**Final Report**

# *Ceriodaphnia dubia*
# Whole Sediment Survival and Reproduction Toxicity Test Results

## TVA, Kingston Monitoring and Analysis Project
## Clinch River Sediment Sample CRM1.5

**Prepared for:**

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## EXECUTIVE SUMMARY

A whole sediment toxicity test was conducted by Environmental Enterprises USA, Inc. (EE USA) to determine potential toxicity of a Clinch River site sediment sample to *Ceriodaphnia dubia* neonates. Three samples were used in this test: Clinch River site sediment identified as BULKSED-CRM1.5-EEUSA (CRM1.5); Clinch River reference sediment identified as BULKSED-CLINCHREFERENCE-EEUSA (CRS); and Clinch River water identified as BULKSW-CRM7.0-EEUSA (CRW). Several dilutions of CRM1.5 prepared with CRS were tested with four concurrent controls. A moderately hard synthetic freshwater (MHSW) only control was included to assess test organism health. Separate laboratory control sediment (LCS) exposures with either MHSW or CRW were included to assess test acceptability requirements.

*C. dubia* survival and reproduction in the CRM1.5 treatments were compared to survival and reproduction in a CRS control with CRW. Survival and reproduction of *C. dubia* neonates in the CRM1.5 treatments were not reduced when compared to survival and reproduction in the CRS control. Test results are shown in Table 1.

**Table 1. *Ceriodaphnia dubia* Chronic Survival and Reproduction Test Results for CRM1.5.**

| SURVIVAL | REPRODUCTION |
|---|---|
| NOEC / LOEC = 100.0 / > 100.0% | NOEC / LOEC = 100.0 / > 100.0% |
| $IC_{25}$ > 100.0% | $IC_{25}$ > 100.0% |

## INTRODUCTION

EE USA was contracted by Tennessee Valley Authority (TVA) to complete whole sediment toxicity tests with Clinch River sediment and water samples using *C. dubia* neonates. The project is described in TVA's Sediment Toxicity Study Design [1]. Site sediment samples were collected from eight representative locations on the Clinch River. Clinch River reference sediment samples and river water samples were collected upstream of the site sediment locations. The two reference sediment samples were mixed together 50:50 and homogenized in the field. TVA's contractors, Jacobs Engineering and Restoration Services, Inc., coordinated sample collection in the field and delivery of the samples to EE USA. The samples were delivered to EE USA on February 12 and 23, 2011, on ice and with custody seals intact (Appendix D).

This test, which was performed on one (CRM1.5) of the eight sediment samples obtained from the Clinch River, was conducted in accordance with American Society for Testing and Materials (ASTM) [2] and U. S. EPA [3] toxicity testing methods. Test organisms were cultured at EE USA and were 7.5 to 15.5 hours old when this test was initiated. Ten replicates of each control treatment and six CRM1.5 concentrations were prepared the day before the test was initiated. CRM1.5 dilutions were prepared with CRS. CRM1.5 concentrations tested were 10.0, 20.0, 40.0, 60.0, 80.0, and 100.0%. A portion of the overlying water in each replicate was replaced daily. This test was initiated March 1, 2011, at 1330 and completed March 7 at 1415.

## MATERIALS AND METHODS

*C. dubia* was cultured and maintained in MHSW at 25 ± 1°C. Test organisms were selected from adults producing at least ten in their third or subsequent brood. Only ten neonates from any one adult were used so that one replicate in each treatment was populated with a neonate from the same adult. Test organisms were fed *Selenastrum capricornutum* (SCAP) and Yeast-Cerophyl-digested Tetramin (YCT) daily at the rate of 0.1 mL each per 15 mL of water.

On February 12, 2011, the CRM1.5 and CRS samples were delivered to EE USA and stored at 0.1 to 6°C. On February 23, 2011, the CRW sample was delivered to EE USA and stored at 0.1 to 6°C (Appendix D & Table 2). Two 1-liter containers each of CRM1.5 and CRS were put into separate mixing bowls and large bark pieces, rocks, and leaves were removed with forceps. Each 2-liter sediment sample was mixed for approximately five minutes with a KitchenAid Model KHM7TGCS hand-held mixer set at position "3", 580 ± 5 rpm. On February 28th (Day -1), the density of each sediment, LCS, CRS, and CRM1.5, was measured and the test treatments were prepared (Appendix A, page 1). Eight-dram shell vials were used as test chambers. The vials were washed with soap and water and rinsed with acetone, 10% HCl, deionized water, and MHSW prior to being used as test chambers. Test chambers were labeled with test concentration, replicate, and EE USA's project number. Dilutions of CRM1.5 were made with CRS according to the calculations on page 1 of Appendix A. For each treatment, 400 mL of sediment was prepared, homogenized, and then 5 mL were transferred to 11 test replicates. The 11th replicate of each treatment was used for water quality only.

**Table 2. Clinch River Site Sediment, Reference Sediment, and Water Samples.**

| TVA Sample ID | EE USA Sample ID | Date Collected | Date Received |
|---|---|---|---|
| BULKSED-CRM1.5-EEUSA<br>Composite Sample, Site Sediment (CRM1.5) | E-088-11 | February 7, 2011 @ 1243 | February 12, 2011 @ 1240 |
| BULKSED-CLINCHREFERENCE-EEUSA<br>Composite Sample, Clinch Reference Sediment (CRS) | E-095-11 | February 9, 2011 @ 0940 | |
| BULKSW-CRM7.0-EEUSA<br>Grab Sample, Clinch River Water (CRW) | E-125-11 | February 22, 2011 @ 1033 | February 23, 2011 @ 0815 |

SCAP and YCT were added to aliquots of the overlying waters, MHSW and CRW; 6.0 mL each of SCAP and YCT was added to 900 mL of MHSW and 12 mL each of SCAP and YCT was added to 1800 mL CRW. The MHSW and CRW aliquots were warmed up to 25 ± 1°C. Twenty mL of MHSW were transferred to 11 test replicates of the MHSW only control. LCS, No. 5 sand supplied by EE USA and wetted to saturation with MHSW, was homogenized with a stainless steel spoon and five mL were transferred to 22 test replicates. Eleven LCS + MHSW replicates received 20 mL MHSW and 11 LCS + CRW replicates received 20 mL CRW. Twenty mL of CRW were added to each replicate of the CRS and CRM1.5 treatments.

After dispensing the sediments and water, the test chambers were placed in an environmental chamber at 25 ± 1°C with a photoperiod of 16 hours light and 8 hours dark. The test was not aerated. Initial water quality parameters (dissolved oxygen (DO) and temperature) were measured daily in the 11th replicate of each treatment. At the end of each 24-hour exposure period, prior to renewal, the ending DO and temperature in each treatment were recorded (Appendix A, pages 9 – 12 & Table 3). Alkalinity, hardness, conductivity, pH, DO, total residual chlorine, and ammonia were measured in CRW and each batch of MHSW (Appendix A, page 2 & Table 4).

**Table 3. Initial and Final Temperature and Dissolved Oxygen Data for Each Treatment: Mean, Minimum, and Maximum.**

| Water Quality Summary for Test Exposures March 1 – 7, 2011 | | | | | Mean<br>Min Max | | | |
|---|---|---|---|---|---|---|---|---|
| % Sample | Temperature, °C | | | | Dissolved Oxygen, mg/L | | | |
| | Initial | | Final | | Initial | | Final | |
| MHSW | 24.7<br>24.3 | 25.0 | 24.8<br>24.4 | 25.2 | 7.2<br>6.9 | 7.4 | 7.2<br>7.0 | 7.3 |
| LCS + MHSW | 24.8<br>24.5 | 25.1 | 24.8<br>24.4 | 25.3 | 7.1<br>6.9 | 7.4 | 7.0<br>6.9 | 7.3 |
| LCS + CRW | 24.9<br>24.5 | 25.2 | 24.7<br>24.2 | 25.0 | 7.0<br>6.6 | 7.5 | 6.7<br>6.4 | 7.1 |
| CRS + CRW | 24.8<br>24.3 | 25.1 | 24.7<br>24.3 | 25.1 | 6.2<br>5.6 | 6.6 | 6.1<br>5.9 | 6.6 |
| 10.0 | 24.9<br>24.4 | 25.1 | 24.9<br>24.5 | 25.1 | 6.3<br>5.7 | 6.6 | 6.1<br>5.4 | 6.5 |
| 20.0 | 25.0<br>24.6 | 25.3 | 25.0<br>24.7 | 25.4 | 6.1<br>5.6 | 6.5 | 5.9<br>5.5 | 6.5 |
| 40.0 | 24.9<br>24.4 | 25.2 | 24.9<br>24.6 | 25.4 | 6.2<br>5.7 | 6.4 | 5.9<br>5.7 | 6.0 |
| 60.0 | 25.0<br>24.3 | 25.3 | 24.9<br>24.6 | 25.4 | 6.1<br>5.4 | 6.5 | 5.7<br>5.5 | 5.9 |
| 80.0 | 25.0<br>24.4 | 25.3 | 24.9<br>24.5 | 25.2 | 4.4[1]<br>3.9 | 4.8 | 4.4[1]<br>4.0 | 4.7 |
| 100.0 | 25.0<br>24.4 | 25.3 | 24.9<br>24.5 | 25.2 | 5.7<br>5.3 | 6.2 | 5.6<br>5.2 | 5.9 |

[1] Low DO concentrations at 80.0% CRM1.5 are due to the particular sediment aliquot in the replicate set up for water quality readings only. On Day 3, ending DO in an actual test replicate was 6.0 mg/l. On Day 6 ending DO in an actual test replicate was 6.2 mg/l.

**Table 4. Water Quality Data for CRW and Each Batch of MHSW.**

| | CRW | MHSW | MHSW | MHSW |
|---|---|---|---|---|
| Collected | 2/22/2011 | ///// | ///// | ///// |
| Batch Number | BULKSW-CRM7.0-EEUSA | FW-023-11[1] | FW-024-11[2] | |
| Alkalinity, mg/l | 132 | 72 | 68 | |
| Hardness, mg/l | 140 | 80 | 100 | |
| Conductivity, µmhos/cm | 309 | 323 | 314 | |
| pH, su | 8.2 | 8.2 | 7.8 | |
| Dissolved Oxygen, mg/l | 9.7 @ 21°C | 8.2 | 8.3 | |
| TRC, mg/l | 0.08 | 0.0 | 0.0 | |
| Total Ammonia, mg/l | < 0.02 | < 0.02 | < 0.02 | |
| | | [1] used 02/28/2011-03/02/2011 | | |
| | | [2] used 03/03-06/2011 | | |

The test was initiated March 1st (Day 0) after 15 mL of water were removed from each replicate of each treatment and replaced with water into which proper aliquots of food had been added. One *C. dubia* neonate was transferred to each replicate, and then the test chambers were placed in an environmental chamber. On Days 1-5, the test exposures were renewed as follows:

1. The *C. dubia* in each replicate and approximately 5 mL of the water in the replicate were transferred to a 30-mL disposable plastic cup.
2. Additional water equivalent to a total of 15 mL was removed from the replicate.
3. 15 mL of fresh MHSW or CRW as appropriate was transferred to the replicate.
4. The *C. dubia* was transferred back to the replicate.

Water was removed from and added to each replicate with a 25-mL pipette. *C. dubia* were transferred with disposable 3.5-mL transfer pipettes. Survival was recorded daily (Appendix A, pages 3 - 8). Reproduction was also recorded and newly produced neonates discarded before renewal. The test was terminated after six days, after $\geq$ 60% of each set of control organisms released their third brood.

The endpoints for the chronic test were survival and neonate production. The test acceptability criteria were 80% or greater survival in the LCS + MHSW control and an average of 15 or more young per surviving female in the control solutions (60% of surviving control females must produce three broods).

The response used in the statistical analysis of the survival data was the proportion of test organisms surviving in each treatment chamber after six days. Fisher's Exact test was used to test for a significant difference between survival in the CRS + CRW control and each CRM1.5 concentration. The response used in the reproduction data analysis was the total number of neonates produced per replicate. Reproduction data were tested for normal distribution and homogeneity of variance using the Kolmogorov D and Bartlett's tests, respectively. Reproduction data were normally distributed, equal in variance, and evaluated by Dunnett's Test. The statistical tests were performed using ToxCalc Version 5.0.32 at a probability level of 0.05 [4].

Sensitivity of test organisms to a known toxicant was determined by performing a chronic Standard Reference Toxicant (SRT) test, CD1102, with potassium chloride (Sigma Chemical, Lot 099K0202). The most recent SRT test was initiated on February 10, 2011, with less than 24-hour-old *C. dubia* neonates.

## RESULTS AND DISCUSION

The control *C. dubia* met the test acceptability criteria of 80% or greater survival and an average of 15 or more young per surviving female in the LCS + MHSW control solution. One hundred percent survival occurred in the LCS + MHSW control. Nine out of ten (90%) of the control females produced three broods; the mean brood size was 24.7.

The No Observed Effect Concentration (NOEC) for survival was 100% CRM1.5. The Lowest Observed Effect Concentration (LOEC) was > 100.0% CRM1.5. The $IC_{25}$, a point estimate of the concentration that causes a 25% reduction in survival was > 100.0% CRM1.5 (Appendix B, page 1 & Table 5).

The NOEC for reproduction was 100.0% CRM1.5. The LOEC was > 100.0% CRM1.5. The Minimum Significant Difference percent for this reproduction data set was 11.8% (Appendix B, page 2). The $IC_{25}$, a point estimate of the concentration that causes a 25% reduction in reproduction was > 100.0% CRM1.5 (Appendix B, page 2 & Table 5).

**Table 5. Summary of Percent Survival, Mean Reproduction, and Survival and Reproduction NOECs, LOECs, and $IC_{25}$s for CRM1.5.**

| | LCS + CRW | CRS + CRW | 10% CRM1.5 | 20% CRM1.5 | 40% CRM1.5 | 60% CRM1.5 | 80% CRM1.5 | 100% CRM1.5 |
|---|---|---|---|---|---|---|---|---|
| **% Survival** | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| **Mean Reproduction** | 26.5 | 29.3 | 29.9 | 30.7 | 28.8 | 30.0 | 28.4 | 30.2 |

| | NOEC | LOEC | $IC_{25}$ |
|---|---|---|---|
| **Survival** | 100% CRM1.5 | > 100% CRM1.5 | > 100% CRM1.5 |
| **Reproduction** | 100% CRM1.5 | > 100% CRM1.5 | > 100% CRM1.5 |

In summary, *C. dubia* survival and reproduction were not significantly reduced in any control or CRM1.5 treatment. Survival and reproduction statistical data for the MHSW only, LCS + MHSW, and LCS + CRW controls are presented on pages 3 and 4 of Appendix B.

