



WORKING COPY

RESULTS OF TOXICITY TESTING  
WITH *Leptocheirus plumulosus* ON 17 FEBRUARY 2005  
SEDIMENT SAMPLES FROM THE DELAWARE RIVER

*Prepared for:*

Department of Natural Resources and Environmental Control  
Division of Air and Waste Management  
391 Lukens Dr.  
New Castle, DE 19720

*Prepared by:*

EA Engineering, Science, and Technology, Inc.  
15 Loveton Circle  
Sparks, Maryland 21152  
ph: 410-771-4950

MAY - 2 / 2005  
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*Results relate only to the items tested or to the samples as received by the laboratory.*

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*This report contains 10 pages plus 2 attachments.*

  
Wayne L. McCulloch  
Laboratory Director

26 April 2005  
Date

## 1. INTRODUCTION

At the request of the State of Delaware Department of Natural Resources and Environmental Control (DNREC), EA Engineering, Science, and Technology performed 10-day solid phase survival toxicity tests with the amphipod *Leptocheirus plumulosus*. The purpose of this study was to evaluate the toxicity of three sediment samples collected from the Delaware River following an oil spill upstream. These three samples were collected on 17 February 2005, which was 80 days after sediment samples were collected to establish baseline toxicity profiles, prior to the oil spill passage. The results of the *L. plumulosus* sediment toxicity testing performed on the 29 November 2004 baseline sediment samples is presented in EA Report #4677.

## 2. MATERIALS AND METHODS

### 2.1 SAMPLE RECEIPT AND PREPARATION

Three sediment samples were collected by DNREC personnel on 17 February 2005 and were transported on ice to EA's Ecotoxicology Laboratory in Sparks, Maryland. Upon receipt at EA on 3 March 2005, the sediment samples were logged in and assigned EA laboratory accession numbers, and were stored in the dark in a secured walk-in cooler at  $\leq 4^{\circ}\text{C}$  until used for testing. Prior to use in testing, each sediment was homogenized, and large rocks and debris were manually removed and discarded from the sample. Table 1 summarizes the sample identifications, accession numbers, and collection and receipt information for the sediment samples. Chain-of-custody records are included in Attachment I.

### 2.2 CONTROL SEDIMENT

A sample of sediment from Codorus Creek, Pennsylvania, was used as the control sediment for the toxicity testing. The sediment was collected in an area designated as a state wild trout stream. Sediment collected from this location has historically been non-toxic and is routinely utilized as a control in EA's sediment toxicity tests.

### 2.3 OVERLYING WATER

Artificial sea water (Forty Fathoms sea salts) at 5 ppt salinity was used as the overlying water. Dechlorinated tap water was used to prepare the artificial sea water. The source of the tap water was the City of Baltimore municipal water system. Upon entering the laboratory, the water was passed through a high-capacity, activated-carbon filtration system to remove any possible contaminants such as chlorine, detergents, and other possible trace organic contaminants. This water source has proven safe for aquatic organism toxicity testing at EA as evidenced by maintenance of multigeneration *Daphnia* sp., *H. azteca* and fathead minnow cultures with no evident loss of fecundity.

## 2.4 TEST ORGANISMS

Whole sediment toxicity testing was conducted with the estuarine amphipod *Leptocheirus plumulosus*. The amphipods (2-4 mm) were acquired from Aquatic BioSystems. Organism lot number LP-027 was received on 10 March 2005 and used to initiate the toxicity test on 11 March 2005. During the holding period, the organisms were gradually acclimated to laboratory water at 20°C and the appropriate test salinity of 5 ppt. The organisms were fed finely ground Tetraamin flake food during the acclimation period.

## 2.5 TOXICITY TEST METHODS

All toxicity testing was conducted following EA's standard operating procedures (EA 2003) which are in accordance with US EPA guidance (1994).

The whole sediment toxicity tests were conducted as static, non-renewal tests with ten days of exposure to the whole sediments and overlying water. Prior to initiation of the toxicity tests, the sediments and overlying water were added to the test chambers, and the suspended sediments were allowed to settle overnight. The addition of the test organisms to the exposure chambers on the following day marked the initiation of the toxicity tests.

The *L. plumulosus* tests utilized 1-L beakers as the exposure chambers, with each beaker containing 200 ml of sediment and 700 ml of overlying water. There were five replicate chambers for each sediment sample and control. Test organisms were randomly assigned to the test chambers, 20 organisms per replicate chamber for a total of 100 organisms per sample.

