AZIMUTH CONSULTING GROUP

POLARIS MINE ENVIRONMENTAL EFFECTS MONITORING PROGRAM

July 30, 2004

LABORATORY REPORT

Prepared for

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EVS Project No.

09-0302-54

September 2004

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ACKNOWLEDGEMENTS

The *A. affinis* toxicity test was conducted by Andy Diewald, Ann-Marie Norris and Jenny Shao. Kathryn Sentance and Armando Tang performed the *D. excentricus* fertilization toxicity test. Statistical analyses were performed by Jenny Shao and Kathryn Sentance. The report was written by Kathryn Sentance and reviewed by Edmund Canaria. Quality Assurance/Quality Control (QA/QC) review on the *D. excentricus* test was conducted by Julianna Kalokai and Armando Tang reviewed the *A. affinis* toxicity test.

1. INTRODUCTION

EVS Environment Consultants conducted sublethal Metal Mining Effluent Regulations (MMER) toxicity testing for Azimuth Consulting Group as part of the Environmental Effects Monitoring (EEM) program for Polaris Mine.

A sample, identified as G Creek, was collected from the Polaris Mine Site on July 27, 2004 in 20-L collapsible polyethylene containers. It was received at the EVS laboratory on July 30, 2004 and was stored in the dark at 4°C prior to test initiation. The sample was evaluated for toxicity using the 7-d topsmelt (*Atherinops affinis*) survival and growth toxicity test and the echinoderm (*Dendraster excentricus*) fertilization toxicity test. Toxicity testing was initiated on the day of initial sample receipt.

This report describes the methods and results of the 7-d topsmelt (*Atherinops affinis*) toxicity test and the echinoderm (*Dendraster excentricus*) fertilization toxicity test. The raw data and statistical analyses are provided in Appendix A and B respectively, and the chain-of-custody form is provided in Appendix C.

2. METHODS

2.1 7-D TOPSMELT (*ATHERINOPS AFFINIS*) SURVIVAL AND GROWTH TOXICITY TEST

A static-renewal 7-d toxicity test and reference toxicant test using topsmelt (A. *affinis*) was conducted in accordance with EVS Environment Consultants Standard Operating Procedures (SOP) 1100-4 (EVS, 2002) with modifications based on U.S. Environmental Protection Agency (USEPA, 1995). Test conditions and methods are summarized in Table 1.

This 7-day test exposes topsmelt larvae to different concentrations of a given sample. Fish are fed on a daily basis and both survival and growth endpoints are measured at test termination. These observations are assessed in comparison to the pooled negative and brine controls.

2.2 ECHINODERM (*DENDRASTER EXCENTRICUS*) FERTILIZATION TOXICITY TEST

The echinoderm (*Dendraster excentricus*) fertilization toxicity test was conducted in accordance with Environment Canada (1992 with 1997 amendments). Test conditions and methods summarized in Table 2.

This fertilization test involves exposing echinoderm sperm to a series of test concentrations for ten minutes, echinoderm eggs are then added allowing fertilization to occur for ten minutes. Following the ten minutes exposure time the eggs are preserved and the number of fertilized and unfertilized eggs in each replicate are counted. These observations are assessed in comparison to the pooled negative and brine controls.

2.3 STATISTICAL ANALYSIS

Statistical analyses for all tests were conducted using the computer software program TOXCALC (version 5.0.23; Tidepool Scientific Software, 1994).

2.4 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

This study followed a comprehensive QA/QC Program to ensure full documentation and minimize possible errors in computation and reporting of results. The following general

QA/QC guidelines were applied in this test: use of negative controls, use of positive controls, use of brine controls, replication, instrument calibration, water quality maintenance and record-keeping, and use of standard operating procedures (SOPs). To ensure the highest quality of data and reporting, all data and statistical analyses were reviewed by a member of our QA/QC Committee prior to reporting the results.

Table 1. 7-d Topsmelt (*Atherinops affinis)* survival and growth toxicity test methods

TEST PARAMETER	TEST CONDITION
Test type	Static-renewal
Test duration	7 d
Test chamber	600-mL beaker
Test solution volume	200 mL
Number of replicate chambers per treatment	5
Number of organisms per test chamber	5
Age of test organisms at test initiation	10d
Food	Newly hatched *Artemia* nauplii (<24 hours old)
Feeding Regime	Fed 0.5 mL/ beaker twice daily of concentrated nauplii suspension (prepared to provide 200 nauplii in 0.5 mL); no feeding at test termination
Sample manipulations (e.g. pre-aeration, pH adjustment, filtration)	Salinity-adjusted
Control/dilution water	UV-sterilized and 0.5µm-filtered natural sea water from Vancouver Aquarium, BC
Dilutions	4.3, 8.6, 17.3, 34.5, 69.0% (v/v)
Renewal of dilutions	Daily
Aeration	None
Water quality parameters and frequency	Temperature, pH, dissolved oxygen, and salinity daily
Temperature	20 ± 1°C
Salinity	30 ± 2 (sample adjusted with hypersaline brine [HSB]. Preparation of HSB and salinity adjustment as per EC guidance document on salinity adjustment –July 1997)
Lighting	Overhead full-spectrum fluorescent lights; 538 – 1076 lux; 16:8 light:dark photoperiod
Reference toxicant	Initiated concurrently with sample using copper to generate LC50 and IC50 values; results compared to lab mean ± 2 SD
Endpoints	Survival and growth (dry weight)
Test validity	≥ 80% mean control survival; ≥ 0.85 mg/fish mean dry weight for surviving control fish
Reference protocol	US EPA (1995), EPA/600/R-95/136