The neonates used in the potassium chloride SRT met all of the quality control test parameters. The following SRT control charts are given in Appendix C:

- Survival IC25 with ± 2 SD Control Limits
- Survival IC25 %CV with 75th and 90th Percentile Warning Limits
- Survival PMSD
- Reproduction IC25 with ± SD Control Limits
- Reproduction IC25 %CV with 75th and 90th Percentile Warning Limits
- Control Reproduction with Lower Limit
- Control Reproduction %CV with TVA Limit
- Reproduction PMSD

## REFERENCES


1. Tennessee Valley Authority. 2011. Kingston Monitoring and Analysis Project Non-Time-Critical Removal Action Sampling and Analysis Plan Sediment Toxicity Study Design. Chattanooga, TN.

2. American Society for Testing and Materials. 2005. Standard Test Method for Measuring the Toxicity of Sediment-Associated Contaminants with Freshwater Invertebrates. Annex A2. Guidance for Conducting Sediment Toxicity Tests with *D. magna* and C. *dubia*. E 1706-05. West Conshohocken, PA.

3. U.S. Environmental Protection Agency. 2002. Short-term methods for estimating the chronic toxicity of effluents and receiving waters to freshwater organisms, 4th ed. EPA-821-R-02-013. Office of Water, Washington, DC.

# REPORT TEST REVIEW

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# APPENDIX A

# Cladoceran, *Ceriodaphnia dubia*

## Whole Sediment Survival and Reproduction Test

ASTM E 1706 – 05, Standard Test Method for Measuring the Toxicity of Sediment-Associated Contaminants with Freshwater Invertebrates: A2.
GUIDANCE FOR CONDUCTING SEDIMENT TOXICITY TESTS WITH
*DAPHNIA MAGNA* (*D. magna*) AND *CERIODAPHNIA DUBIA* (*C. dubia*)

## TVA, Kingston Monitoring and Analysis Project

**CRM 1.5 Sediment & CRS Reference Sediment**

| | Density | | |
|---|---|---|---|
| | LCS | CRS | CRM 1.5 |
| 1 | 72.32 g/40 ml | 63.52 g/40 ml | 50.94 g/40 ml |
| 2 | 72.78 g/40 ml | 63.08 g/40 ml | 50.44 g/40 ml |
| 3 | 72.21 g/40 ml | 63.41 g/40 ml | 50.58 g/40 ml |
| MEAN | 72.44 g/40 ml | 63.34 g/40 ml | 50.65 g/40 ml |
| g/ml | 1.81 | 1.58 | 1.27 |
| g/5 ml | 9.06 | 7.92 | 6.33 |
| Initial | DW JG | DW JG | DW JG |

2/28/11
Balance ID: N7
DW 3/10/11

| Test Concentrations, % CRM 1.5 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Ceriodaphnia dubia* | Total Sediment Vol./ Conc., ml | CRM 1.5 ml / gram | CRS ml / gram | LCS ml / gram | grams sediment/ replicate | CRW/rep | | MHSW/rep | | Tech | |
| | | | | | | Day 0 | Days 1 - 6 | Day 0 | Days 1 - 6 | Sed | H2O |
| 100.0% | 400 | 400 / 506.5 | 0 (A) | 0 | 6.33 | 20 | 15 | 0 | 0 | JG | DW |
| 80.0% | 400 | 320 / 405.2 | 80 / ~~126.68~~ | 0 | 6.64 | 20 | 15 | 0 | 0 | | |
| 60.0% | 400 | 240 / 303.9 | 160 / 253.4 | 0 | 6.97 | 20 | 15 | 0 | 0 | | |
| 40.0% | 400 | 160 / 202.6 | 240 / 380.0 | 0 | 7.28 | 20 | 15 | 0 | 0 | | |
| 20.0% | 400 | 80 / 101.3 | 320 / 506.7 | 0 | 7.60 | 20 | 15 | 0 | 0 | | |
| 10.0% | 400 | 40 / 50.65 | 360 / 570.1 | 0 | 7.76 | 20 | 15 | 0 | 0 | | |
| CRS w CRW | 400 | 0 | 400 / 633.4 | 0 | 7.92 | 20 | 15 | 0 | 0 | | |
| LCS w CRW | 400 | 0 | 0 | 400 / 724.4 | 9.06 | 20 | 15 | 0 | 0 | | |
| LCS w MHSW | 400 | 0 | 0 | 400 / 724.4 | 9.06 | 0 | 0 | 20 | 15 | | |
| MHSW | n/a | 0 | 0 | 0 | n/a | 0 | 0 | 20 | 15 | | |

Data pages & Calculations by: [signature] QA/QC Check by: [signature]

Overlying water + sediment dispensed on 2/28/11, Day -1.
DW 3/10/11

TVA, CRM 1.5, Site Sediment
TVA, CRS, Reference Sediment
TVA, CRW, River Water

(A) 126.7 DW 5/2/11

E-088-11
E-095-11
E-125-11

MHSW = Moderately Hard Synthetic Freshwater
CRW = Clinch River Reference Water

| | MHSW | MHSW | MHSW | CRW | Meter # |
|---|---|---|---|---|---|
| Date | 02/28/2011 | 3/3/2011 | /2011 | 2/28/2011 | /// |
| Batch # | FW-023-11 | FW-024-11 | FW- -11 | Delivered 02/23/2011 | |
| Alkalinity | 72 | 68 | | 132 | |
| Hardness | 80 | 100 | | 140 | |
| Conductivity | 323 | 314 | | 309 | A46 |
| pH | 8.2 | 7.8 | | 8.2 | Q8 |
| DO | 8.2 | 8.3 | | 9.7/21°C | S7 |
| TRC | 0.0 | 0.0 | | 0.08 | A27 * |
| Ammonia | <0.02 | <0.02 | | <0.02 | |
| Initial | DW | DW | | DW | |

Alkalinity: mg/l as $CaCO_3$ Hardness: mg/l as $CaCO_3$ Conductivity: µS/cm pH: su
TRC: mg/l Dissolved Oxygen (DO): mg/l Total Residual Chlorine (TRC): mg/l Ammonia, Total: mg/l

Comments: CRS sandy w/ some small bits of bark and leaves.
CRM 1.5 very clean. DW 2/28/11

* Meter ID recorded 3/1/11 DW

# Cladoceran, *Ceriodaphnia dubia*

## Whole Sediment Survival and Reproduction Test

ASTM E 1706 – 05, Standard Test Method for Measuring the Toxicity of Sediment-Associated Contaminants with Freshwater Invertebrates:
A2. GUIDANCE FOR CONDUCTING SEDIMENT TOXICITY TESTS WITH
*DAPHNIA MAGNA* (*D. magna*) AND *CERIODAPHNIA DUBIA* (*C. dubia*)

# TVA, Kingston Monitoring and Analysis Project

**CRM 1.5 Sediment & CRS Reference Sediment**

Test Organisms Age: 7.5 – 15.5 Hours Old
Test Organisms Source: EEUSA Test Initiation At: 1330 on 3/1/2011
Counted by: David L. Daniel QC/QA by: Veronica McAllen
Loaded by: David L. Daniel Organism Lot # CD030111-01

**Exposure Chamber**: 8 dram vials. **Feeding**: 0.1 ml *S. capricornutum* (Lot # S1-11) & 0.1 ml YCT (Lot # Y2-11) / 15 ml.

## *C. dubia* Daily Survival & Reproduction Data

**Treatment: MHSW only.**

| DAY | REP | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | % Sur. | No. of Neonates Per Day | Tech CD | Tech H2O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | /// | /// | DD | VL |
| | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 | DD | VL |
| | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 | DD | VL |
| | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 | DD | VL |
| | 4 | 5 | 4 | 4 | 4 | 4 | 5 | 5 | 3 | 4 | 4 | 100 | 42 | DD | DD |
| | 5 | 0 | 9 | 8 | 8 | 8 | 8 | 8 | 7 | 9 | 8 | 100 | 73 | DD | DD |
| | 6 | 11 | 12 | 10 | 13 | 11 | 10 | 10 | 8 | 11 | 9 | 100 | 105 | DD | DD |
| | 7 | | | | | | | | | | | | | | |
| | 3rd Brood Reproduction Per Replicate | | | | | | | | | | | Mean | CV % | /////// | |
| | | 16 | 25 | 22 | 25 | 23 | 23 | 23 | 18 | 24 | 21 | 22.0 | 13.4 | | |

Comments:

## *C. dubia* Daily Survival & Reproduction Data Cont.

**Treatment: LCS w MHSW.**

| DAY | REP | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | % Sur. | No. of Neonates Per Day | Tech CD | Tech H2O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | /// | /// | DD | VL |
| | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 | DD | VL |
| | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 | DD | VL |
| | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 | DD | VL |
| | 4 | 4 | 5 | 4 | 4 | 4 | 5 | 4 | 4 | 4 | 6 | 100 | 44 | DD | DD |
| | 5 | 9 | 10 | 8 | 8 | 9 | 12 | 9 | 0 | 8 | 9 | 100 | 82 | DD | DD |
| | 6 | 15 | 13 | 12 | 12 | 10 | 14 | 11 | 13 | 11 | 10 | 100 | 121 | DD | DD |
| | 7 | | | | | | | | | | | | | | |
| | 3rd Brood Reproduction Per Replicate | | | | | | | | | | | Mean | CV % | /////// | |
| | | 28 | 28 | 24 | 24 | 23 | 31 | 24 | 17 | 23 | 25 | 24.7 | 15.3 | | |

**Treatment: LCS w CRW.**

| DAY | REP | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | % Sur. | No. of Neonates Per Day | Tech CD | Tech H2O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | /// | /// | DD | VL |
| | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 | DD | VL |
| | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 | DD | VL |
| | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 | DD | VL |
| | 4 | 5 | 5 | 4 | 6 | 5 | 6 | 5 | 5 | 4 | 5 | 100 | 50 | DD | DD |
| | 5 | 11 | 11 | 9 | 10 | 12 | 0 | 10 | 8 | 9 | 10 | 100 | 89 | DD | DD |
| | 6 | 14 | 16 | 10 | 11 | 14 | 12 | 12 | 11 | 13 | 13 | 100 | 1286 | DD | DD |
| | 7 | | | | | | | | | | | | (A) | | |
| | 3rd Brood Reproduction Per Replicate | | | | | | | | | | | Mean | CV % | /////// | |
| | | 30 | 32 | 23 | 27 | 31 | 18 | 27 | 24 | 25 | 28 | 26.5 | 15.8 | | |

Comments: (A) wrong date DD 3/3/11

TVA, CRM 1.5, Site Sediment
TVA, CRS, Reference Sediment
TVA, CRW, River Water

E-088-11
E-095-11
E-125-11

# *C. dubia* Daily Survival & Reproduction Data Cont.

**Treatment: CRS w CRW.**

| DAY | REP | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | % Sur. | No. of Neonates Per Day | Tech CD | Tech H2O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | /// | /// | DD | VL |
| | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 | DD | VL |
| | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 | DD | VL |
| | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 | DD | VL |
| | 4 | 5 | 5 | 5 | 4 | 6 | 6 | 5 | 6 | 6 | 6 | 100 | 54 | DD | DD |
| | 5 | 9 | 12 | 12 | 10 | 9 | 11 | 10 | 12 | 12 | 9 | 100 | 106 | DD | DD |
| | 6 | 13 | 15 | 14 | 12 | 8 | 13 | 13 | 15 | 16 | 14 | 100 | 133 | DD | DD |
| | 7 | | | | | | | | | | | | | | |
| | 3rd Brood Reproduction Per Replicate | | | | | | | | | | | Mean | CV % | ////// | |
| | | 27 | 32 | 31 | 26 | 23 | 30 | 28 | 33 | 34 | 29 | 29.3 | 11.6 | | |

**Treatment: 10% CRM 1.5 w CRW.**

| DAY | REP | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | % Sur. | No. of Neonates Per Day | Tech CD | Tech H2O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | /// | /// | DD | VL |
| | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 | DD | VL |
| | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 | DD | VL |
| | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 | DD | VL |
| | 4 | 5 | 4 | 6 | 5 | 5 | 6 | 5 | 5 | 5 | 6 | 100 | 52 | DD | DD |
| | 5 | 9 | 11 | 10 | 13 | 11 | 9 | 10 | 11 | 12 | 10 | 100 | 106 | DD | DD |
| | 6 | 13 | 15 | 14 | 15 | 15 | 12 | 12 | 14 | 15 | 16 | 100 | 141 | DD | DD |
| | 7 | | | | | | | | | | | | | | |
| | 3rd Brood Reproduction Per Replicate | | | | | | | | | | | Mean | CV % | ////// | |
| | | 27 | 30 | 30 | 33 | 31 | 27 | 27 | 30 | 32 | 32 | 29.9 | 7.5 | | |

Comments:

TVA, CRM 1.5, Site Sediment
TVA, CRS, Reference Sediment
TVA, CRW, River Water

E-088-11
E-095-11
E-125-11

# *C. dubia* Daily Survival & Reproduction Data Cont.

**Treatment: 20% CRM 1.5 w CRW.**

| DAY | REP | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | % Sur. | No. of Neonates Per Day | Tech CD | Tech H2O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | /// | /// | DW | VL |
| | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 | DW | VL |
| | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 | DW | VL |
| | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 | DW | VL |
| | 4 | 5 | 5 | 5 | 6 | 5 | 6 | 3 | 5 | 5 | 6 | 100 | 51 | DW | DW |
| | 5 | 12 | 10 | 11 | 12 | 10 | 13 | 9 | 11 | 10 | 12 | 100 | 110 | DW | DW |
| | 6 | 14 | 14 | 14 | 14 | 15 | 17 | 15 | 16 | 13 | 14 | 100 | 146 | DW | DW |
| | 7 | | | | | | | | | | | | | | |
| | 3rd Brood Reproduction Per Replicate | | | | | | | | | | | Mean | CV % | /////// | |
| | | 31 | 29 | 30 | 32 | 30 | 36 | 27 | 32 | 28 | 32 | 30.7 | 8.3 | | |