The tests were maintained at 20±1°C with a 16-hour light/8-hour dark photoperiod. The test chambers were visually inspected daily for abnormal organism behavior/lack of burrowing. Water quality measurements of temperature, pH, dissolved oxygen, and salinity were recorded daily on one replicate of each sample and control. The water quality parameters measured during the toxicity tests are summarized in Table 2. The test organisms were not fed during the 10-day exposure period. After ten days of exposure, the test organisms were retrieved from the samples and the number of live organisms per replicate was recorded.

Statistical analyses were performed on the whole sediment test data according to US EPA (1994) guidance and using the ToxCalc statistical software package (Version 5.0, Tidepool Scientific Software). Statistical analyses were performed to determine if exposure to either of the sediment samples resulted in significantly lower ( $p=0.05$ ) survival of the test organisms as compared to the control sediment. A summary of the survival data for the *L. plumulosus* exposed to each sediment sample is provided in Table 3. Copies of the original data sheets are included as Attachment I.

## 2.6 REFERENCE TOXICANT TESTING

In conformance with EA's quality assurance/quality control program requirements, reference toxicant testing was performed on an acquired lot of *L. plumulosus*. The reference toxicant test consisted of a graded concentration series of cadmium chloride in water only tests, with no sediment present in the test chambers. The results of the reference toxicant test was compared to established control chart limits.

## 2.7 ARCHIVES

Original data sheets, records, memoranda, notes, and computer printouts are archived at EA's Baltimore Office in Sparks, Maryland. These data will be retained for a period of 5 years unless a longer period of time is requested by the State of Delaware Department of Natural Resources and Environmental Control.

### 3. RESULTS AND DISCUSSION

The results of the *Leptocheirus plumulosus* whole sediment toxicity tests met the current NELAC standards, where applicable.

Table 3 summarizes the results of the toxicity tests conducted on the 17 February 2005 Delaware River sediment samples. There was 96 percent survival of *L. plumulosus* in sample DRSED01, and 94 percent survival in sample DRSED02, after 10 days of exposure. The 10-day survival in sediment DRSED03 was 59 percent. The DRSED02 and DRSED03 samples gave off an oily sheen, and had a strong petroleum odor. Survival in the control sediment was 97 percent. Statistical analysis indicated that the DRSED03 sample was the only post oil spill sediment sample that was significantly ( $p=0.05$ ) different from the control. There was no evidence of any oil in the DRSED01 sample.

The 48-hour LC50 for the reference toxicant test conducted on *L. plumulosus* was 10.9 mg/L Cd, which was within EA's established laboratory control chart limits of 1 – 15.0 mg/L Cd.

#### 4. REFERENCES CITED

EA. 2003. EA Ecotoxicology Laboratory Quality Assurance and Standard Operating Procedures Manual. EA Manual ATS-102. Internal document prepared by EA's Ecotoxicology Laboratory, EA Engineering, Science, and Technology, Inc., Sparks, Maryland.

US EPA. 1994. Methods for Assessing the Toxicity of Sediment-associated Contaminants with Estuarine and marine Amphipods. EPA 600/R-94/025. U.S. Environmental Protection Agency, Office of Research and Development, Narragansett, Rhode Island.

TABLE 1 SUMMARY OF COLLECTION AND RECEIPT INFORMATION FOR 17  
FEBRUARY 2005 SAMPLES FROM DELAWARE RIVER

<u>Sample Identification</u>	<u>EA Accession Number</u>	<u>Collection Time and Date</u>	<u>Receipt Time and Date</u>
CONTROL	AT5-021	10 January 2005	10 January 2005
DRSED 01	AT5-103	1025, 17 February 2005	1200, 3 March 2005
DRSED 02	AT5-104	1125, 17 February 2005	1200, 3 March 2005
DRSED 03	AT5-102	0930, 17 February 2005	1200, 3 March 2005

TABLE 2 SUMMARY OF WATER QUALITY PARAMETERS FROM 10-DAY WHOLE SEDIMENT TOXICITY TESTING WITH *Leptocheirus plumulosus* ON 17 FEBRUARY 2005 DELAWARE RIVER SEDIMENTS