Table 2. Echinoderm (*Dendraster excentricus*) fertilization toxicity test methods

TEST PARAMETER	TEST CONDITION
Test type	Static
Test duration	10:10 min
Test chamber	16 X 125 mm test tubes
Test solution volume	10 mL
Number of replicate chambers per treatment	4
Number of eggs per test chamber	2000
Age of test organisms	< 4 hours after spawning
Sample manipulations (e.g. pre-aeration, pH adjustment, filtration)	Salinity adjusted
Control/dilution water	UV-sterilized and 0.5µm-filtered natural sea water from Vancouver Aquarium, BC
Dilutions	4.6, 9.1, 18.3, 36.6, 73.1% (v/v)
Renewal of dilutions	None
Aeration	None during testing
Water quality parameters and frequency	Temperature, pH, dissolved oxygen, and conductivity daily; hardness and alkalinity at test initiation
Temperature	15 ± 1°C
Salinity	30 ± 2 (sample adjusted with hypersaline brine [HSB]. Preparation of HSB and salinity adjustment as per EC guidance document on salinity adjustment –July 1997)
Lighting	Ambient laboratory illumination (moderate intensity)
Reference toxicant	Initiated concurrently with test; same test methods as above using SDS to generate an EC50 value; results compared to lab mean ± 2 SD
Endpoint	Fertilization of eggs
Test validity	≥ 50% and ≤ 100% mean control fertilization
Reference protocols	Environment Canada (1992), (EPS/1/RM/27 with 1997 amendments)

3. RESULTS

3.1 7-D TOPSMELT (*ATHERINOPS AFFINIS*) SURVIVAL AND GROWTH TOXICITY TEST

The test results are summarized in Table 1 and the raw statistical analyses are provided in Appendix A.

The highest concentration tested was 69.0% due to salinity adjustment. The mean survival in both the negative and brine controls was 100%. The negative and brine controls were not significantly different for the growth and survival endpoints (p =1.00 and p =0.93, respectively).

The *A. affinis* survival and growth toxicity test showed no adverse effects on survival in all tested concentrations relative to the pooled controls ($p \leq 0.05$). Adverse effects for growth were observed in the 17.3 and 69.0% (v/v) concentrations. For the survival and growth endpoints the NOEC was 69.0 and 8.6, and the LOEC was >69.0 and 17.3% (v/v), respectively. The LC50 for survival was >69.0% (v/v). The IC50 and IC25 for growth were both >69.0% (v/v)

3.2 ECHINODERM (*DENDRASTER EXCENTRICUS*) FERTILIZATION TOXICITY TEST

The test results are summarized in Table 2 and the raw statistical analyses are provided in Appendix B.

The highest concentration tested was 73.1% due to salinity adjustment. Mean fertilization in the pooled controls was 59.9%. The negative and brine controls were not significantly different (p =0.72).

The *D. excentricus* fertilization toxicity test exhibited adverse effects on egg fertilization in all except the lowest (4.6%(v/v)) test concentrations relative to the pooled controls ($p \leq 0.05$). The NOEC was 4.6 and LOEC was 9.1 %(v/v). The IC50 and IC25 (95% confidence limits) values were 37.3 (24.4 – 46.0) and 8.7 (7.6 – 9.9) %(v/v), respectively.

3.2 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

The tests met all passing criteria for test validity as outlined in the respective protocols. Water quality parameters during the test were all within the acceptable range of values. Point

estimates for the reference toxicant tests were all within the laboratory mean ± 2 standard deviations, indicating that the tests were within acceptable limits of variability.

Table 3. Summary of results for the 7-d Topsmelt (*Atherinops affinis)* survival and growth toxicity test

TEST CONCENTRATION (% v/v)	SURVIVAL (%)(MEAN ± SD)	GROWTH (DRY WEIGHT MG) (MEAN ± SD)
D-Control	100.0 ± 0.0	0.98 ± 0.09
Brine Control	100.0 ± 0.0	0.99 ± 0.14
Pooled Controls	100.0 ± 0.0	0.98 ± 0.11
4.3	96.0 ± 8.9	0.91 ± 0.15
8.6	96.0 ± 8.9	0.87 ± 0.14
17.3	100.0 ± 0.0	0.78 ± 0.14*
34.5	100.0 ± 0.0	0.90 ± 0.03
69.0	96.0 ± 8.9	0.77 ± 0.19*
TEST ENDPOINT	**SURVIVAL (% v/v)**	**GROWTH (% v/v)**
NOEC	69.0	8.6
LOEC	>69.0	17.3
LC50	>69.0	na
IC50	na	>69.0
IC25	na	>69.0

*Indicates significant difference ($p \leq 0.05$) relative to the pooled controls.
SD – Standard Deviation; na – not applicable.

Table 4. Summary of results for the Echinoderm (*Dendraster excentricus*) fertilization toxicity test

TEST CONCENTRATION (% v/v)	PROPORTION FERTILIZED (%) (MEAN ± SD)
Negative Control	60.0 ± 4.1
Brine Control	60.0 ± 2.1
Pooled Control	60.0 ± 3.0
4.6	60.0 ± 4.3
9.1	43.8 ± 2.1*
18.3	37.0 ± 1.4*
36.6	30.2 ± 3.8*
73.1	20.0 ± 0.8*
TEST ENDPOINT	**PROPORTION FERTILIZED %(v/v)**
NOEC	4.6
LOEC	9.1
IC50 (95% CL)	37.3 (24.4 – 46.0)
IC25 (95% CL)	8.7 (7.6 – 9.9)

*Indicates significant difference ($p \leq 0.05$) relative to the pooled controls.
SD – Standard Deviation; CL – Confidence Limits.