**Treatment: 40% CRM 1.5 w CRW.**

| DAY | REP | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | % Sur. | No. of Neonates Per Day | Tech CD | Tech H2O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | /// | /// | DW | VL |
| | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 | DW | VL |
| | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 | DW | VL |
| | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 | DW | VL |
| | 4 | 5 | 5 | 6 | 6 | 5 | 7 | 5 | 5 | 5 | 6 | 100 | 55 | DW | DW |
| | 5 | 0 | 12 | 10 | 11 | 9 | 11 | 12 | 7 | 11 | 12 | 100 | 95 | DW | DW |
| | 6 | 14 | 13 | 16 | 14 | 15 | 14 | 11 | 11 | 15 | 15 | 100 | 138 | DW | DW |
| | 7 | | | | | | | | | | | | | | |
| | 3rd Brood Reproduction Per Replicate | | | | | | | | | | | Mean | CV % | /////// | |
| | | 19 | 30 | 32 | 31 | 29 | 32 | 28 | 23 | 31 | 33 | 28.8 | 15.5 | | |

Comments:

TVA, CRM 1.5, Site Sediment
TVA, CRS, Reference Sediment
TVA, CRW, River Water

E-088-11
E-095-11
E-125-11

# *C. dubia* Daily Survival & Reproduction Data Cont.

**Treatment: 60% CRM 1.5 w CRW.**

| DAY | REP | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | % Sur. | No. of Neonates Per Day | Tech CD | Tech H2O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | /// | /// | DW | VL |
| | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 | DW | VL |
| | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 | DW | VL |
| | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 | DW | VL |
| | 4 | 6 | 5 | 4 | 6 | 6 | 6 | 5 | 5 | 5 | 6 | 100 | 54 | DW | DW |
| | 5 | 11 | 12 | 12 | 13 | 8 | 12 | 12 | 9 | 9 | 10 | 100 | 108 | DW | DW |
| | 6 | 16 | 11 | 14 | 15 | 18 | 13 | 12 | 12 | 14 | 13 | 100 | 138 | DW | DW |
| | 7 | | | | | | | | | | | | | | |
| | 3rd Brood Reproduction Per Replicate | | | | | | | | | | | Mean | CV % | /////// | |
| | | 33 | 28 | 30 | 34 | 32 | 31 | 29 | 26 | 28 | 29 | 30.0 | 8.3 | | |

**Treatment: 80% CRM 1.5 w CRW.**

| DAY | REP | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | % Sur. | No. of Neonates Per Day | Tech CD | Tech H2O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | /// | /// | DW | VL |
| | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 | DW | VL |
| | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 | DW | VL |
| | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 | DW | VL |
| | 4 | 5 | 2 | 5 | 6 | 5 | 5 | 6 | 5 | 5 | 6 | 100 | 50 | DW | DW |
| | 5 | 10 | 4 | 14 | 12 | 9 | 10 | 12 | 8 | 10 | 10 | 100 | 99 | DW | DW |
| | 6 | 14 | 11 | 12 | 12 | 16 | 16 | 14 | 12 | 13 | 15 | 100 | ~~115~~ (A) 135 | DW | DW |
| | 7 | | | | | | | | | | | | | | |
| | 3rd Brood Reproduction Per Replicate | | | | | | | | | | | Mean | CV % | /////// | |
| | | 29 | 17 | 31 | 30 | 30 | 31 | 32 | 25 | 28 | 31 | 28.4 | 15.8 | | |

Comments: (A) wrong data DG 032811

## *C. dubia* Daily Survival & Reproduction Data Cont.

**Treatment: 100% CRM 1.5 w CRW.**

| DAY | REP | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 | % Sur. | No. of Neonates Per Day | Tech CD | Tech H2O | Time |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | /// | /// | DW | VR | 1330 |
| | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 | DW | VR | 1300 |
| | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 | DW | VR | 1315 |
| | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 | DW | VR | 1505 |
| | 4 | 5 | 6 | 6 | 6 | 6 | 5 | 4 | 5 | 5 | 6 | 100 | 54 | DW | DW | 1620 |
| | 5 | 11 | 11 | 12 | 11 | 13 | 10 | 10 | 11 | 9 | 12 | 100 | 110 | DW | DW | 1115 |
| | 6 | 12 | 14 | 16 | 15 | 14 | 13 | 14 | 15 | 12 | 13 | 100 | 138 | DW | DW | 1415 |
| | 7 | | | | | | | | | | | | | | | |
| | 3rd Brood Reproduction Per Replicate | | | | | | | | | | | Mean | CV % | /////// | | |
| | | 28 | 31 | 34 | 32 | 33 | 28 | 28 | 31 | 26 | 31 | 30.2 | 8.5 | | | |

Calculations by: [signature] QA/QC by: Jennifer Griffith

Data Entry by: [signature]

Double Data Entry by: [signature] or

QA/QC Officer: n/a

Comments:

TVA, CRM 1.5, Site Sediment
TVA, CRS, Reference Sediment
TVA, CRW, River Water

E-088-11
E-095-11
E-125-11

# *C. dubia* Water Quality Data

All Treatments: Initial Temp.: 23.5 to 26.4°C; Initial DO: 4.0 to 8.3 mg/l

| Day -1 | Controls | | | | Treatment % CRM 1.5 | | | | | | Meter # |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | MHSW | | Clinch River Water | | | | | | | | |
| 02/28/11 | MHSW | LCS + MHSW | LCS + CRW | CRS | 10.0% | 20.0% | 40.0% | 60.0% | 80.0% | 100.0% | |
| DO I | 8.0 | 8.1 | 8.2 | 6.4 | 6.4 | 6.0 | 6.1 | 6.0 | 5.5 | 5.8 | 57 |
| Temp I | 24.4 | 24.6 | 24.6 | 24.7 | 24.6 | 24.4 | 24.4 | 24.4 | 25 | 24.4 | A46 |
| Tech. Initials | Initials: DWD | | | | | | | | | | |
| Times | Initial Time: 1545 | | | | | | | | | | |

| Day 0 | Controls | | | | Treatment % CRM 1.5 | | | | | | Meter # |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | MHSW | | Clinch River Water | | | | | | | | |
| 03/01/11 | MHSW | LCS + MHSW | LCS + CRW | CRS | 10.0% | 20.0% | 40.0% | 60.0% | 80.0% | 100.0% | |
| DO F | 7.5 | 7.2 | 7.4 | 5.4 | 6.2 | 6.0 | 5.9 | 5.1 | 5.2 | 5.7 | 57 |
| I | 7.4 | 7.4 | 7.5 | 6.1 | 6.5 | 6.3 | 6.3 | 6.4 | 4.7* | 5.9 | 57 |
| Temp F | 24.4 | 24.2 | 24.6 | 24.8 | 24.7 | 24.6 | 24.7 | 24.8 | 24.9 | 25.0 | A46 |
| I | 24.5 | 24.5 | 24.5 | 24.3 | 24.4 | 24.6 | 24.4 | 24.3 | 24.4 | 24.4 | A46 |
| Tech. Initials | Finals: DWD | | | | | | Initials: DWD | | | | |
| Times | Final Time: 1000 | | | | | | Initial Time: 1505 | | | | |

| Day 1 | Controls | | | | Treatment % CRM 1.5 | | | | | | Meter # |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | MHSW | | Clinch River Water | | | | | | | | |
| 03/02/11 | MHSW | LCS + MHSW | LCS + CRW | CRS | 10.0% | 20.0% | 40.0% | 60.0% | 80.0% | 100.0% | |
| DO F | 7.2 | 7.3 | 7.1 | 5.9 | 6.2 | 5.8 | 6.0 | 5.9 | 4.0 | 5.5 | 57 |
| I | 7.2 | 6.9 | 6.8 | 5.6 | 5.7 | 5.6 | 6.0 | DWD ~~X~~ 5.4 | 4.4* | 5.4 | 57 |
| Temp F | 24.4 | 24.4 | 24.5 | 24.6 | 24.9 | 25.0 | 24.9 | 25.0 | 25.0 | 24.9 | A46 |
| I | 24.3 | 24.6 | 24.8 | 24.9 | 25.1 | 25.3 | 25.2 | 25.3 | 25.3 | 25.3 | A46 |
| Tech. Initials | Finals: DWD | | | | | | Initials: DWD | | | | |
| Times | Final Time: 1010 | | | | | | Initial Time: 1540 | | | | |

TVA, CRM 1.5, Site Sediment E-088-11
TVA, CRS, Reference Sediment E-095-11
TVA, CRW, River Water E-125-11

## *C. dubia* Water Quality Data Cont.

All Treatments: Initial Temp.: 23.5 to 26.4°C; Initial DO: 4.0 to 8.3 mg/l

| Day 2 | Controls | | | | Treatment % CRM 1.5 | | | | | | Meter # |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | MHSW | | Clinch River Water | | | | | | | | |
| 03/03/11 | MHSW | LCS + MHSW | LCS + CRW | CRS | 10.0% | 20.0% | 40.0% | 60.0% | 80.0% | 100.0% | |
| DO F | 7.2 | 7.0 | 6.9 | 6.0 | 6.1 | 5.5 | 5.9 | 5.9 | 4.6 | 5.8 | 57 |
| I | 7.0 | 7.0 | 6.7 | 6.0 | 5.9 | 5.9 | 5.7 | 5.9 | 3.9* | 5.3 | 57 |
| Temp F | 24.4 | 24.6 | 24.2 | 24.3 | 24.5 | 24.7 | 24.7 | 24.6 | 24.6 | 24.5 | A46 |
| I | 25.0 | 25.1 | 25.1 | 25.1 | 25.1 | 25.3 | 25.2 | 25.2 | 25.2 | 25.3 | A46 |
| Tech. Initials | Finals: DCW | | | | | | Initials: DCW | | | | |
| Times | Final Time: 0915 | | | | | | Initial Time: 1540 | | | | |

| Day 3 | Controls | | | | Treatment % CRM 1.5 | | | | | | Meter # |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | MHSW | | Clinch River Water | | | | | | | | |
| 03/04/11 | MHSW | LCS + MHSW | LCS + CRW | CRS | 10.0% | 20.0% | 40.0% | 60.0% | 80.0% | 100.0% | |
| DO F | 7.0 | 7.0 | 6.4 | 6.0 | 6.0 | 5.9 | 5.7 | 5.8 | 4.3 | 5.2 | 57 |
| I | 7.2 | 7.0 | 7.1 | 6.6 | 6.6 | 6.5 | 6.4 | 6.5 | 4.0* | 6.2 | 57 |
| Temp F | 25.0 | 25.3 | 24.9 | 25.1 | 25.1 | 25.4 | 25.4 | 25.4 | 25.2 | 25.2 | A46 |
| I | 24.4 | 24.6 | 24.5 | 24.6 | 24.5 | 24.9 | 24.8 | 25.0 | 25.0 | 24.9 | A46 |
| Tech. Initials | Finals: DCW | | | | | | Initials: DCW | | | | |
| Times | Final Time: 0924 | | | | | | Initial Time: 1605 | | | | |

Comments: * low DO at 80% CRM1.5 is an artifact of the 11th rep. set for water quality measurements only. Measured DO of test solution from a test replicate 3/4/11 and it was 6.0 mg/l for ending DO. DCW 3/4/11

TVA, CRM 1.5, Site Sediment
TVA, CRS, Reference Sediment
TVA, CRW, River Water

E-088-11
E-095-11
E-125-11

# *C. dubia* Water Quality Data Cont.

All Treatments: Initial Temp.: 23.5 to 26.4°C; Initial DO: 4.0 to 8.3 mg/l

| Day 4 | Controls | | | | Treatment % CRM 1.5 | | | | | | Meter # |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | MHSW | | Clinch River Water | | | | | | | | |
| 03/05/11 | MHSW | LCS + MHSW | LCS + CRW | CRS | 10.0% | 20.0% | 40.0% | 60.0% | 80.0% | 100.0% | |
| DO F | 7.3 | 7.1 | 7.1 | 6.6 | 6.5 | 6.5 | 5.9 | 5.6 | 4.7 | 5.9 | 57 |
| I | 7.3 | 7.3 | 7.4 | 6.5 | 6.6 | 6.0 | 6.4 | 5.9 | 4.3 | 5.5 | 57 |
| Temp F | 25.2 | 25.0 | 25.0 | 24.9 | 25.0 | 25.0 | 24.9 | 24.9 | 25.1 | 25.0 | A46 |
| I | 24.7 | 25.0 | 25.2 | 25.0 | 25.1 | 25.1 | 25.2 | 25.2 | 25.3 | 25.2 | A46 |
| Tech. Initials | Finals: DLD | | | | | | Initials: DLD | | | | |
| Times | Final Time: 0836 | | | | | | Initial Time: 1632 | | | | |

| Day 5 | Controls | | | | Treatment % CRM 1.5 | | | | | | Meter # |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | MHSW | | Clinch River Water | | | | | | | | |
| 03/06/11 | MHSW | LCS + MHSW | LCS + CRW | CRS | 10.0% | 20.0% | 40.0% | 60.0% | 80.0% | 100.0% | |
| DO F | 7.2 | 6.9 | 6.4 | 6.2 | 6.1 | 5.8 | 5.8 | 5.5 | 4.6 | 5.6 | 57 |
| I | 6.9 | 7.0 | 6.6 | 6.3 | 6.3 | 6.4 | 6.2 | 6.4 | 4.8 | 5.9 | 57 |
| Temp F | 24.5 | 24.7 | 24.5 | 24.5 | 24.8 | 24.8 | 24.6 | 24.6 | 24.5 | 24.6 | A46 |
| I | 25.0 | 25.0 | 25.0 | 24.7 | 25.1 | 24.8 | 24.8 | 25.0 | 25.0 | 24.9 | A46 |
| Tech. Initials | Finals: DLD | | | | | | Initials: DLD | | | | |
| Times | Final Time: 0735 | | | | | | Initial Time: 1522 | | | | |

Comments:

TVA, CRM 1.5, Site Sediment
TVA, CRS, Reference Sediment
TVA, CRW, River Water

E-088-11
E-095-11
E-125-11

# *C. dubia* Water Quality Data Cont.

All Treatments: Initial Temp.: 23.5 to 26.4°C; Initial DO: 4.0 to 8.3 mg/l

| Day 6 | Controls | | | | Treatment % CRM 1.5 | | | | | | Meter # |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | MHSW | | Clinch River Water | | | | | | | | |
| 03/07/11 | MHSW | LCS + MHSW | LCS + CRW | CRS | 10.0% | 20.0% | 40.0% | 60.0% | 80.0% | 100.0% | |
| DO F | 7.0 | 6.9 | 6.5 | 6.1 | 5.4 | 5.8 | 6.0 | 5.7 | 4.4* | 5.6 | 57 |
| I | | | | | | | | | | | |
| Temp F | 25.0 | 25.0 | 25.0 | 24.7 | 24.8 | 24.8 | 24.8 | 25.0 | 25.2 | 25.2 | A46 |
| I | | | | | | | | | | | |
| Tech. Initials | Finals: DCD | | | | | | Initials: | | | | |
| Times | Final Time: 0950 | | | | | | Initial Time: N/A | | | | |

| Day 7 | Controls | | | | Treatment % CRM 1.5 | | | | | | Meter # |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | MHSW | | TVA Supplied Clinch River Water | | | | | | | | |
| 03/08/11 | MHSW | LCS + MHSW | LCS + CRW | CRS | 10.0% | 20.0% | 40.0% | 60.0% | 80.0% | 100.0% | |
| DO F | | | | | | | | | | | |
| Temp F | | | | | | | | | | | |
| Tech. Initials | Finals: | | | | | | Initials: | | | | |
| Times | Final Time: N/A | | | | | | Initial Time: N/A | | | | |