Test Species: <i>Leptocheirus plumulosus</i>		Water Quality Parameters – Range			
Test Number: TN-05-131					
Sample ID	EA Accession Number	Temperature (°C)	pH	Dissolved Oxygen (mg/L)	Salinity (ppt)
Lab Control	AT5-021	19.4-20.9	7.0-7.8	4.2-5.4	4.2-4.6
DRSED 01	AT5-103	20.2-20.8	7.0-7.6	3.8-5.8	4.2-4.6
DRSED 02	AT5-104	20.2-20.7	7.0-7.7	5.2-6.2	4.4-4.7
DRSED 03	AT5-102	20.0-21.0	7.0-7.7	4.7-5.8	4.3-4.5

TABLE 3 RESULTS OF 10-DAY WHOLE SEDIMENT TOXICITY TESTING WITH *Leptocheirus plumulosus* ON 17 FEBRUARY 2005 DELAWARE RIVER SEDIMENTS

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Test Species: *Leptocheirus plumulosus*  
 Test Number: TN-05-131  
 Sample Date: 17 February 2005  
 Test Date: 11-21 March 2005

<u>Test Treatment</u>	<u>10-Day % Survival</u>
LAB CONTROL	97
DRSED 01	96
DRSED 02	94
DRSED 03	59 <sup>(a)</sup>

<sup>(a)</sup> Significantly different (p=0.05) from the laboratory control.

**ATTACHMENT I**

Data Sheets and Statistical Analyses  
(11 pages)

**STL EDISON**

777 New Durham Road  
Edison, New Jersey 08817  
Phone: (732) 549-3900 Fax: (732) 549-3679

**CHAIN OF CUSTODY / ANALYSIS REQUEST**

Name (for report and invoice) <b>Robert Schulte</b>		Samplers Name (Printed) <b>Kristen Thornton</b>		Site/Project Identification <b>Delaware R. Oil Spill NRDA</b>					
Company <b>DNREC-SIRB</b>		P.O. #		State (Location of site): NJ: <input type="checkbox"/> NY: <input type="checkbox"/> Other: <b>DE</b>		Regulatory Program: <b>DNREC-SIRB</b>			
Address <b>391 Lukens Dr.</b>		Analysis Turnaround Time Standard <input checked="" type="checkbox"/>		ANALYSIS REQUESTED (ENTER 'X' BELOW TO INDICATE REQUEST)				LAB USE ONLY Project No:  Job No:  Sample Numbers	
City <b>New Castle, DE</b> State <b>19720</b>		Rush Charges Authorized For:							
Phone <b>302-395-2600</b> Fax <b>302-395-2600</b>		2 Week <input type="checkbox"/> 1 Week <input type="checkbox"/> Other <input type="checkbox"/>							
Sample Identification		Date	Time	Matrix	No. of Cont.	<div style="writing-mode: vertical-rl; transform: rotate(180deg);">Benzene/Assem</div> <div style="writing-mode: vertical-rl; transform: rotate(180deg);">Leptochlorin/Assem</div>			
<b>DRSED030217050930</b>		<b>02/05</b>	<b>0930</b>	<b>Sed</b>	<b>4</b>	<b>X</b>	<b>X</b>	<b>AT5-102</b>	
<b>DRSED010217051025</b>		<b>02/05</b>	<b>1025</b>	<b>Sed</b>	<b>4</b>	<b>X</b>	<b>X</b>	<b>AT5-103</b>	
<b>DRSED020217051125</b>		<b>02/05</b>	<b>1125</b>	<b>Sed</b>	<b>4</b>	<b>X</b>	<b>X</b>	<b>AT5-104</b>	
Preservation Used: 1 = ICE, 2 = HCl, 3 = H <sub>2</sub> SO <sub>4</sub> , 4 = HNO <sub>3</sub> , 5 = NaOH		Soil:		Water:					
6 = Other <b>Formalin</b> 7 = Other									

**Special Instructions**

Water Metals Filtered (Yes/No)?

Relinquished by 1) <b>Kristen Thornton</b>	Company <b>DNREC-SIRB</b>	Date / Time <b>03/02/05 1417</b>	Received by 1) <b>[Signature]</b>	Company <b>ELA Engineering</b>	1200 <b>3/3/05</b>
Relinquished by 2)	Company	Date / Time	Received by 2)	Company	
Relinquished by 3)	Company	Date / Time	Received by 3)	Company	
Relinquished by 4)	Company	Date / Time	Received by 4)	Company	





# SEDIMENT TOXICITY TEST SET-UP BENCH SHEET

Project Number: 70005.08

Client: INREC

QC Test Number: TN-05-131

## TEST ORGANISM INFORMATION

Common Name: Amphipod Adults Isolated (Time, Date): \_\_\_\_\_  
 Scientific Name: L. plumulosus Neonates Pulled (Time, Date): \_\_\_\_\_  
 Lot Number: LP-027 Acclimation: 24hs Age: 3-4 weeks  
 Source: ABS Culture Water (T/S): 20°C °C 6 ppt