4. REFERENCES

Environment Canada. 1992. Biological test method: fertilization of echinoids (sea urchins and sand dollars). Environmental Protection Series, Report EPS 1/RM/27, December 1992. Environment Canada, Conservation and Protection, Ottawa, ON. 68 pp + appendices. Amended November 1997.

EVS (EVS Environment Consultants). 2002. Topsmelt (*Atherinops affinis*) 7-d larval survival and growth test. EVS SOP 1100-4. In: EVS Consultants Laboratory Standard Operating Procedures (SOP) Manual. Volume II: Water Toxicity Tests. EVS Environment Consultants, North Vancouver, BC.

US EPA (U.S. Environmental Protection Agency). 2002. Short-term methods for estimating the chronic toxicity of effluents and receiving waters to marine and estuarine organisms. 3rd edition. US Environmental Protection Agency, Office of Water (4303T). US Environmental Protection Agency, Washington, DC. EPA/821/R-02/014. 464 pp.

US EPA. 1995. Short term methods for estimating the chronic toxicity of effluents and receiving waters to marine and estuarine organisms. 2nd edition. US Environmental Protection Agency, Environmental Monitoring Systems Laboratory, Office of Research and Development, Washington, DC. EPA/600/R-95/136. 563 pp.

Tidepool Scientific Software. 1994. TOXCALC: Comprehensive Toxicity Data Analysis and Database Software, Version 5.0.23. Tidepool Scientific Software, McKinleyville, CA. 80 pp.

APPENDIX A

Raw Data and Statistical Analyses:

Atherinops affinis

EVS ENVIRONMENT CONSULTANTS
7-d *Atherinops affinis* SURVIVAL AND GROWTH TEST DATA SUMMARY

Client Azimuth (Polaris) | EVS Analysts AWD. JES. AKN

EVS Project No. 09-0302-54

EVS Work Order No. 0400339 | Test Initiation Date July 30, 2004

Sample	Initial Sample	Refresh Samples	
	Day 0	Day 2	Day 4
Identification	G-Creek - sublethal - 27704		
Amount Received	20 L		
Date Collected	July 27, 2004		
Date Received	July 30, 2004		
Temperature (°C)	20.0 D→ 20.0		
pH	7.8 D→ 8.3		
DO (mg/L)	10.7 D→ 7.4		
Conductivity (µmhos/cm)	4880		
Salinity (ppt)	2.6 D→ 28		
Ammonia (mg/L N)	—		
Chlorine (mg/L Cl)	—		
Other	0 Brine adjusted to 30±2 ppt with 90 ppt HSB		

DILUTION/CONTROL WATER (initial water quality)

Water Type Filtered, UV sterilized seaH2O

Temperature (°C) 20.0

pH 8.1

Dissolved Oxygen (mg/L) 7.4

Salinity 28 ppt

TEST SPECIES INFORMATION

Source Aquatic Biosystems (ABS)

Date Received July 29, 2004

Age (on Day 0) 10-d

Reference Toxicant Cu

Current Reference Toxicant Result (incl. 95% CL)

Reference Toxicant Test Date July 30, 2004

7-d survival LC50 130 (115-147) mg/L Cu

7-d growth IC50 124 (87-144) mg/L Cu

Reference Toxicant Warning Limits (mean ± 2SD) and CV

7-d survival LC50 129 ± 48 mg/L Cu. CV=19%

7-d growth IC50 130 ± 52 mg/L Cu. CV=20%

TEST CONDITIONS

Temperature Range (°C) 20.0-20.5

pH Range 7.8-8.1

Dissolved Oxygen Range (mg/L) 6.4-7.7

Salinity (ppt) 28

Photoperiod (L:D h) 16:8

Aeration Provided? NA

Other —

TEST RESULTS

Endpoint	Conc. Units	NOEC	LOEC	LC50 (95% CL)	IC50 (95% CL)	IC25 (95% CL)
Survival	% (v/v)	69	>69	>69		
Growth		8.6 ~~34.5~~	17.3 ~~69~~		>69	>69

Other

Data Verified By [signature] | Date Verified Sept. 16/04

EVS ENVIRONMENT CONSULTANTS

7-d *Atherinops affinis* SURVIVAL AND GROWTH TEST – WATER QUALITY DATA

Client Azimuth (Polaris) Sample ID G-Creek - Acute - 270704

EVS Project No. 09-0302-54 Test Initiation Date/Time July 30/1500 h

EVS Work Order No. 0400339 Source/Date Received ABS / July 29/04

Concentration (%)	Temperature (°C)													
	0	1 old	1 new	2		3		4		5		6		7
Neg. CTL	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5
B-CTL	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5
4.3	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5
8.6	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5
17.3	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5
34.5	20.0	20.5	20.0	20.5	20.0	20.6	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5
69	20.0	20.5	20.0	20.5	20.0	20.6	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5
Tech. Initials	JES													