Comments: * DO in a test replicate was 6.2 mg/L on 3/3/11. DCD

TVA, CRM 1.5, Site Sediment
TVA, CRS, Reference Sediment
TVA, CRW, River Water

E-088-11
E-095-11
E-125-11

# APPENDIX B

## Ceriodaphnia Survival and Reproduction Test-7 Day Survival

| | | | | | |
|---|---|---|---|---|---|
| Start Date: | 3/1/2011 | Test ID: | cd08811 | Sample ID: | CRM1.5 |
| End Date: | 3/7/2011 | Lab ID: | EE USA | Sample Type: | WHOLE SEDIMENT |
| Sample Date: | 2/7/2011 | Protocol: | ASTM E1706-05 Annex A2 | Test Species: | CD-Ceriodaphnia dubia |

Comments: LCS=Lab Control Sediment; CRW=Clinch River Water; CRS=Clinch Reference Sediment

| Conc-% | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| LCS+CRW | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| CRS+CRW | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 10 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 20 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 40 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 60 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 80 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 100 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |

| Conc-% | Mean | N-Mean | Resp | Not Resp | Total | N | Fisher's Exact P | 1-Tailed Critical | Isotonic Mean | Isotonic N-Mean |
|---|---|---|---|---|---|---|---|---|---|---|
| LCS+CRW | 1.0000 | 1.0000 | 0 | 10 | 10 | 10 | 0.6238 | | | |
| CRS+CRW | 1.0000 | 1.0000 | 0 | 10 | 10 | 10 | * | | 1.0000 | 1.0000 |
| 10 | 1.0000 | 1.0000 | 0 | 10 | 10 | 10 | 1.0000 | 0.0500 | 1.0000 | 1.0000 |
| 20 | 1.0000 | 1.0000 | 0 | 10 | 10 | 10 | 1.0000 | 0.0500 | 1.0000 | 1.0000 |
| 40 | 1.0000 | 1.0000 | 0 | 10 | 10 | 10 | 1.0000 | 0.0500 | 1.0000 | 1.0000 |
| 60 | 1.0000 | 1.0000 | 0 | 10 | 10 | 10 | 1.0000 | 0.0500 | 1.0000 | 1.0000 |
| 80 | 1.0000 | 1.0000 | 0 | 10 | 10 | 10 | 1.0000 | 0.0500 | 1.0000 | 1.0000 |
| 100 | 1.0000 | 1.0000 | 0 | 10 | 10 | 10 | 1.0000 | 0.0500 | 1.0000 | 1.0000 |

| Hypothesis Test (1-tail, 0.05) | NOEC | LOEC | ChV | TU |
|---|---|---|---|---|
| Fisher's Exact Test | 100 | >100 | | 1 |
| Treatments vs CRS+CRW | | | | |

### Linear Interpolation (200 Resamples)

| Point | % | SD | 95% CL | Skew |
|---|---|---|---|---|
| IC05 | >100 | | | |
| IC10 | >100 | | | |
| IC15 | >100 | | | |
| IC20 | >100 | | | |
| IC25 | >100 | | | |
| IC40 | >100 | | | |
| IC50 | >100 | | | |



ToxCalc v5.0.32

Reviewed by: MAO

## Ceriodaphnia Survival and Reproduction Test-Reproduction

| | | | | | |
|---|---|---|---|---|---|
| Start Date: | 3/1/2011 | Test ID: | cd08811 | Sample ID: | CRM1.5 |
| End Date: | 3/7/2011 | Lab ID: | EE USA | Sample Type: | WHOLE SEDIMENT |
| Sample Date: | 2/7/2011 | Protocol: | ASTM E1706-05 Annex A2 | Test Species: | CD-Ceriodaphnia dubia |

Comments: LCS=Lab Control Sediment; CRW=Clinch River Water; CRS=Clinch Reference Sediment

| Conc-% | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| LCS+CRW | 30.000 | 32.000 | 23.000 | 27.000 | 31.000 | 18.000 | 27.000 | 24.000 | 25.000 | 28.000 |
| CRS+CRW | 27.000 | 32.000 | 31.000 | 26.000 | 23.000 | 30.000 | 28.000 | 33.000 | 34.000 | 29.000 |
| 10 | 27.000 | 30.000 | 30.000 | 33.000 | 31.000 | 27.000 | 27.000 | 30.000 | 32.000 | 32.000 |
| 20 | 31.000 | 29.000 | 30.000 | 32.000 | 30.000 | 36.000 | 27.000 | 32.000 | 28.000 | 32.000 |
| 40 | 19.000 | 30.000 | 32.000 | 31.000 | 29.000 | 32.000 | 28.000 | 23.000 | 31.000 | 33.000 |
| 60 | 33.000 | 28.000 | 30.000 | 34.000 | 32.000 | 31.000 | 29.000 | 26.000 | 28.000 | 29.000 |
| 80 | 29.000 | 17.000 | 31.000 | 30.000 | 30.000 | 31.000 | 32.000 | 25.000 | 28.000 | 31.000 |
| 100 | 28.000 | 31.000 | 34.000 | 32.000 | 33.000 | 28.000 | 28.000 | 31.000 | 26.000 | 31.000 |

| | | | Transform: Untransformed | | | | | | 1-Tailed | | Isotonic | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Conc-% | Mean | N-Mean | Mean | Min | Max | CV% | N | t-Stat | Critical | MSD | Mean | N-Mean |
| LCS+CRW | 26.500 | 0.9044 | 26.500 | 18.000 | 32.000 | 15.836 | 10 | | | | | |
| CRS+CRW | 29.300 | 1.0000 | 29.300 | 23.000 | 34.000 | 11.607 | 10 | * | | | 29.967 | 1.0000 |
| 10 | 29.900 | 1.0205 | 29.900 | 27.000 | 33.000 | 7.470 | 10 | -0.408 | 2.347 | 3.455 | 29.967 | 1.0000 |
| 20 | 30.700 | 1.0478 | 30.700 | 27.000 | 36.000 | 8.276 | 10 | -0.951 | 2.347 | 3.455 | 29.967 | 1.0000 |
| 40 | 28.800 | 0.9829 | 28.800 | 19.000 | 33.000 | 15.511 | 10 | 0.340 | 2.347 | 3.455 | 29.400 | 0.9811 |
| 60 | 30.000 | 1.0239 | 30.000 | 26.000 | 34.000 | 8.315 | 10 | -0.475 | 2.347 | 3.455 | 29.400 | 0.9811 |
| 80 | 28.400 | 0.9693 | 28.400 | 17.000 | 32.000 | 15.764 | 10 | 0.611 | 2.347 | 3.455 | 29.300 | 0.9778 |
| 100 | 30.200 | 1.0307 | 30.200 | 26.000 | 34.000 | 8.521 | 10 | -0.611 | 2.347 | 3.455 | 29.300 | 0.9778 |

| Auxiliary Tests | Statistic | Critical | Skew | Kurt |
|---|---|---|---|---|
| Kolmogorov D Test indicates normal distribution (p > 0.05) | 0.845819 | 0.895 | -1.17735 | 2.263508 |
| Bartlett's Test indicates equal variances (p = 0.17) | 9.067506 | 16.81189 | | |
| The control means are not significantly different (p = 0.12) | 1.6392 | 2.100922 | | |

| Hypothesis Test (1-tail, 0.05) | NOEC | LOEC | ChV | TU | MSDu | MSDp | MSB | MSE | F-Prob | df |
|---|---|---|---|---|---|---|---|---|---|---|
| Dunnett's Test | 100 | >100 | | 1 | 3.455407 | 0.117932 | 6.647619 | 10.83651 | 0.718673 | 6, 63 |
| Treatments vs CRS+CRW | | | | | | | | | | |

Linear Interpolation (200 Resamples)

| Point | % | SD | 95% CL | Skew |
|---|---|---|---|---|
| IC05 | >100 | | | |
| IC10 | >100 | | | |
| IC15 | >100 | | | |
| IC20 | >100 | | | |
| IC25 | >100 | | | |
| IC40 | >100 | | | |
| IC50 | >100 | | | |

## Ceriodaphnia Survival and Reproduction Test-7 Day Survival

| | | | | | |
|---|---|---|---|---|---|
| Start Date: | 3/1/2011 | Test ID: | cd08811 | Sample ID: | CRM1.5 |
| End Date: | 3/7/2011 | Lab ID: | EE USA | Sample Type: | WHOLE SEDIMENT |
| Sample Date: | 2/7/2011 | Protocol: | ASTM E1706-05 Annex A2 | Test Species: | CD-Ceriodaphnia dubia |

Comments: MHSW=Mod Hard Synthetic Water; LCS=Lab Control Sediment; CRW=Clinch River Water

| Conc-% | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| MHSW | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| LCS+MHSW | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| LCS+CRW | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |

| Conc-% | Mean | N-Mean | Resp | Not Resp | Total | N | Fisher's Exact P | 1-Tailed Critical |
|---|---|---|---|---|---|---|---|---|
| MHSW | 1.0000 | 1.0000 | 0 | 10 | 10 | 10 | 0.6238 | |
| LCS+MHSW | 1.0000 | 1.0000 | 0 | 10 | 10 | 10 | * | |
| LCS+CRW | 1.0000 | 1.0000 | 0 | 10 | 10 | 10 | 1.0000 | 0.0500 |

**Hypothesis Test (1-tail, 0.05)**

Fisher's Exact Test indicates no significant differences

Treatments vs LCS+MHSW

## Ceriodaphnia Survival and Reproduction Test-Reproduction

| | | | | | |
|---|---|---|---|---|---|
| Start Date: | 3/1/2011 | Test ID: | cd08811 | Sample ID: | CRM1.5 |
| End Date: | 3/7/2011 | Lab ID: | EE USA | Sample Type: | WHOLE SEDIMENT |
| Sample Date: | 2/7/2011 | Protocol: | ASTM E1706-05 Annex A2 | Test Species: | CD-Ceriodaphnia dubia |

Comments: MHSW=Mod Hard Synthetic Water; LCS=Lab Control Sediment; CRW=Clinch River Water

| Conc-% | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| MHSW | 16.000 | 25.000 | 22.000 | 25.000 | 23.000 | 23.000 | 23.000 | 18.000 | 24.000 | 21.000 |
| LCS+MHSW | 28.000 | 28.000 | 24.000 | 24.000 | 23.000 | 31.000 | 24.000 | 17.000 | 23.000 | 25.000 |
| LCS+CRW | 30.000 | 32.000 | 23.000 | 27.000 | 31.000 | 18.000 | 27.000 | 24.000 | 25.000 | 28.000 |

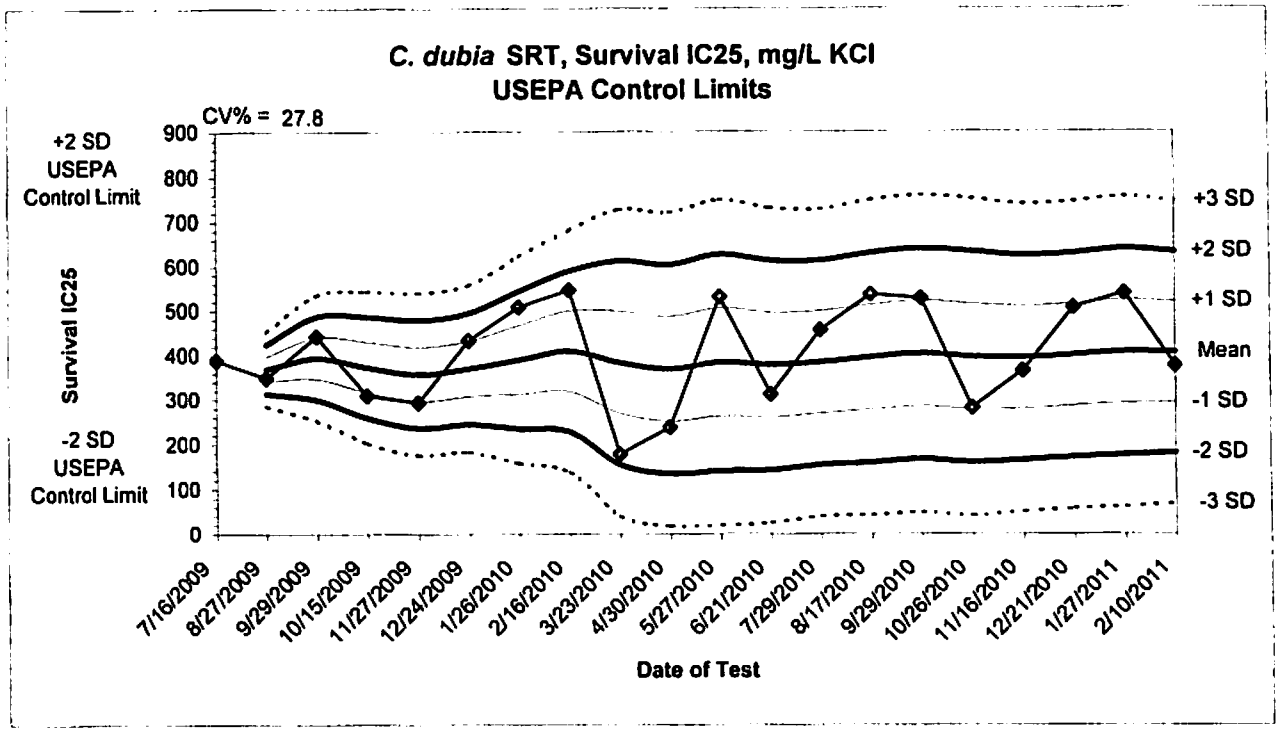
| | | | Transform: Untransformed | | | | | | 1-Tailed | |
|---|---|---|---|---|---|---|---|---|---|---|
| Conc-% | Mean | N-Mean | Mean | Min | Max | CV% | N | t-Stat | Critical | MSD |
| MHSW | 22.000 | 0.8907 | 22.000 | 16.000 | 25.000 | 13.381 | 10 | | | |
| LCS+MHSW | 24.700 | 1.0000 | 24.700 | 17.000 | 31.000 | 15.274 | 10 | * | | |
| LCS+CRW | 26.500 | 1.0729 | 26.500 | 18.000 | 32.000 | 15.836 | 10 | -1.009 | 1.734 | 3.094 |

| Auxiliary Tests | Statistic | Critical | Skew | Kurt |
|---|---|---|---|---|
| Shapiro-Wilk's Test indicates normal distribution (p > 0.05) | 0.951278 | 0.905 | -0.51651 | 0.346803 |
| F-Test indicates equal variances (p = 0.76) | 1.237315 | 6.54109 | | |
| The control means are not significantly different (p = 0.09) | 1.78421 | 2.100922 | | |

| Hypothesis Test (1-tail, 0.05) | MSDu | MSDp | MSB | MSE | F-Prob | df |
|---|---|---|---|---|---|---|
| Homoscedastic t Test indicates no significant differences Treatments vs LCS+MHSW | 3.094439 | 0.125281 | 16.2 | 15.92222 | 0.326494 | 1, 18 |

Environmental Enterprises USA, Inc.