## TEST INITIATION

Date	Time	Initials	Activity
3/10/05	1545	MA	Sediment Added to Chambers
3/10/05	1630	MA	Overlying Water Added to Chambers
3/11/05	1500	MA	Organisms Transferred

## TEST SET-UP

Sample Number(s): ATS-102, 103, 104, ATS-021

Overlying Water Number: 5ppt FF

Treatment	Volume Test Sediment	Volume Overlying Water
Control ATS-021	200ml	700 ml
ATS-102	↓	↓
ATS-103		
ATS-104		



# TOXICITY TEST OBSERVATION DATA SHEET

Project Number: 70005.08

TEST ORGANISM

Beginning Date: 3/11/05 Time: 1500

Client: DUREC

Common Name: Amphipod

Ending Date: 3/21/05 Time: 1320

QC Test Number: TN-05-131

Scientific Name: L. Nummulosus

Test Material: Sediment

Accession Number: ATS-102/103/104/024 TEST TYPE:  Static /  Flowthrough

Test Container: 1 L beaker

Dilution Water: 5ppt FF

Renewal  /  Non-renewal

Test Volume: 200ml sed./700ml H<sub>2</sub>O

Accession Number:                     

Test Duration: 10 days

Concentration	Rep	Number of Surviving Organisms											
		Day 0 Date	Day 1 Date	Day 2 Date	Day 3 Date	Day 4 Date	Day 5 Date	Day 6 Date	Day 7 Date	Day 8 Date	Day 9 Date	Day 10 Date	
Control	A	20											19
	B	20											<sup>065</sup> <sub>3/21/05</sub> 19
	C	20											19
	D	20											20
	E	20											<sup>065</sup> <sub>3/21/05</sub> 19 20
ATS-102	A	20											10
	B	20											15
	C	20											10
	D	20											11
	E	20											13
Time / Initials		1500 <sup>065</sup> <sub>3/11/05</sub> RST											1320 <sup>065</sup> RST



# TOXICITY TEST OBSERVATION DATA SHEET

Project Number: 70005.08

Client: DNREC

QC Test Number: TN-05-131

Test Material: Sediment

Accession Number: ATS-021/102/103/104

Dilution Water: 5ppt FF

Accession Number: \_\_\_\_\_

TEST ORGANISM

Common Name: Amphipod

Scientific Name: L. Plumulosus

Beginning Date: 3/11/05 Time: 1500

Ending Date: 3/21/05 Time: 1320

TEST TYPE:  Static /  Flowthrough

Renewal  /  Non-renewal

Test Container: 1 L beaker

Test Volume: 250ml sed./700 ml H<sub>2</sub>O

Test Duration: 10 day

Concentration	Rep	Number of Surviving Organisms											
		Day 0 Date	Day 1 Date	Day 2 Date	Day 3 Date	Day 4 Date	Day 5 Date	Day 6 Date	Day 7 Date	Day 8 Date	Day 9 Date	Day 10 Date	
ATS-103	A	20											20
	B	20											18 extend
	C	20											20
	D	20											19
	E	20											19
ATS-104	A	20											20
	B	20											20
	C	20											17
	D	20											20
	E	20											17
Time / Initials		1500 MAY											1320 CES RSH



# TOXICITY TEST WATER QUALITY DATA SHEET - NEW SOLUTIONS

Project Number: 70005.08

TEST ORGANISM

Beginning Date: 3/11/05 Time: 1500

Client: DUREC

Common Name: Amphipod

Ending Date: 3/21/05 Time: 1320

QC Test Number: TN-05-131

Scientific Name: L. phumulosus

TARGET VALUES Temp: 20 °C

pH: 6.0 - 9.0

DO: ≥40% mg/L

Salinity: 5 ppt

Test Conc	Rep	Temperature (°C)						pH						Dissolved Oxygen (mg/L)						Conductivity (µS/cm) Salinity (ppt)							
		0	1	2	3	4	5	6	0	1	2	3	4	5	6	0	1	2	3	4	5	6	0	1	2	3	4
ATS-102		20.4						7.1						5.3						4.5							
ATS-103		20.3						7.0						5.8						4.6							
ATS-104		20.2						7.0						5.7						4.6							
Control		20.2						7.1						5.4						4.6							
Meter Number		312						101						310						312							
Time		1150						1150						1155						1150							
Initials		MM						R/L						MM						MM							