Concentration (%)	pH													
	0	1		2		3		4		5		6		7
Neg. CTL	8.1	8.1	7.9	7.9	8.0	8.0	7.9	8.0	7.8	8.0	7.8	7.9	8.0	7.9
B-CTL	8.1	8.1	7.9	7.9	8.0	7.9	7.9	8.0	7.8	8.0	7.8	7.9	8.0	7.9
4.3	8.2	8.0	8.1	8.1	8.1	7.9	8.1	7.9	8.1	7.9	8.1	8.0	8.1	8.0
8.6	8.2	8.1	8.2	8.2	8.1	8.1	8.2	8.1	8.1	8.0	8.2	8.1	8.1	8.1
17.3	8.2	8.1	8.2	8.2	8.2	8.1	8.2	8.2	8.2	8.1	8.2	8.2	8.2	8.1
34.5	8.2	8.1	8.3	8.3	8.2	8.2	8.2	8.2	8.3	8.2	8.2	8.2	8.3	8.2
69	8.3	8.2	8.4	8.4	8.4	8.3	8.3	8.3	8.4	8.3	8.7	8.4	8.3	8.2
Tech. Initials	JES													

WQ Instruments Used: Temp. Calibrated Hg thermometer pH II-A-51

Comments

Test Set Up By AWD. JES. AKN Data Verified By [signature] Date Verified Sept. 13/04

EVS ENVIRONMENT CONSULTANTS

7-d *Atherinops affinis* SURVIVAL AND GROWTH TEST – WATER QUALITY DATA

Client Azimuth (Polaris) Sample ID G - Creek - Anuke - 270704

EVS Project No. 09-0302-54 Test Initiation Date/Time July 30 / 15:00 h

EVS Work Order No. 0400339 Source/Date Received ABS / July 29/04

Concentration % (v/v)	Salinity (ppt)							
	0	1	2	3	4	5	6	7
Neg-CTL	28	28	28	28	28	28	28	28
B-CTL	28	28	28	28	28	28	28	28
4.3	28	28	28	28	28	28	28	28
8.6	28	28	28	28	28	28	28	28
17.3	28	28	28	28	28	28	28	28
34.5	28	28	28	28	28	28	28	28
69	28	28	28	28	28	28	28	28
Tech. Initials	JES	~	~	~	~	~	~	~

Concentration % (v/v)	Dissolved Oxygen (mg/L)													
	0	1		new 2 old		3		4		5		6		7
Neg. CTL	7.4	6.6	7.4	7.5	6.8	7.4	7.0	7.5	7.0	7.6	6.8	6.7	7.6	6.8
B-CTL	7.4	6.8	7.4	7.5	6.7	7.4	6.9	7.5	6.9	7.6	6.7	6.6	7.6	6.9
4.3	7.4	6.7	7.4	7.5	6.8	7.4	6.8	7.5	6.8	7.6	6.7	6.6	7.6	6.9
8.6	7.4	6.8	7.0	7.5	6.9	7.4	6.8	7.5	6.8	7.6	6.7	6.5	7.7	6.8
17.3	7.4	6.9	7.4	7.5	6.8	7.4	6.6	7.5	6.5	7.6	6.8	6.6	7.7	6.7
34.5	7.4	6.7	7.4	7.5	6.7	7.4	6.7	7.5	6.4	7.6	6.8	6.7	7.7	6.7
69	7.4	6.7	7.4	7.4	6.7	7.4	6.7	7.5	6.4	7.6	6.8	6.7	7.7	6.7
Tech. Initials	JES	~	~	~	~	~	~	~	~	~	~	~	~	~

WQ Instruments Used: Salinity II-A-030304 DO II-A-011202

Comments

Test Set Up By AWD, JES, AKN Data Verified By Qualified Date Verified Sept 13/04

EVS ENVIRONMENT CONSULTANTS
7-d *Atherinops affinis* SURVIVAL AND GROWTH TOXICITY TEST – DRY WEIGHT DATA

Client Azimuth (Polaris)
EVS Project No. 09-0302-54
EVS Work Order No. 0400339

Start Date (Day 0) July 30/04
Sample ID G-Creek - Acute - 270704
Balance Type/Serial Number Sartorius BP211D

Sample ID % v/v	Rep.	Pan No.	Pan Weight (mg) [1]	Final Weight (mg) (pan + biomass) [1]	Number of Survivors	Number Weighed	Comments (e.g., confirmation weights, organisms lost in transfer)	Tech. Init.
Neg. CTL	A	A 1	1239.31	1244.31	5	5		JBA JWS/AD
	B	A 2	1249.28	1254.89	5	5		
	C	A 3	1245.80	1250.56	5	5		
	D	A 4	1249.65	1254.46	5	5		
	E	A 5	1272.31	1276.64	5	5		
Brine CTL	A	A 6	1247.06	1252.91	5	5		
	B	A 7	1253.79	1257.85	5	5	confirmed 1257.82 ✓	
	C	A 8	1281.77	1286.98	5	5		
	D	A 9	1251.58	1255.98	5	5		
	E	A 10	1259.93	1265.08	5	5		
4.3	A	A 11	1257.42	1261.19	4	4		
	B	A 12	1236.86	~~1242.25~~	5	5	confirmed 1242.19 ✓	
	C	A 13	1239.81	1244.13	5	5		
	D	A 14	1242.95	1246.92	5	5		
	E	A 15	1235.71	1239.91	5	5		

1. Re-confirm weights for 10% of final weights and record under "Comments"; relative percent difference (RPD) between pairs of weights should be ≤10% of organism weight.