# APPENDIX C



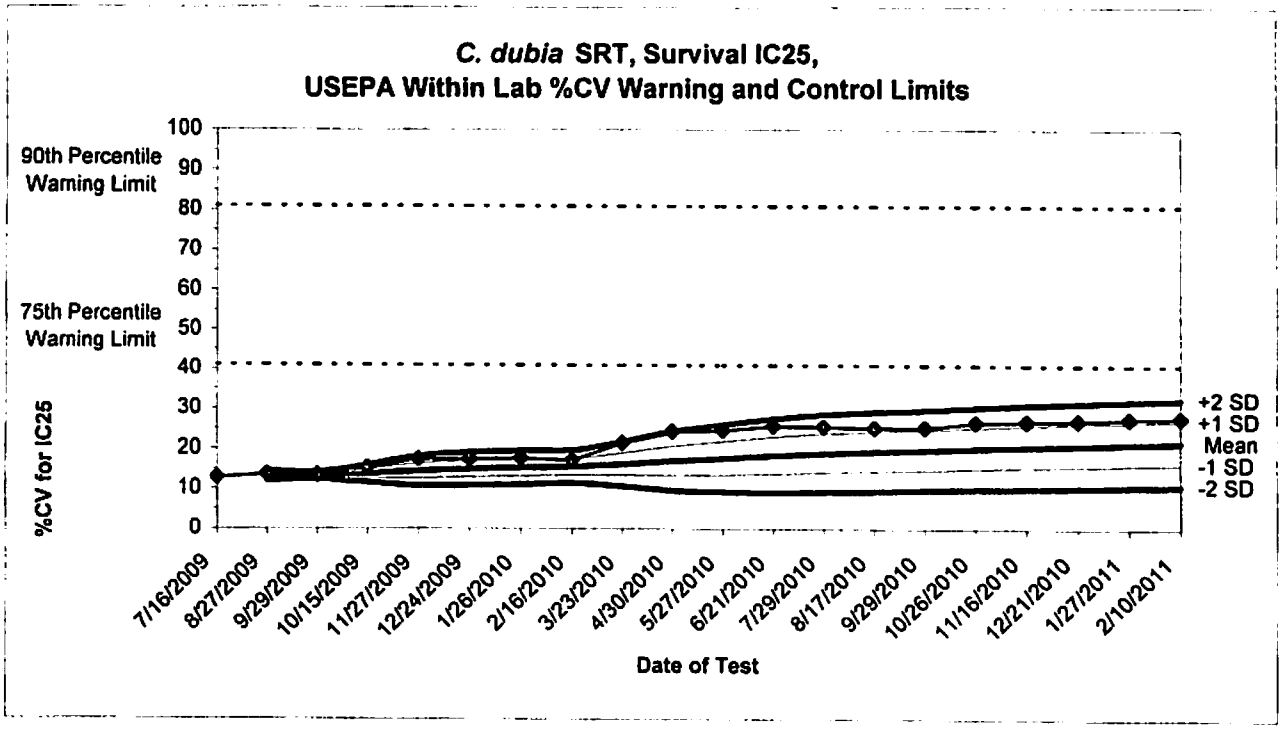

| Test # | Test Date | Survival IC25 | Mean IC25 | -1 SD | -2 SD | +1 SD | +2 SD | -3 SD | +3 SD | Toxicant Lot # |
|---|---|---|---|---|---|---|---|---|---|---|
| CD0909 | 7/16/2009 | 389 | | | | | | | | 029K0050 |
| CD0910 | 8/27/2009 | 350 | 370 | 342 | 314 | 397 | 425 | 287 | 452 | 029K0050 |
| CD0911 | 9/29/2009 | 443 | 394 | 347 | 301 | 441 | 487 | 254 | 534 | 029K0050 |
| CD0912 | 10/15/2009 | 310 | 373 | 316 | 260 | 430 | 486 | 203 | 543 | 029K0050 |
| CD0913 | 11/27/2009 | 294 | 357 | 297 | 236 | 418 | 478 | 176 | 539 | 049K0305 |
| CD0915 | 12/24/2009 | 433 | 370 | 307 | 245 | 432 | 495 | 183 | 557 | 049K0305 |
| CD1002 | 1/26/2010 | 508 | 390 | 312 | 235 | 467 | 544 | 158 | 621 | 079K0011 |
| CD1003 | 2/16/2010 | 546 | 409 | 319 | 228 | 500 | 590 | 138 | 680 | 079K0011 |
| CD1004 | 3/23/2010 | 178 | 383 | 269 | 155 | 498 | 612 | 40 | 727 | 049K0305 |
| CD1006 | 4/30/2010 | 238 | 369 | 252 | 134 | 486 | 603 | 17 | 721 | 049K0305 |
| CD1007 | 5/27/2010 | 531 | 384 | 262 | 141 | 505 | 627 | 19 | 748 | 049K0305 |
| CD1009 | 6/21/2010 | 312 | 378 | 260 | 142 | 495 | 613 | 25 | 731 | 049K0305 |
| CD1010 | 7/29/2010 | 456 | 384 | 269 | 154 | 498 | 613 | 39 | 728 | 079K0011 |
| CD1011 | 8/17/2010 | 536 | 395 | 277 | 160 | 512 | 630 | 42 | 747 | 079K0011 |
| CD1012 | 9/29/2010 | 527 | 403 | 285 | 167 | 522 | 640 | 49 | 758 | 079K0011 |
| CD1013 | 10/26/2010 | 281 | 396 | 277 | 159 | 514 | 632 | 41 | 751 | 099K0202 |
| CD1014 | 11/16/2010 | 364 | 394 | 279 | 164 | 509 | 623 | 49 | 738 | 099K0202 |
| CD1015 | 12/21/2010 | 506 | 400 | 286 | 171 | 515 | 629 | 57 | 744 | 099K0202 |
| CD1101 | 1/27/2011 | 539 | 407 | 292 | 176 | 523 | 639 | 60 | 755 | 099K0202 |
| CD1102 | 2/10/2011 | 376 | 406 | 293 | 180 | 519 | 632 | 67 | 744 | 099K0202 |

CD1005 - IC25 less than lowest concentration tested and could not be graphed

CD1002 - Widened dilution series to 140, 212, 316, 476, & 716 mg/L KCl

CD1001 - Training lab tech

CD0914 - Training lab tech



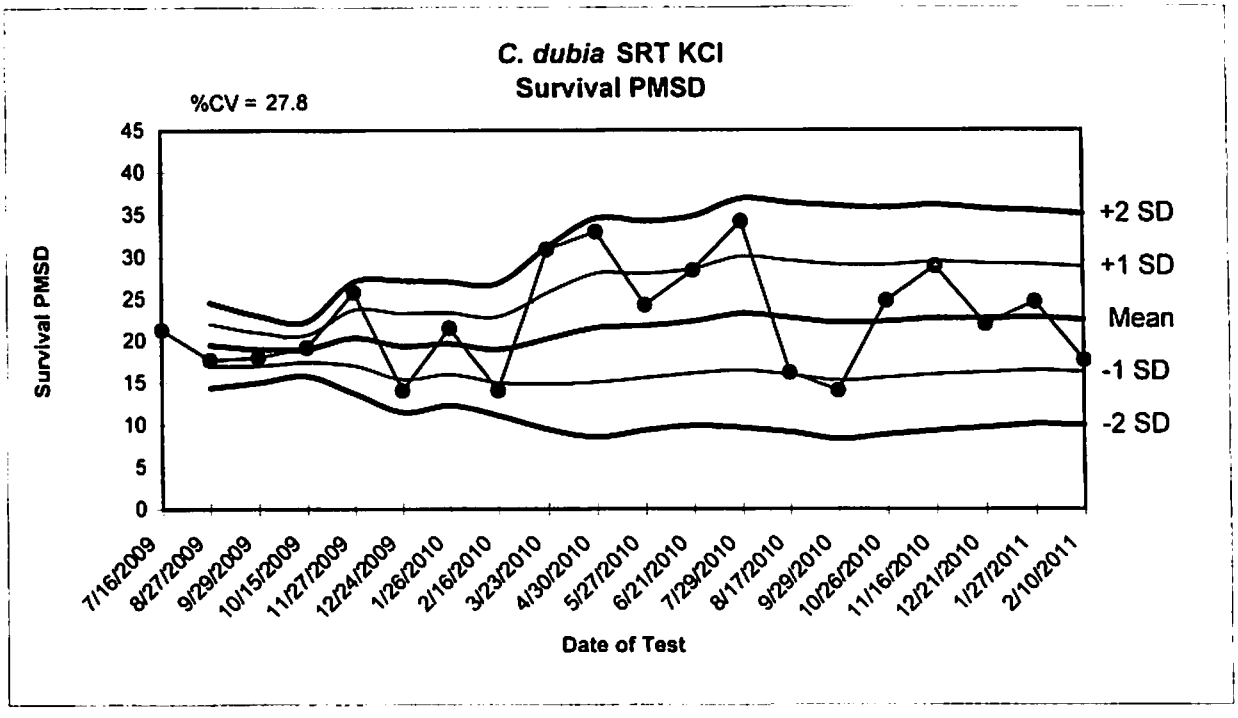

| Test # | Test Date | %CV for IC25 | Mean %CV | -1 SD | -2 SD | +1 SD | +2 SD | 75th Warning Limit | 90th Warning Limit | Toxicant Lot # |
|---|---|---|---|---|---|---|---|---|---|---|
| CD0909 | 7/16/2009 | 12.8 | | | | | | 41.0 | 81.0 | 029K0050 |
| CD0910 | 8/27/2009 | 13.6 | 13.2 | 12.6 | 12.0 | 13.8 | 14.4 | 41.0 | 81.0 | 029K0050 |
| CD0911 | 9/29/2009 | 13.4 | 13.3 | 12.8 | 12.4 | 13.7 | 14.1 | 41.0 | 81.0 | 029K0050 |
| CD0912 | 10/15/2009 | 15.3 | 13.8 | 12.7 | 11.6 | 14.9 | 15.9 | 41.0 | 81.0 | 029K0050 |
| CD0913 | 11/27/2009 | 17.4 | 14.5 | 12.6 | 10.8 | 16.3 | 18.2 | 41.0 | 81.0 | 049K0305 |
| CD0915 | 12/24/2009 | 17.4 | 15.0 | 12.9 | 10.9 | 17.0 | 19.0 | 41.0 | 81.0 | 049K0305 |
| CD1002 | 1/26/2010 | 17.6 | 15.3 | 13.2 | 11.1 | 17.5 | 19.6 | 41.0 | 81.0 | 079K0011 |
| CD1003 | 2/16/2010 | 17.2 | 15.6 | 13.5 | 11.5 | 17.6 | 19.7 | 41.0 | 81.0 | 079K0011 |
| CD1004 | 3/23/2010 | 21.5 | 16.2 | 13.5 | 10.7 | 19.0 | 21.7 | 41.0 | 81.0 | 049K0305 |
| CD1006 | 4/30/2010 | 24.4 | 17.0 | 13.4 | 9.7 | 20.7 | 24.4 | 41.0 | 81.0 | 049K0305 |
| CD1007 | 5/27/2010 | 24.7 | 17.7 | 13.6 | 9.4 | 21.9 | 26.1 | 41.0 | 81.0 | 049K0305 |
| CD1009 | 6/21/2010 | 25.7 | 18.4 | 13.8 | 9.2 | 23.0 | 27.6 | 41.0 | 81.0 | 049K0305 |
| CD1010 | 7/29/2010 | 25.5 | 19.0 | 14.1 | 9.3 | 23.8 | 28.6 | 41.0 | 81.0 | 079K0011 |
| CD1011 | 8/17/2010 | 25.2 | 19.4 | 14.5 | 9.6 | 24.3 | 29.2 | 41.0 | 81.0 | 079K0011 |
| CD1012 | 9/29/2010 | 25.3 | 19.8 | 14.8 | 9.8 | 24.8 | 29.8 | 41.0 | 81.0 | 079K0011 |
| CD1013 | 10/26/2010 | 26.6 | 20.2 | 15.1 | 10.0 | 25.3 | 30.4 | 41.0 | 81.0 | 099K0202 |
| CD1014 | 11/16/2010 | 26.8 | 20.6 | 15.4 | 10.2 | 25.8 | 31.0 | 41.0 | 81.0 | 099K0202 |
| CD1015 | 12/21/2010 | 27.1 | 21.0 | 15.7 | 10.4 | 26.2 | 31.5 | 41.0 | 81.0 | 099K0202 |
| CD1101 | 1/27/2011 | 27.6 | 21.3 | 16.0 | 10.6 | 26.7 | 32.0 | 41.0 | 81.0 | 099K0202 |
| CD1102 | 2/10/2011 | 27.8 | 21.6 | 16.2 | 10.8 | 27.0 | 32.4 | 41.0 | 81.0 | 099K0202 |

