	1	90%		
F	10	7	3	70%		
G	10	1	9	10%		
H	10	5	5	50%		
Mean	10.0			50%		

10 DAY CHIRONOMUS SEDIMENT TOXICITY TEST

Lab ID#	Client: WSRC	Start Date: 8/24/99
T12304	Sample Identification: D-7	End Date: 9/3/99

RESULTS

SURVIVAL DATA		GROWTH DATA	
Mean of Eight Replicates		Mean Length (mm)	
	Mean %		Mean
Control	67.1%	Control	NA
Sample	50.0%	Sample	NA

STATISTICAL ANALYSES

SURVIVAL DATA	GROWTH DATA
Test for Normality: W= 0.94 Critical value: 0.84 Data are normal in distribution	Test for Normality: W= NA Critical value: 0.84 NA
Test for Homogeneity of Variance: F= 1.36 Critical value: 6.64 Data are homogeneous in variance	Test for Homogeneity of Variance: F= NA Critical value: 6.635 NA
Test for Differences in Survival: "t" Test t= 1.35 Critical value: 1.75 The sediment did not significantly reduce survival of the test organisms.	Test for Differences in Survival: "t" Test t= NA Critical value: 1.94

COMMENTS

Control survival was less than recommended minimum of 80%; this is believed to be due to high coarse silt content of the sediment. Tubificid worms were also noted in several control replicates.

Principal Analyst:	Marsha Leitzel	Signature: <i>Marsha Leitzel</i>	Date: 10-11-97
Report Reviewed By:	Robert W. Kelley, Ph.D.	Signature: <i>Robert W. Kelley</i>	Date: 10-19-99

CONCLUSIONS

The sediment does not reduce the survival of the test organisms.