Data Verified By Ralph

Date Verified Sept. 13/04

EVS ENVIRONMENT CONSULTANTS

7-d *Atherinops affinis* SURVIVAL AND GROWTH TOXICITY TEST – DRY WEIGHT DATA

Client Azimuth (Polaris)
EVS Project No. 09-0302-54
EVS Work Order No. 0400339

Start Date (Day 0) July 30, 2004
Sample ID G-Creek - Acute - 270704
Balance Type/Serial Number Sartorius BP 211D

Sample ID % %N	Rep.	Pan No.	Pan Weight (mg) [1]	Final Weight (mg) (pan + biomass) [1]	Number of Survivors	Number Weighed	Comments (e.g., confirmation weights, organisms lost in transfer)	Tech. Init.
8.6	A	A16	1227.02	1232.51	5	5		
	B	A17	1239.24	1243.57	5	5		
	C	A18	1229.02	1233.44	4	4		
	D	A19	1233.84	1237.47	5	5		
	E	A20	1228.86	1232.75	5	5	confirmed 1232.80 ✓	
17.3	A	A21	1231.20	1234.75	5	5		
	B	A22	1233.22	1237.19	5	5		
	C	A23	1222.38	1227.10	5	5		
	D	A24	1222.20	1225.18	5	5		
	E	A25	1226.00	1230.36	5	5		
34.5	A	A26	1225.11	1229.67	5	5		
	B	A27	1233.99	1238.36	5	5		
	C	A28	1237.10	1241.69	5	5	confirmed 1241.64 ✓	
	D	A29	1222.42	1226.65	5	5		
	E	A30	1233.63	1238.25	5	5		

1. Re-confirm weights for 10% of final weights and record under "Comments"; relative percent difference (RPD) between pairs of weights should be ≤10% of organism weight.

Data Verified By Ralph K

Date Verified Sept. 13/04

EVS ENVIRONMENT CONSULTANTS

7-d *Atherinops affinis* SURVIVAL AND GROWTH TOXICITY TEST – DRY WEIGHT DATA

Client: Azimuth (Polaris)
EVS Project No.: 09-0302-54
EVS Work Order No.: 0400339

Start Date (Day 0): July 30/04
Sample ID: G-Creek - Acute - 270704
Balance Type/Serial Number: Sartorius BP211D

Sample ID	Rep.	Pan No.	Pan Weight (mg) [1]	Final Weight (mg) (pan + biomass) [1]	Number of Survivors	Number Weighed	Comments (e.g., confirmation weights, organisms lost in transfer)	Tech. Init.
69	A	A31	1239.64	1242.07	4	4		~~JJ~~
	B	A32	1237.11	1241.20	5	5		
	C	A33	1231.11	1234.89	5	5		
	D	A34	1239.84	1243.88	5	5		
	E	A35	1233.50	1238.50	5	5	confirmed 1238.46 ✓	

1. Re-confirm weights for 10% of final weights and record under "Comments"; relative percent difference (RPD) between pairs of weights should be ≤10% of organism weight.

Data Verified By: [signature]
Date Verified: Sept. 13/04

EVS ENVIRONMENT CONSULTANTS
7-d *Atherinops affinis* TOXICITY TEST – DAILY SURVIVAL DATA

Client: Azimuth (Polaris Mine)
EVS Project No.: 09-0302-54
EVS Work Order No.: 0400339

Sample ID: G-Creek - Grab - 270704
Test Species/Batch: A. affinis
Test Initiation Date/Time: July 30 / 15:00 2004
No. of Organisms/Volume: 5 / 200 ml

Concentration % v/v	Rep.	Pan No.	Number of Survivors – Day of Test							Comments
			1	2	3	4	5	6	7	
Neg. CTL	A		5	5	5	5	5	5	5	
	B		5	5	5	5	5	5	5	
	C		5	5	5	5	5	5	5	
	D		5	5	5	5	5	5	5	
	E		5	5	5	5	5	5	5	
B-CTL	A		5	5	5	5	5	5	5	
	B		5	5	5	5	5	5	5	
	C		5	5	5	5	5	5	5	
	D		5	5	5	5	5	5	5	
	E		5	5	5	5	5	5	5	
4.3	A		5	5	5	5	5	5	4	
	B		5	5	5	5	5	5	5	
	C		5	5	5	5	5	5	5	
	D		5	5	5	5	5	5	5	
	E		5	5	5	5	5	5	5	
8.6	A		5	5	5	5	5	5	5	
	B		5	5	5	5	5	5	5	
	C		5	5	5	5	5	5	4	
	D		5	5	5	5	5	5	5	
	E		5	5	5	5	5	5	5	
Technician Initials										

Sample Description: clear, colorless
Data Verified By: [signature]
Date Verified: Sept. 15/04

EVS ENVIRONMENT CONSULTANTS
7-d *Atherinops affinis* TOXICITY TEST – DAILY SURVIVAL DATA

Client: Azimuth (Polaris Mine)
EVS Project No.: 09-0302-54
EVS Work Order No.: 0400339

Sample ID: G-Creek - Acute - 270704
Test Species/Batch: A. affinis / July 29, 04
Test Initiation Date/Time: July 30 / 15:00
No. of Organisms/Volume: 5/200ml