CD1005 - IC25 less than lowest concentration tested and could not be graphed

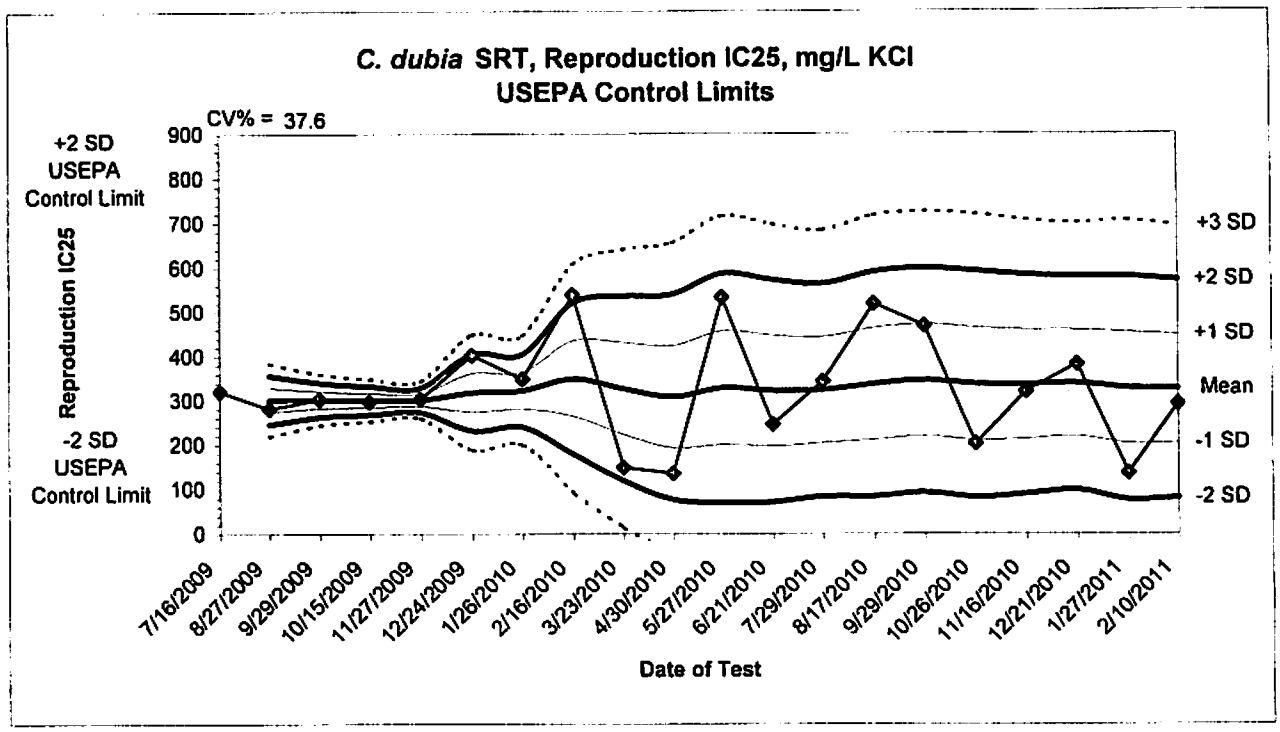
CD1002 - Widened dilution series to 140, 212, 316, 476, & 716 mg/L KCl

CD1001 - Training lab tech

CD0914 - Training lab tech




| Test # | Test Date | Survival PMSD | Mean | -1 SD | -2 SD | +1 SD | +2 SD | Toxicant Lot # |
|---|---|---|---|---|---|---|---|---|
| CD0909 | 7/16/2009 | 21.3 | | | | | | 029K0050 |
| CD0910 | 8/27/2009 | 17.7 | 19.5000 | 16.9544 | 14.4088 | 22.0456 | 24.5912 | 029K0050 |
| CD0911 | 9/29/2009 | 18.0 | 19.0000 | 17.0025 | 15.0050 | 20.9975 | 22.9950 | 029K0050 |
| CD0912 | 10/15/2009 | 19.2 | 19.0500 | 17.4160 | 15.7820 | 20.6840 | 22.3180 | 029K0050 |
| CD0913 | 11/27/2009 | 25.8 | 20.4000 | 17.0661 | 13.7322 | 23.7339 | 27.0678 | 049K0305 |
| CD0915 | 12/24/2009 | 14.1 | 19.3500 | 15.4121 | 11.4742 | 23.2879 | 27.2258 | 049K0305 |
| CD1002 | 1/26/2010 | 21.5 | 19.6571 | 15.9717 | 12.2862 | 23.3426 | 27.0281 | 079K0011 |
| CD1003 | 2/16/2010 | 14.1 | 18.9625 | 15.0252 | 11.0878 | 22.8998 | 26.8372 | 079K0011 |
| CD1004 | 3/23/2010 | 30.9 | 20.2889 | 14.8668 | 9.4448 | 25.7109 | 31.1330 | 049K0305 |
| CD1006 | 4/30/2010 | 33.0 | 21.5600 | 15.0570 | 8.5540 | 28.0630 | 34.5660 | 049K0305 |
| CD1007 | 5/27/2010 | 24.3 | 21.8091 | 15.5847 | 9.3603 | 28.0335 | 34.2579 | 049K0305 |
| CD1009 | 6/21/2010 | 28.4 | 22.3583 | 16.1261 | 9.8939 | 28.5906 | 34.8228 | 049K0305 |
| CD1010 | 7/29/2010 | 34.2 | 23.2692 | 16.4582 | 9.6471 | 30.0803 | 36.8914 | 079K0011 |
| CD1011 | 8/17/2010 | 16.2 | 22.7643 | 15.9531 | 9.1420 | 29.5754 | 36.3866 | 079K0011 |
| CD1012 | 9/29/2010 | 14.1 | 22.1867 | 15.2525 | 8.3183 | 29.1208 | 36.0550 | 079K0011 |
| CD1013 | 10/26/2010 | 24.8 | 22.3500 | 15.6192 | 8.8884 | 29.0808 | 35.8116 | 099K0202 |
| CD1014 | 11/16/2010 | 28.9 | 22.7353 | 16.0274 | 9.3195 | 29.4432 | 36.1511 | 099K0202 |
| CD1015 | 12/21/2010 | 22.0 | 22.6944 | 16.1845 | 9.6746 | 29.2044 | 35.7143 | 099K0202 |
| CD1101 | 1/27/2011 | 24.7 | 22.8000 | 16.4568 | 10.1135 | 29.1432 | 35.4865 | 099K0202 |
| CD1102 | 2/10/2011 | 17.7 | 22.5450 | 16.2665 | 9.9880 | 28.8235 | 35.1020 | 099K0202 |



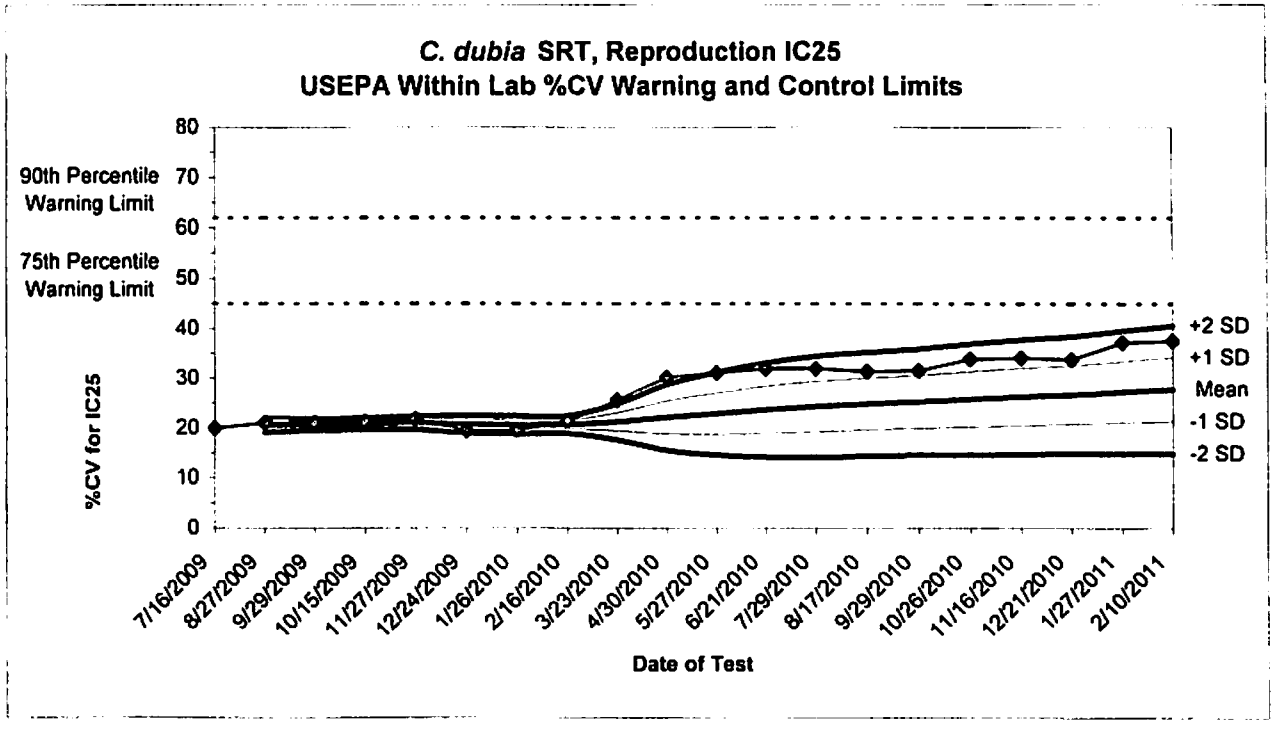

| Test # | Test Date | Repro. IC25 | Mean IC25 | -1 SD | -2 SD | +1 SD | +2 SD | -3 SD | +3 SD | Toxicant Lot # |
|---|---|---|---|---|---|---|---|---|---|---|
| CD0909 | 7/16/2009 | 321 | | | | | | | | 029K0050 |
| CD0910 | 8/27/2009 | 282 | 302 | 274 | 246 | 329 | 357 | 219 | 384 | 029K0050 |
| CD0911 | 9/29/2009 | 303 | 302 | 282 | 263 | 322 | 341 | 243 | 361 | 029K0050 |
| CD0912 | 10/15/2009 | 297 | 301 | 285 | 268 | 317 | 333 | 252 | 349 | 029K0050 |
| CD0913 | 11/27/2009 | 304 | 301 | 287 | 273 | 315 | 329 | 259 | 344 | 049K0305 |
| CD0915 | 12/24/2009 | 403 | 318 | 275 | 232 | 362 | 405 | 188 | 448 | 049K0305 |
| CD1002 | 1/26/2010 | 349 | 323 | 281 | 240 | 364 | 405 | 199 | 446 | 079K0011 |
| CD1003 | 2/16/2010 | 539 | 350 | 264 | 179 | 435 | 521 | 93 | 606 | 079K0011 |
| CD1004 | 3/23/2010 | 149 | 327 | 223 | 119 | 432 | 536 | 15 | 640 | 049K0305 |
| CD1006 | 4/30/2010 | 135 | 308 | 193 | 77 | 424 | 539 | -39 | 655 | 049K0305 |
| CD1007 | 5/27/2010 | 533 | 329 | 200 | 71 | 458 | 586 | -58 | 715 | 049K0305 |
| CD1009 | 6/21/2010 | 246 | 322 | 197 | 71 | 447 | 572 | -54 | 697 | 049K0305 |
| CD1010 | 7/29/2010 | 343 | 323 | 203 | 83 | 443 | 563 | -37 | 683 | 079K0011 |
| CD1011 | 8/17/2010 | 518 | 337 | 211 | 84 | 464 | 590 | -42 | 717 | 079K0011 |
| CD1012 | 9/29/2010 | 469 | 346 | 220 | 93 | 473 | 599 | -34 | 726 | 079K0011 |
| CD1013 | 10/26/2010 | 202 | 337 | 210 | 82 | 465 | 592 | -45 | 719 | 099K0202 |
| CD1014 | 11/16/2010 | 320 | 336 | 213 | 89 | 460 | 583 | -34 | 707 | 099K0202 |
| CD1015 | 12/21/2010 | 382 | 339 | 218 | 98 | 459 | 579 | -22 | 699 | 099K0202 |
| CD1101 | 1/27/2011 | 136 | 328 | 202 | 76 | 454 | 580 | -49 | 705 | 099K0202 |
| CD1102 | 2/10/2011 | 292 | 326 | 203 | 81 | 449 | 572 | -42 | 694 | 099K0202 |