# TOXICITY TEST WATER QUALITY DATA SHEET - OLD SOLUTIONS

Project Number: 70005.08  
 Client: DUREC  
 QC Test Number: TN-05-131

TEST ORGANISM  
 Common Name: Amphipod  
 Scientific Name: L. pumilus

Beginning Date: 3/11/05 Time: 1500  
 Ending Date: 3/21/05 Time: 1320

TARGET VALUES Temp: 20 °C pH: 6.0 - 9.0 DO: 240% mg/L Salinity: 5 ppt

Test Conc	Rep	Temperature (°C)							pH							Dissolved Oxygen (mg/L) <sup>at 5ppt</sup>							Conductivity (µS/cm) Salinity (ppt)						
		A		B		C			A		B		1		2		3			4		5		6		7			
		1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Control		20.1	20.2	20.5	20.9	19.4	19.9	20.7	7.3	7.1	7.2	7.2	7.3	7.4	7.3	4.4	4.4	4.3	4.7	4.2	4.4	4.2	4.3	4.4	4.2	4.5	4.6	4.6	4.5
ATS-102		20.7	20.4	20.5	21.0	20.0	20.6	20.5	7.1	7.0	7.0	7.1	7.2	7.2	7.2	5.1	4.8	4.7	5.3	5.3	5.2	5.0	4.4	4.4	4.3	4.4	4.4	4.4	4.4
ATS-103		20.6	20.3	20.5	20.7	20.2	20.8	20.6	7.2	7.1	7.1	7.1	7.1	7.1	7.1	4.3	4.7	4.2	5.0	4.6	3.9	3.8	4.4	4.3	4.2	4.3	4.4	4.2	4.3
ATS-104		20.7	20.3	20.3	20.5	20.2	20.1	20.5	7.3	7.2	7.2	7.1	7.1	7.1	7.1	5.4	5.2	5.2	5.6	5.7	5.8	5.4	4.5	4.5	4.4	4.6	4.5	4.7	4.5
Meter Number		340	342	342	340	342	342	340	101	101	101	101	101	101	101	340	340	340	340	340	340	340	342	342	342	342	342	342	342
Time		1520	1430	1415	1405	1425	1410	1130	1520	1430	1415	1405	1425	1410	1135	1520	1430	1415	1405	1425	1410	1130	1520	1430	1412	1405	1425	1410	1135
Initials		MK	CES	PG	PG	PG	PG	MM	MK	CES	PG	PG	PG	PG	RM	MK	CES	PG	PG	PG	PG	MM	MK	CES	PG	PG	PG	PG	MM



# TOXICITY TEST WATER QUALITY DATA SHEET - OLD SOLUTIONS

Project Number: 70005-08

TEST ORGANISM

Beginning Date: 3/11/05 Time: 1500

Client: DNREC

Common Name: Amphipod

Ending Date: 3/21/05 Time: 1320

QC Test Number: TN-05-131

Scientific Name: L. plumulosus

TARGET VALUES Temp: 20 °C

pH: 6.0 - 9.0

DO: 2.409 mg/L

Salinity: 5 ppt

Test Conc	Rep	Temperature (°C)							pH							Dissolved Oxygen (mg/L)							Conductivity (µS/cm) Salinity (ppt)													
		C			D				E			8			9				10				11			12				13			14			
		8	9	10	11	12	13	14	8	9	10	11	12	13	14	8	9	10	11	12	13	14	8	9	10	11	12	13	14							
Control		20.4	20.2	20.5				7.1	7.0	7.8				4.4	4.2	4.4				4.4	4.5	4.5														
ATS-102		20.5	20.3	20.6				7.0	7.0	7.7				5.5	5.1	5.8				4.4	4.4	4.4														
ATS-103		20.4	20.4	20.5				7.0	7.0	7.6				4.9	4.6	5.6				4.3	4.4	4.3														
ATS-104		20.3	20.2	20.5				7.1	7.1	7.7				6.2	5.8	6.2				4.6	4.5	4.6														
Meter Number		342	342	342				101	101	101				340	340	340				342	342	342														
Time		8:55	10:05	10:52				8:55	10:05	10:50				8:55	10:05	10:58				8:55	10:05	10:52														
Initials		MX	CES	CES				MX	CES	CES				MX	CES	CES				MX	CES	CES														