Concentration %	Rep.	Pan No.	Number of Survivors – Day of Test							Comments
			1	2	3	4	5	6	7	
17.3	A		5	5	5	5	5	5	5	
	B		5	5	5	5	5	5	5	
	C		5	5	5	5	5	5	5	
	D		5	5	5	5	5	5	5	
	E		5	5	5	5	5	5	5	
34.5	A		5	5	5	5	5	5	5	
	B		5	5	5	5	5	5	5	
	C		5	5	5	5	5	5	5	
	D		5	5	5	5	5	5	5	
	E		5	5	5	5	5	5	5	
69	A		5	5	5	5	4	4	4	
	B		5	5	5	5	5	5	5	
	C		5	5	5	5	5	5	5	
	D		5	5	5	5	5	5	5	
	E		5	5	5	5	5	5	5	
	A									
	B									
	C									
	D									
	E									
Technician Initials										

Sample Description: clear colorless
Data Verified By: Qualified
Date Verified: Sept 15/04

Test: LF-Larval Fish Growth and Survival Test | Test ID: 0400339
Species: AA-Atherinops affinis | Protocol: EPAW 95-EPA West Coast
Sample ID: G-Creek-sublethal-270704 | Sample Type: EFF2-Industrial
Start Date: 7/30/2004 End Date: 8/6/2004 | Lab ID: BCEVS-EVS Environment Consultants

Pos	ID	Rep	Group	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	No. Fish Weighed	Total Wgt(mg)	Tare Wgt(mg)
	1	1	Neg Control	5							5	5	1244.31	1239.31
	2	2	Neg Control	5							5	5	1254.89	1249.28
	3	3	Neg Control	5							5	5	1250.56	1245.8
	4	4	Neg Control	5							5	5	1254.46	1249.65
	5	5	Neg Control	5							5	5	1276.64	1272.31
	6	1	Brine Control	5							5	5	1252.91	1247.06
	7	2	Brine Control	5							5	5	1257.85	1253.79
	8	3	Brine Control	5							5	5	1286.98	1281.77
	9	4	Brine Control	5							5	5	1255.98	1251.58
	10	5	Brine Control	5							5	5	1265.08	1259.93
	11	1	4.300	5							4	4	1261.19	1257.42
	12	2	4.300	5							5	5	1242.25	1236.86
	13	3	4.300	5							5	5	1245.13	1239.81
	14	4	4.300	5							5	5	1246.92	1242.85
	15	5	4.300	5							5	5	1239.91	1235.71
	16	1	8.600	5							5	5	1232.51	1227.02
	17	2	8.600	5							5	5	1243.57	1239.24
	18	3	8.600	5							4	4	1233.44	1229.02
	19	4	8.600	5							5	5	1237.47	1233.84
	20	5	8.600	5							5	5	1232.75	1228.86
	21	1	17.300	5							5	5	1234.75	1231.2
	22	2	17.300	5							5	5	1237.19	1233.22
	23	3	17.300	5							5	5	1227.1	1222.38
	24	4	17.300	5							5	5	1225.18	1222.2
	25	5	17.300	5							5	5	1230.36	1226
	26	1	34.500	5							5	5	1229.67	1225.11
	27	2	34.500	5							5	5	1238.36	1233.99
	28	3	34.500	5							5	5	1241.69	1237.1
	29	4	34.500	5							5	5	1226.65	1222.38
	30	5	34.500	5							5	5	1238.25	1233.63
	31	1	69.000	5							4	4	1242.07	1239.64
	32	2	69.000	5							5	5	1241.2	1237.11
	33	3	69.000	5							5	5	1234.89	1231.11
	34	4	69.000	5							5	5	1243.88	1239.84
	35	5	69.000	5							5	5	1238.5	1233.5

Comments: Azimuth(Polaris Mine)09-0302-54

Reviewed by: 8/17/04

Larval Fish Growth and Survival Test-7 Day Survival

Start Date:	7/30/2004	Test ID:	400339	Sample ID:	G-Creek-sublethal-270704
End Date:	8/6/2004	Lab ID:	BCEVS-EVS Environment Cc	Sample Type:	EFF2-Industrial
Sample Date:	7/27/2004	Protocol:	EPAW 95-EPA West Coast	Test Species:	AA-Atherinops affinis
Comments:	Azimuth(Polaris Mine)09-0302-54				

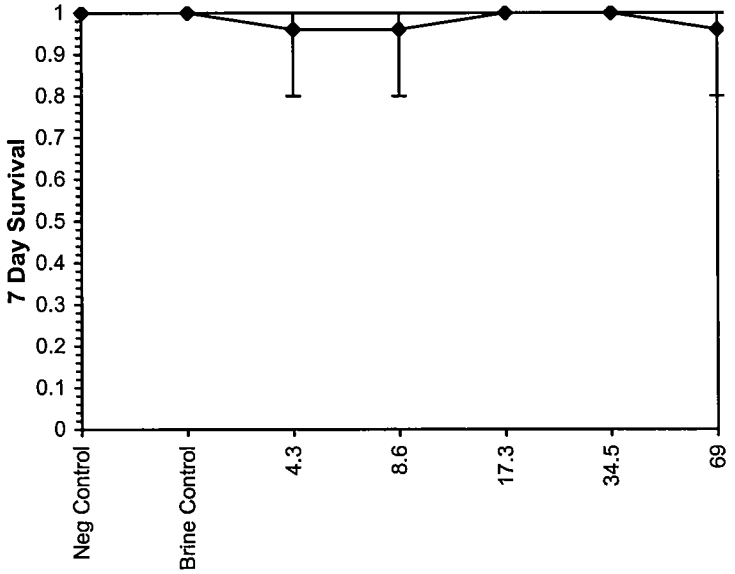
Conc-%	1	2	3	4	5
Neg Control	1.0000	1.0000	1.0000	1.0000	1.0000
Brine Control	1.0000	1.0000	1.0000	1.0000	1.0000
4.3	0.8000	1.0000	1.0000	1.0000	1.0000
8.6	1.0000	1.0000	0.8000	1.0000	1.0000
17.3	1.0000	1.0000	1.0000	1.0000	1.0000
34.5	1.0000	1.0000	1.0000	1.0000	1.0000
69	0.8000	1.0000	1.0000	1.0000	1.0000