CD1005 - IC25 less than lowest concentration tested and could not be graphed

CD1002 - Widened dilution series to 140, 212, 316, 476, & 716 mg/L KCl

CD1001 - Training lab tech

CD0914 - Training lab tech



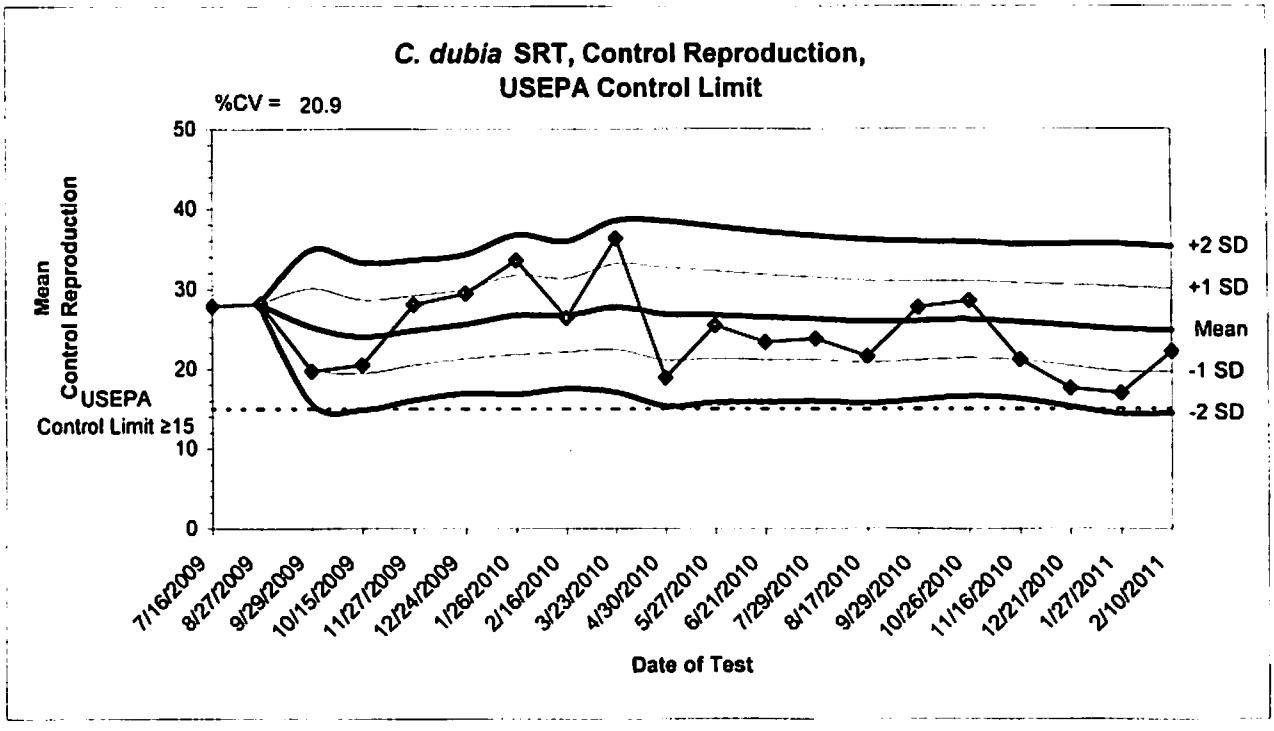

| Test # | Test Date | %CV for IC25 | Mean %CV | -1 SD | -2 SD | +1 SD | +2 SD | 75th Warning Limit | 90th Warning Limit | Toxicant Lot # |
|---|---|---|---|---|---|---|---|---|---|---|
| CD0909 | 7/16/2009 | 19.9 | | | | | | 45.0 | 62.0 | 029K0050 |
| CD0910 | 8/27/2009 | 21.0 | 20.4 | 19.7 | 19.0 | 21.2 | 21.9 | 45.0 | 62.0 | 029K0050 |
| CD0911 | 9/29/2009 | 21.0 | 20.6 | 20.0 | 19.4 | 21.2 | 21.8 | 45.0 | 62.0 | 029K0050 |
| CD0912 | 10/15/2009 | 21.3 | 20.8 | 20.2 | 19.6 | 21.4 | 21.9 | 45.0 | 62.0 | 029K0050 |
| CD0913 | 11/27/2009 | 21.8 | 21.0 | 20.3 | 19.6 | 21.7 | 22.3 | 45.0 | 62.0 | 049K0305 |
| CD0915 | 12/24/2009 | 19.4 | 20.7 | 19.9 | 19.0 | 21.6 | 22.5 | 45.0 | 62.0 | 049K0305 |
| CD1002 | 1/26/2010 | 19.6 | 20.6 | 19.6 | 18.7 | 21.5 | 22.4 | 45.0 | 62.0 | 079K0011 |
| CD1003 | 2/16/2010 | 21.3 | 20.7 | 19.8 | 18.9 | 21.5 | 22.4 | 45.0 | 62.0 | 079K0011 |
| CD1004 | 3/23/2010 | 25.5 | 21.2 | 19.4 | 17.6 | 23.0 | 24.8 | 45.0 | 62.0 | 049K0305 |
| CD1006 | 4/30/2010 | 30.1 | 22.1 | 18.8 | 15.5 | 25.4 | 28.7 | 45.0 | 62.0 | 049K0305 |
| CD1007 | 5/27/2010 | 31.1 | 22.9 | 18.8 | 14.6 | 27.0 | 31.2 | 45.0 | 62.0 | 049K0305 |
| CD1009 | 6/21/2010 | 31.9 | 23.7 | 18.9 | 14.2 | 28.4 | 33.1 | 45.0 | 62.0 | 049K0305 |
| CD1010 | 7/29/2010 | 31.9 | 24.3 | 19.2 | 14.1 | 29.4 | 34.4 | 45.0 | 62.0 | 079K0011 |
| CD1011 | 8/17/2010 | 31.3 | 24.8 | 19.6 | 14.3 | 30.0 | 35.2 | 45.0 | 62.0 | 079K0011 |
| CD1012 | 9/29/2010 | 31.6 | 25.2 | 19.9 | 14.6 | 30.6 | 35.9 | 45.0 | 62.0 | 079K0011 |
| CD1013 | 10/26/2010 | 33.9 | 25.8 | 20.2 | 14.6 | 31.4 | 36.9 | 45.0 | 62.0 | 099K0202 |
| CD1014 | 11/16/2010 | 34.1 | 26.3 | 20.5 | 14.7 | 32.0 | 37.8 | 45.0 | 62.0 | 099K0202 |
| CD1015 | 12/21/2010 | 33.8 | 26.7 | 20.8 | 14.9 | 32.6 | 38.4 | 45.0 | 62.0 | 099K0202 |
| CD1101 | 1/27/2011 | 37.2 | 27.2 | 21.0 | 14.9 | 33.4 | 39.6 | 45.0 | 62.0 | 099K0202 |
| CD1102 | 2/10/2011 | 37.6 | 27.8 | 21.3 | 14.8 | 34.2 | 40.7 | 45.0 | 62.0 | 099K0202 |

CD1005 - IC25 less than lowest concentration tested and could not be graphed

CD1002 - Widened dilution series to 140, 212, 316, 476, & 716 mg/L KCl

CD1001 - Training lab tech

CD0914 - Training lab tech

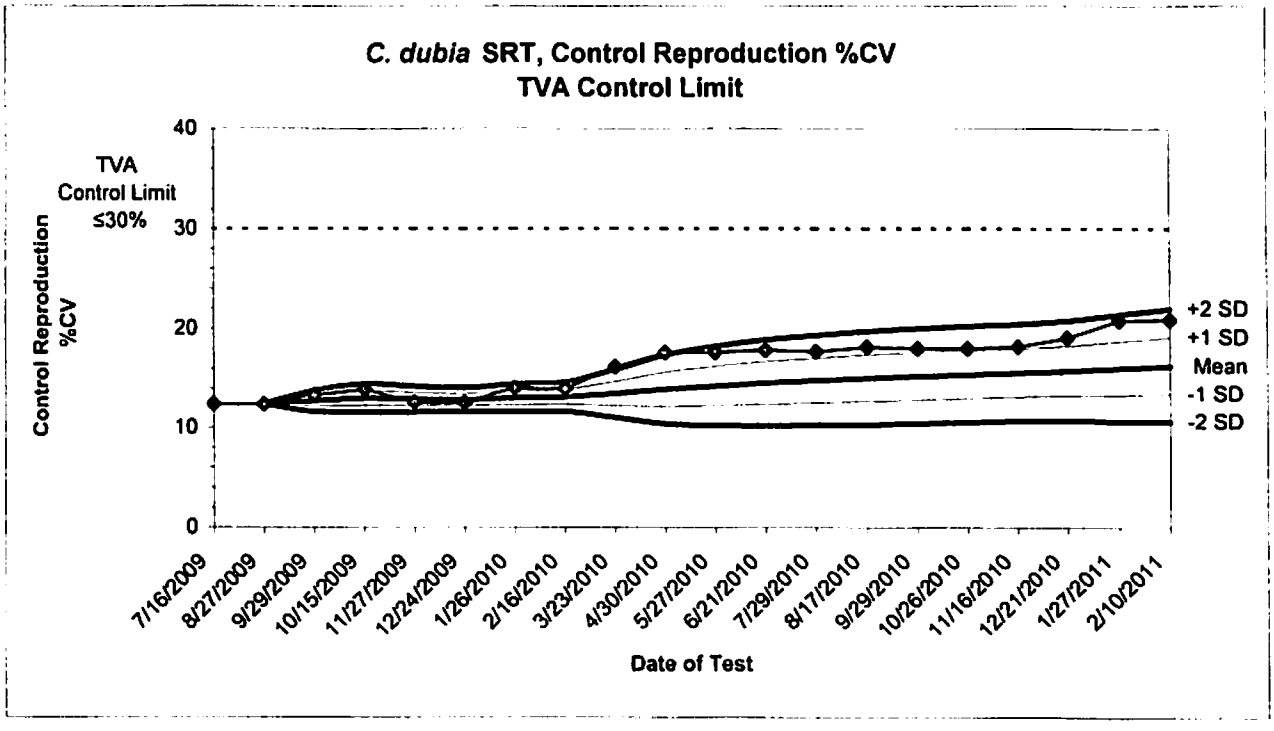



| Test # | Test Date | Mean Control Repro. | Mean | -1 SD | -2 SD | +1 SD | +2 SD | | Control Limit | Toxicant Lot # |
|---|---|---|---|---|---|---|---|---|---|---|
| CD0909 | 7/16/2009 | 27.9 | | | | | | | 15.0 | 029K0050 |
| CD0910 | 8/27/2009 | 28.2 | 28.1 | 27.8 | 27.6 | 28.3 | 28.5 | | 15.0 | 029K0050 |
| CD0911 | 9/29/2009 | 19.7 | 25.3 | 20.4 | 15.6 | 30.1 | 34.9 | | 15.0 | 029K0050 |
| CD0912 | 10/15/2009 | 20.5 | 24.1 | 19.5 | 14.9 | 28.7 | 33.3 | | 15.0 | 029K0050 |
| CD0913 | 11/27/2009 | 28.1 | 24.9 | 20.5 | 16.1 | 29.3 | 33.6 | | 15.0 | 049K0305 |
| CD0915 | 12/24/2009 | 29.5 | 25.7 | 21.3 | 17.0 | 30.0 | 34.3 | | 15.0 | 049K0305 |
| CD1002 | 1/26/2010 | 33.6 | 26.8 | 21.8 | 16.8 | 31.8 | 36.7 | | 15.0 | 079K0011 |
| CD1003 | 2/16/2010 | 26.4 | 26.7 | 22.1 | 17.5 | 31.3 | 36.0 | | 15.0 | 079K0011 |
| CD1004 | 3/23/2010 | 36.3 | 27.8 | 22.4 | 17.1 | 33.2 | 38.5 | | 15.0 | 049K0305 |
| CD1006 | 4/30/2010 | 18.9 | 26.9 | 21.1 | 15.3 | 32.7 | 38.5 | | 15.0 | 049K0305 |
| CD1007 | 5/27/2010 | 25.5 | 26.8 | 21.3 | 15.8 | 32.3 | 37.8 | | 15.0 | 049K0305 |
| CD1009 | 6/21/2010 | 23.4 | 26.5 | 21.2 | 15.8 | 31.8 | 37.2 | | 15.0 | 049K0305 |
| CD1010 | 7/29/2010 | 23.8 | 26.3 | 21.1 | 16.0 | 31.5 | 36.6 | | 15.0 | 079K0011 |
| CD1011 | 8/17/2010 | 21.6 | 26.0 | 20.8 | 15.7 | 31.1 | 36.2 | | 15.0 | 079K0011 |
| CD1012 | 9/29/2010 | 27.8 | 26.1 | 21.1 | 16.2 | 31.0 | 36.0 | | 15.0 | 079K0011 |
| CD1013 | 10/26/2010 | 28.6 | 26.2 | 21.4 | 16.6 | 31.1 | 35.9 | | 15.0 | 099K0202 |
| CD1014 | 11/16/2010 | 21.2 | 25.9 | 21.1 | 16.3 | 30.8 | 35.6 | | 15.0 | 099K0202 |
| CD1015 | 12/21/2010 | 17.6 | 25.5 | 20.4 | 15.3 | 30.6 | 35.6 | | 15.0 | 099K0202 |
| CD1101 | 1/27/2011 | 17.0 | 25.0 | 19.7 | 14.4 | 30.3 | 35.7 | | 15.0 | 099K0202 |
| CD1102 | 2/10/2011 | 22.2 | 24.9 | 19.7 | 14.5 | 30.1 | 35.3 | | 15.0 | 099K0202 |