# TOXICOLOGY LABORATORY BENCH SHEET

Project Number: 70005.08  
 Client: DNREC  
 QC Test Number: TN-05-131

Date/Time/Initials	Comments/Activity
3/21/05 CES 1140	102A → 5 <i>L. plumulosus</i> 1 dead, but recently 1 dead → no deterioration 102C → 5 recently 1 dead 102B → 3 recently 1 dead 102D → 1 recently 1 dead 102E → 1 recently 1 dead
3/21/05 CES 1345	samples 102 + 104 had an oil smell. sample 104 had visible globs of oil on the surface of the jar used to count the <i>L. plumulosus</i> * oil globs were sticky + <i>L. plumulosus</i> stuck to them
1350 RIA	Rep D had little oil spots on water surface during organism counts (104)

**Leptocheirus 10-day survival test**

Start Date: 3/11/2005	Test ID: TN-05-131	Sample ID: DNREC -Feb seds
End Date: 3/21/2005	Lab ID:	Sample Type:
Sample Date:	Protocol: EPAM 87-EPA Marine	Test Species: LP-Leptocheirus plumulosus
Comments:		

Conc-%	1	2	3	4	5
Control	0.9500	0.9500	0.9500	1.0000	1.0000
DRSED 01	1.0000	0.9000	1.0000	0.9500	0.9500
DRSED 02	1.0000	1.0000	0.8500	1.0000	0.8500
DRSED 03	0.5000	0.7500	0.5000	0.5500	0.6500

Conc-%	Mean	N-Mean	Transform: Arcsin Square Root					N	t-Stat	1-Tailed Critical	MSD
			Mean	Min	Max	CV%					
Control	0.9700	1.0000	1.3907	1.3453	1.4588	4.469	5				
DRSED 01	0.9600	0.9897	1.3714	1.2490	1.4588	6.481	5	0.275	2.230	0.1562	
DRSED 02	0.9400	0.9691	1.3445	1.1731	1.4588	11.637	5	0.659	2.230	0.1562	
*DRSED 03	0.5900	0.6082	0.8782	0.7854	1.0472	12.877	5	7.318	2.230	0.1562	

Auxiliary Tests	Statistic	Critical	Skew	Kurt		
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.93702	0.868	-0.1353	-1.089		
Bartlett's Test indicates equal variances (p = 0.37)	3.11554	11.3449				
Hypothesis Test (1-tail, 0.05)	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test indicates significant differences	0.07679	0.07933	0.30268	0.01226	3.0E-06	3, 16

*Yue*  
4/26/05

**ATTACHMENT II**

Report Quality Assurance Record  
(2 pages)



# REPORT QUALITY ASSURANCE RECORD

Client: DNREC

Project Number: 70005.08

Author: Dayne McCulloch

EA Report Number: 4750

## REPORT CHECKLIST

<u>QA/QC ITEM</u>	<u>REVIEWER</u>	<u>DATE</u>
1. Samples collected, transported, and received according to study plan requirements.	<u>W McCulloch</u>	<u>20 April 2005</u>
2. Samples prepared and processed according to study plan requirements.	<u>W McCulloch</u>	<u>20 April 2005</u>
3. Data collected using calibrated instruments and equipment.	<u>W McCulloch</u>	<u>20 April 2005</u>
4. Calculations checked:		
- Hand calculations checked	<u>W McCulloch</u>	<u>20 April 2005</u>
- Documented and verified statistical procedure used.	<u>W McCulloch</u>	<u>20 April 2005</u>
5. Data input/statistical analyses complete and correct.	<u>Richard A. Connolly</u>	<u>4/26/05</u>
6. Reported results and facts checked against original sources.	<u>Richard A. Connolly</u>	<u>4/26/05</u>
7. Data presented in figures and tables correct and in agreement with text.	<u>Richard A. Connolly</u>	<u>4/26/05</u>
8. Results reviewed for compliance with study plan requirements.	<u>W McCulloch</u>	<u>20 April 2005</u>

	<u>AUTHOR</u>	<u>DATE</u>
9. Commentary reviewed and resolved.	<u>W McCulloch</u>	<u>4/26/05</u>
10. All study plan and quality assurance/control requirements have been met and the report is approved:		
	<u>W McCulloch</u> PROJECT MANAGER	<u>4/26/05</u> DATE
	<u>Richard A. Connolly</u> QUALITY CONTROL OFFICER	<u>4/26/05</u> DATE
	<u>Angela A. John</u> SENIOR TECHNICAL REVIEWER	<u>4/26/05</u> DATE