			Transform: Arcsin Square Root					Rank	1-Tailed
Conc-%	Mean	SD	Mean	Min	Max	CV%	N	Sum	Critical
Neg Control	1.0000	0.0000	1.3453	1.3453	1.3453	0.000	5		
Brine Control	1.0000	0.0000	1.3453	1.3453	1.3453	0.000	5		
4.3	0.9600	0.0894	1.2977	1.1071	1.3453	8.207	5	25.00	16.00
8.6	0.9600	0.0894	1.2977	1.1071	1.3453	8.207	5	25.00	16.00
17.3	1.0000	0.0000	1.3453	1.3453	1.3453	0.000	5	27.50	16.00
34.5	1.0000	0.0000	1.3453	1.3453	1.3453	0.000	5	27.50	16.00
69	0.9600	0.0894	1.2977	1.1071	1.3453	8.207	5	25.00	16.00

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.59678	0.9	-2.2346	4.3922
Equality of variance cannot be confirmed				
The control means are not significantly different (p = 1.00)	0	2.30601		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Steel's Many-One Rank Test	69	>69		1.44928

Dose-Response Plot



Statistical comparisons were against the D-Control only

Reviewed by: Galfi 4
Sent · 15/04

Larval Fish Growth and Survival Test-7 Day Survival

Start Date:	7/30/2004	Test ID:	400339	Sample ID:	G-Creek-sublethal-270704
End Date:	8/6/2004	Lab ID:	BCEVS-EVS Environment Cc	Sample Type:	EFF2-Industrial
Sample Date:	7/27/2004	Protocol:	EPAW 95-EPA West Coast	Test Species:	AA-Atherinops affinis
Comments:	Azimuth(Polaris Mine)09-0302-54				

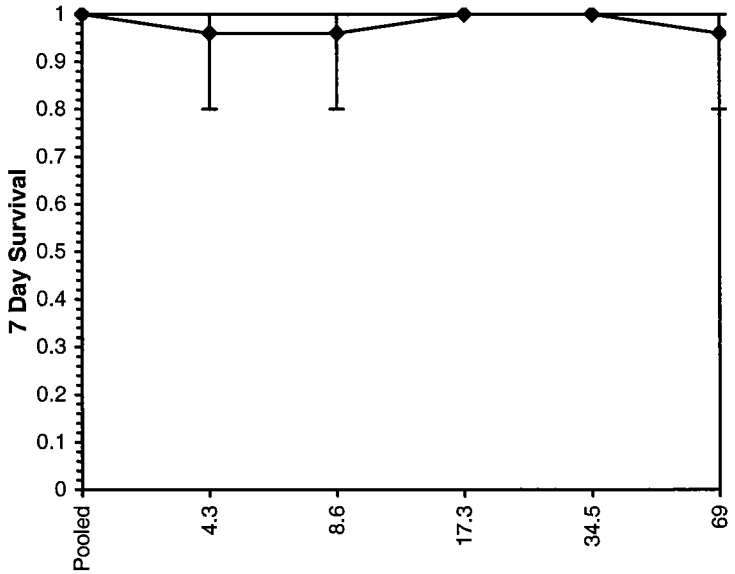
Conc-%	1	2	3	4	5
Neg Control	1.0000	1.0000	1.0000	1.0000	1.0000
Brine Control	1.0000	1.0000	1.0000	1.0000	1.0000
4.3	0.8000	1.0000	1.0000	1.0000	1.0000
8.6	1.0000	1.0000	0.8000	1.0000	1.0000
17.3	1.0000	1.0000	1.0000	1.0000	1.0000
34.5	1.0000	1.0000	1.0000	1.0000	1.0000
69	0.8000	1.0000	1.0000	1.0000	1.0000

			Transform: Arcsin Square Root					Rank	1-Tailed
Conc-%	Mean	SD	Mean	Min	Max	CV%	N	Sum	Critical
Pooled	1.0000	0.0000	1.3453	1.3453	1.3453	0.000	10		
4.3	0.9600	0.0894	1.2977	1.1071	1.3453	8.207	5	35.00	21.00
8.6	0.9600	0.0894	1.2977	1.1071	1.3453	8.207	5	35.00	21.00
17.3	1.0000	0.0000	1.3453	1.3453	1.3453	0.000	5	40.00	21.00
34.5	1.0000	0.0000	1.3453	1.3453	1.3453	0.000	5	40.00	21.00
69	0.9600	0.0894	1.2977	1.1071	1.3453	8.207	5	35.00	21.00

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.58129	0.91	-2.3952	5.50568
Equality of variance cannot be confirmed				
The control means are not significantly different (p = 1.00)	0	2.30601		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Wilcoxon Rank Sum Test	69	>69		1.44928

Dose-Response Plot



Statistical comparisons were against the Pooled control.