CD1002 - Widened dilution series to 140, 212, 316, 476, & 716 mg/L KCl

CD1001 - Training lab tech

CD0914 - Training lab tech

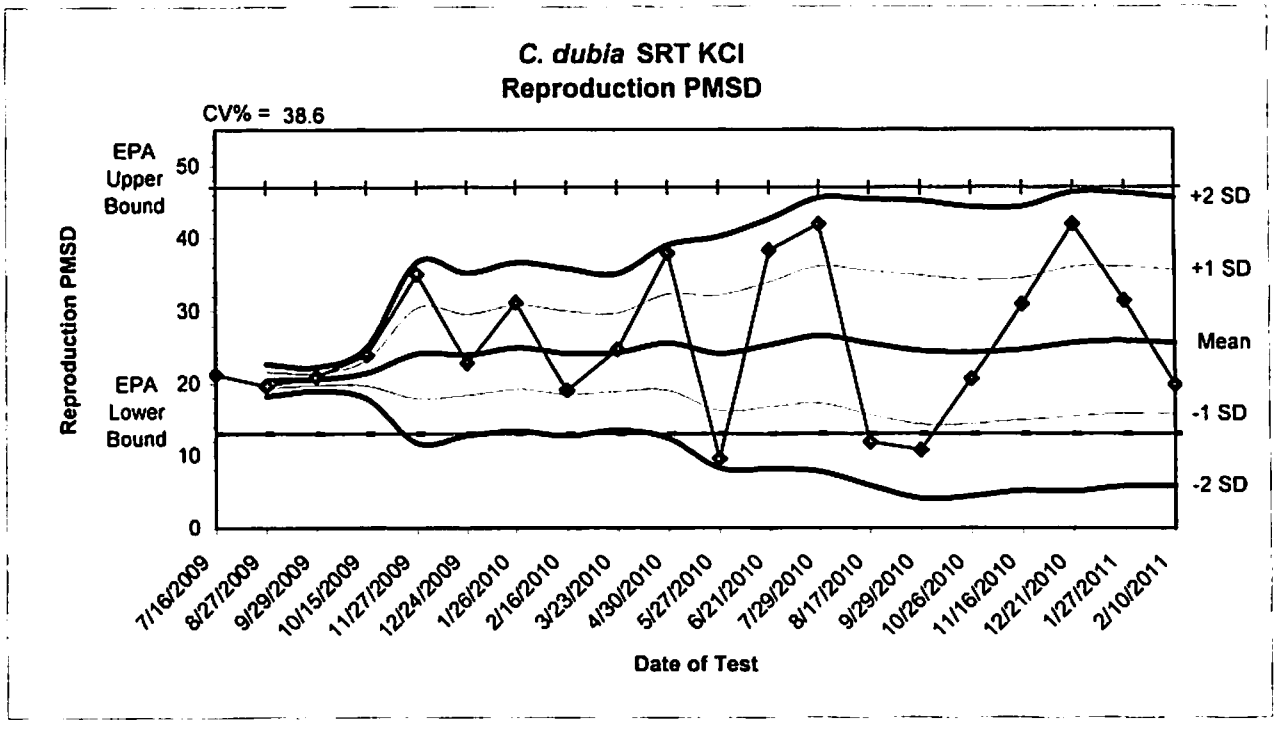



| Test # | Test Date | Control Repro. %CV | Mean %CV | -1 SD | -2 SD | +1 SD | +2 SD | | Control Limit | Toxicant Lot # |
|---|---|---|---|---|---|---|---|---|---|---|
| CD0909 | 7/16/2009 | 12.4 | | | | | | | 30.0 | 029K0050 |
| CD0910 | 8/27/2009 | 12.4 | 12.4 | 12.4 | 12.3 | 12.4 | 12.4 | | 30.0 | 029K0050 |
| CD0911 | 9/29/2009 | 13.3 | 12.7 | 12.1 | 11.6 | 13.2 | 13.8 | | 30.0 | 029K0050 |
| CD0912 | 10/15/2009 | 13.8 | 13.0 | 12.3 | 11.5 | 13.7 | 14.4 | | 30.0 | 029K0050 |
| CD0913 | 11/27/2009 | 12.6 | 12.9 | 12.2 | 11.6 | 13.6 | 14.2 | | 30.0 | 049K0305 |
| CD0915 | 12/24/2009 | 12.5 | 12.8 | 12.2 | 11.6 | 13.4 | 14.0 | | 30.0 | 049K0305 |
| CD1002 | 1/26/2010 | 14.1 | 13.0 | 12.3 | 11.6 | 13.7 | 14.5 | | 30.0 | 079K0011 |
| CD1003 | 2/16/2010 | 14.0 | 13.1 | 12.4 | 11.6 | 13.9 | 14.6 | | 30.0 | 079K0011 |
| CD1004 | 3/23/2010 | 16.2 | 13.5 | 12.2 | 11.0 | 14.7 | 15.9 | | 30.0 | 049K0305 |
| CD1006 | 4/30/2010 | 17.6 | 13.9 | 12.1 | 10.4 | 15.6 | 17.4 | | 30.0 | 049K0305 |
| CD1007 | 5/27/2010 | 17.6 | 14.2 | 12.2 | 10.2 | 16.2 | 18.2 | | 30.0 | 049K0305 |
| CD1009 | 6/21/2010 | 17.9 | 14.5 | 12.3 | 10.2 | 16.7 | 18.9 | | 30.0 | 049K0305 |
| CD1010 | 7/29/2010 | 17.7 | 14.8 | 12.5 | 10.2 | 17.0 | 19.3 | | 30.0 | 079K0011 |
| CD1011 | 8/17/2010 | 18.2 | 15.0 | 12.7 | 10.3 | 17.4 | 19.7 | | 30.0 | 079K0011 |
| CD1012 | 9/29/2010 | 18.0 | 15.2 | 12.8 | 10.4 | 17.6 | 20.0 | | 30.0 | 079K0011 |
| CD1013 | 10/26/2010 | 18.0 | 15.4 | 13.0 | 10.5 | 17.8 | 20.2 | | 30.0 | 099K0202 |
| CD1014 | 11/16/2010 | 18.2 | 15.6 | 13.1 | 10.7 | 18.0 | 20.5 | | 30.0 | 099K0202 |
| CD1015 | 12/21/2010 | 19.1 | 15.8 | 13.2 | 10.7 | 18.3 | 20.8 | | 30.0 | 099K0202 |
| CD1101 | 1/27/2011 | 20.8 | 16.0 | 13.3 | 10.6 | 18.7 | 21.4 | | 30.0 | 099K0202 |
| CD1102 | 2/10/2011 | 20.9 | 16.3 | 13.4 | 10.6 | 19.1 | 22.0 | | 30.0 | 099K0202 |

CD1002 - Widened dilution series to 140, 212, 316, 476, & 716 mg/L KCl

CD1001 - Training lab tech

CD0914 - Training lab tech




| Test # | Test Date | Reprod. PMSD | Mean PMSD | -1 SD | -2 SD | +1 SD | +2 SD | Upper PMSD Bound | Lower PMSD Bound | Toxicant Lot # |
|---|---|---|---|---|---|---|---|---|---|---|
| CD0909 | 7/16/2009 | 21.3 | | | | | | 47 | 13 | 029K0050 |
| CD0910 | 8/27/2009 | 19.7 | 20.5000 | 19.3686 | 18.2373 | 21.6314 | 22.7627 | 47 | 13 | 029K0050 |
| CD0911 | 9/29/2009 | 21.0 | 20.6667 | 19.8162 | 18.9657 | 21.5172 | 22.3676 | 47 | 13 | 029K0050 |
| CD0912 | 10/15/2009 | 24.0 | 21.5000 | 19.6945 | 17.8889 | 23.3055 | 25.1111 | 47 | 13 | 029K0050 |
| CD0913 | 11/27/2009 | 35.0 | 24.2000 | 17.9634 | 11.7268 | 30.4366 | 36.6732 | 47 | 13 | 049K0305 |
| CD0915 | 12/24/2009 | 22.9 | 23.9833 | 18.3800 | 12.7766 | 29.5867 | 35.1901 | 47 | 13 | 049K0305 |
| CD1002 | 1/26/2010 | 31.2 | 25.0143 | 19.2173 | 13.4204 | 30.8112 | 36.6082 | 47 | 13 | 079K0011 |
| CD1003 | 2/16/2010 | 19.1 | 24.2750 | 18.5151 | 12.7552 | 30.0349 | 35.7948 | 47 | 13 | 079K0011 |
| CD1004 | 3/23/2010 | 24.8 | 24.3333 | 18.9426 | 13.5519 | 29.7241 | 35.1148 | 47 | 13 | 049K0305 |
| CD1006 | 4/30/2010 | 37.9 | 25.6900 | 19.0389 | 12.3879 | 32.3411 | 38.9921 | 47 | 13 | 049K0305 |
| CD1007 | 5/27/2010 | 9.6 | 24.2273 | 16.2681 | 8.3090 | 32.1864 | 40.1456 | 47 | 13 | 049K0305 |
| CD1009 | 6/21/2010 | 38.3 | 25.4000 | 16.7923 | 8.1846 | 34.0077 | 42.6154 | 47 | 13 | 049K0305 |
| CD1010 | 7/29/2010 | 41.9 | 26.6692 | 17.2426 | 7.8160 | 36.0958 | 45.5224 | 47 | 13 | 079K0011 |
| CD1011 | 8/17/2010 | 11.9 | 25.6143 | 15.7347 | 5.8551 | 35.4939 | 45.3734 | 47 | 13 | 079K0011 |
| CD1012 | 9/29/2010 | 10.8 | 24.6267 | 14.3668 | 4.1069 | 34.8865 | 45.1464 | 47 | 13 | 079K0011 |
| CD1013 | 10/26/2010 | 20.7 | 24.3813 | 14.4208 | 4.4603 | 34.3417 | 44.3022 | 47 | 13 | 099K0202 |
| CD1014 | 11/16/2010 | 31.0 | 24.7706 | 14.9937 | 5.2168 | 34.5475 | 44.3243 | 47 | 13 | 099K0202 |
| CD1015 | 12/21/2010 | 41.9 | 25.7222 | 15.4137 | 5.1052 | 36.0307 | 46.3392 | 47 | 13 | 099K0202 |
| CD1101 | 1/27/2011 | 31.5 | 26.0263 | 15.9209 | 5.8156 | 36.1317 | 46.2371 | 47 | 13 | 099K0202 |
| CD1102 | 2/10/2011 | 19.9 | 25.7200 | 15.7892 | 5.8584 | 35.6508 | 45.5816 | 47 | 13 | 099K0202 |

Environmental Enterprises USA, Inc.

# APPENDIX D

Logbooks: TVA-KIF-NTC-TOX-001, 002, 003

# BIOMONITORING CHAIN OF CUSTODY RECORD



RECORD COPY

COC No. BULKSED-021111-EEUSA

Client: TVA

Project Name: KIF Ash Toxicity Study

Date of Sample Collection: 02/07/11, 02/08/11, 02/09/11

Location: CRM0.0, CRM1.5, CRM2.0, CRM2.5, CRM3.0, CRM3.5, CRM4.0, CRM4.5, CRM6.5, CRM7.5

Collected By: R. Josefczyk (RSI), L. Jackson (TVA), R. Vance (RSI), E. Arnold (RSI), M. Greer (RSI), D. Mathis (RSI)

Environmental Enterprises USA, Inc.
58485 Pearl Acres Road, Suite D
Slidell, LA 70461
Attn: David L. Daniel
Office 800.966.2788
Cell 985.707.5442

Delivered By (Circle One):
FedEx UPS Bus Client Courier
Other (specify):_

**General Comments:**
Homogenized sediment from the Clinch River

"CLINCHREFERENCE" is a composite sample of CRM6.5 and CRM7.5.

| Field Identification / Sample Description | Grab/ Comp | Collection Date/Time | | Number of Containers & Volume Collected | Depth (ft) | Rain Event? (Mark as Appropriate) | | | | Laboratory Use (as applicable) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Yes | If Yes, Inches | No | Trace | Log # | Arrival Temp. (°C) | By | Time | Appearance |
| Example: BULKSED-CRM0.0-EEUSA | — | Date | Time | — | — | | | | | | | | | |
| BULKSED-CRM0.0-EEUSA | G | 02/07/11 | 1014 | (4) 1000 mL | 0.0-0.5 | N/A | N/A | N/A | N/A | E-087-11 | 1.0+1.1 | DD | 1330/1430 | Sediment |
| BULKSED-CRM1.5-EEUSA | G | 02/07/11 | 1243 | (4) 1000 mL | 0.0-0.5 | N/A | N/A | N/A | N/A | E-088-11 | 0.3+1.1 | DD | 1310/1505 | " |
| BULKSED-CRM2.0-EEUSA | G | 02/07/11 | 0955 | (4) 1000 mL | 0.0-0.5 | N/A | N/A | N/A | N/A | E-089-11 | 0.8+1.9 | DD | 1515/1345 | " |
| BULKSED-CRM2.5-EEUSA | G | 02/07/11 | 1340 | (4) 1000 mL | 0.0-0.5 | N/A | N/A | N/A | N/A | E-090-11 | 0.9+0.7 | DD | 1355/1520 | " |
| BULKSED-CRM3.0-EEUSA | G | 02/08/11 | 0921 | (4) 1000 mL | 0.0-0.5 | N/A | N/A | N/A | N/A | E-091-11 | 1.3+1.8 | DD | 1530/1410 | " |
| BULKSED-CRM3.5-EEUSA | G | 02/08/11 | 1000 | (4) 1000 mL | 0.0-0.5 | N/A | N/A | N/A | N/A | E-092-11 | 0.9 | DD | 1425 | " |
| BULKSED-CRM4.0-EEUSA | G | 02/08/11 | 1235 | (4) 1000 mL | 0.0-0.5 | N/A | N/A | N/A | N/A | E-093-11 | 0.8 | DD | 1400 | " |
| BULKSED-CRM4.5-EEUSA | G | 02/08/11 | 1058 | (4) 1000 mL | 0.0-0.5 | N/A | N/A | N/A | N/A | E-094-11 | 1.9 | DD | 1400 | " |
| BULKSED-CLINCHREFERENCE-EEUSA | C | 02/09/11 | 0940 | 32 ~~(4)~~ 1000 mL | 0.0-0.5 | N/A | N/A | N/A | N/A | E-095-11 | 0.8, 2.3, +1.6 | DD | * | " |

*1320, 1450, +1545

Sample Custody – Fill In From Top Down

| Relinquished By (Signature)/Affiliation: | Date/Time | Received By (Signature)/ Affiliation: | Date/Time |
|---|---|---|---|
| Ramona Josefczyk / RSI | 021011 ~~0940~~ / 0920 | Katie Jackson / TVA | 021011 / 0920 |
| Kate Jackson / TVA | ~~1502011~~ 021111 / 1100 | David Daniel | 021211 / 1240 |

Associated UPS Tracking #s (if applicable):

## COURIER TRANSPORT DOCUMENTATION

DATE: 02/11/2011

COURIER COMPANY:

Sonic Subcontractor

| From: | To: |
|---|---|
| TVA<br>c/o Katie Gassaway<br>189 Lakeshore Drive<br>Harriman, TN 37748<br><br>865-803-4503 | Environmental Enterprises USA, Inc.<br>58485 Pearl Acres Road, Suite D<br>Slidell, LA 70461<br>Attn: David L. Daniel<br>1-800-966-2788<br>985-707-5442 |

| No. of Items: | Description: |
|---|---|
| 7 | Cooler(s) taped and custody sealed. Coolers are batched 1 of 1, 2 of 2, and 4 of 4 containing water and sediment. |

Shippers Name/Company: Sonic KG02111 Katie Gassaway/TV

Date / Time: 021111 / 1400

Courier Signature/Company:

Date / Time: 2-11-11 1400

Receipt Signature/Company: EEUSA

Date / Time: 2/12/11 12:40 David Daniel

Corresponding Chains of Custody:

| |
|---|
| BULKSED-021111-EEUSA page 1 of 1 |
| BULKSW-021111-EEUSA page 1 of 1 |

**CHAIN OF CUSTODY RECORD** RECORD COPY **Page 1 of 1** **COC No. BULKSW-022211-EEUSA**

Client: TVA

Project Name: KIF Ash Toxicity Study

Date of Sample Collection: 02/22/2011

Location: CRM7.0

Collected By: R. Josefczyk (RSI), J. Kerr (RSI)

Environmental Enterprises USA, Inc.
58485 Pearl Acres Road, Suite D
Slidell, LA 70461
Attn: David L. Daniel
Office 800.966.2788
Cell 985.707.5442

Delivered By (Circle One):
FedEx (UPS) Bus Client Courier
Other (specify):_

**General Comments:**

Bulk Clinch River reference water for sediment toxicity study collected in 2.5 gallon (10L) cubitainers.

Logbook: TVA-KIF-NTC-TOX-003

| Field Identification / Sample Description | Grab/ Comp. | Collection Date/Time | | Number of Containers & Volume Collected | Depth (m) | Rain Event? (Mark as Appropriate) | | | | Laboratory Use (as applicable) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Date | Time | | | Yes | If Yes, Inches | No | Trace | Log # | Arrival Temp. (°C) | By | Time | Appearance |
| BULKSW-CRM7.0-EEUSA | G | 02/22/2011 | 1033 | (2) 10L cubitainers | 8.91 | NA | NA | X | NA | E-125-11 | 0.9 | VL | 0827 | water |

B022211

Sample Custody – Fill In From Top Down

| Relinquished By (Signature)/Affiliation: | Date/Time | Received By (Signature)/Affiliation: | Date/Time |
|---|---|---|---|
| [signature] (RSI) | 022211/1204 | [signature] RSI | 022211/1204 |
| [signature] RSI | 022211/1345 | T O'Reilly EE | 2-23-11 0815 |

Relinquished by T. O'Reilly EE 2-23-11 0825 Received by: Veronica McHenry EE 02/23/11 0827

Associated UPS Tracking #s (if applicable): 1Z 939 EX2 15 9307 0578