Reviewed by: Galfi
Sent. 16/04

Larval Fish Growth and Survival Test-7 Day Growth (US)

Start Date:	7/30/2004	Test ID:	400339	Sample ID:	G-Creek-sublethal-270704
End Date:	8/6/2004	Lab ID:	BCEVS-EVS Environment Cc	Sample Type:	EFF2-Industrial
Sample Date:	7/27/2004	Protocol:	EPAW 95-EPA West Coast	Test Species:	AA-Atherinops affinis
Comments:	Azimuth(Polaris Mine)09-0302-54				

Conc-%	1	2	3	4	5
Neg Control	1.0000	1.1220	0.9520	0.9620	0.8660
Brine Control	1.1700	0.8120	1.0420	0.8800	1.0300
4.3	0.7540	1.0780	1.0640	0.8140	0.8400
8.6	1.0980	0.8660	0.8840	0.7260	0.7780
17.3	0.7100	0.7940	0.9440	0.5960	0.8720
34.5	0.9120	0.8740	0.9180	0.8540	0.9240
69	0.4860	0.8180	0.7560	0.8080	1.0000

			Transform: Untransformed					1-Tailed			Isotonic	
Conc-%	Mean	SD	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Mean	N-Mean
Neg Control	0.9804	0.0931	0.9804	0.8660	1.1220	9.496	5				0.9804	1.0000
Brine Control	0.9868	0.1418	0.9868	0.8120	1.1700	14.370	5					
4.3	0.9100	0.1503	0.9100	0.7540	1.0780	16.519	5	0.840	2.360	0.1979	0.9100	0.9282
8.6	0.8704	0.1426	0.8704	0.7260	1.0980	16.389	5	1.312	2.360	0.1979	0.8704	0.8878
17.3	0.7832	0.1363	0.7832	0.5960	0.9440	17.397	5	2.352	2.360	0.1979	0.8398	0.8566
34.5	0.8964	0.0307	0.8964	0.8540	0.9240	3.425	5	1.002	2.360	0.1979	0.8398	0.8566
*69	0.7736	0.1854	0.7736	0.4860	1.0000	23.961	5	2.466	2.360	0.1979	0.7736	0.7891

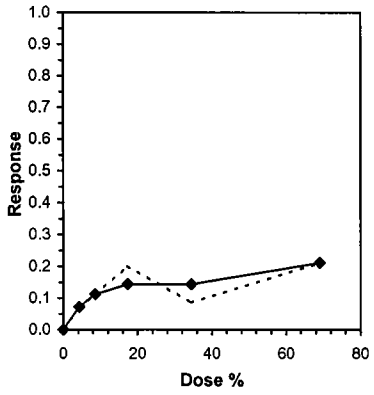
Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.97283	0.9	-0.0321	0.12793
Bartlett's Test indicates equal variances (p = 0.10)	9.1539	15.0863		
The control means are not significantly different (p = 0.93)	0.08436	2.30601		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	34.5	69	48.7904	2.89855	0.1979	0.20186	0.03131	0.01758	0.15497	5, 24

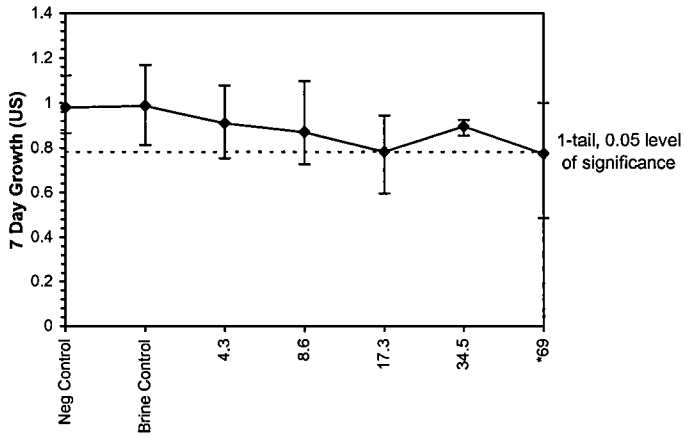
Linear Interpolation (200 Resamples)

Point	%	SD	95% CL(Exp)		Skew
IC05*	2.994	3.701	0.790	14.903	3.3103
IC10	7.301				
IC15	37.867				
IC20	63.413				
IC25	>69				
IC40	>69				
IC50	>69				

* indicates IC estimate less than the lowest concentration



Dose-Response Plot



Statistical comparisons were against the D-Control only

Reviewed by Sept. 15-'04

Larval Fish Growth and Survival Test-7 Day Growth (US)

Start Date:	7/30/2004	Test ID:	400339	Sample ID:	G-Creek-sublethal-270704
End Date:	8/6/2004	Lab ID:	BCEVS-EVS Environment Cc	Sample Type:	EFF2-Industrial
Sample Date:	7/27/2004	Protocol:	EPAW 95-EPA West Coast	Test Species:	AA-Atherinops affinis
Comments:	Azimuth(Polaris Mine)09-0302-54				

Conc-%	1	2	3	4	5
Neg Control	1.0000	1.1220	0.9520	0.9620	0.8660
Brine Control	1.1700	0.8120	1.0420	0.8800	1.0300
4.3	0.7540	1.0780	1.0640	0.8140	0.8400
8.6	1.0980	0.8660	0.8840	0.7260	0.7780
17.3	0.7100	0.7940	0.9440	0.5960	0.8720
34.5	0.9120	0.8740	0.9180	0.8540	0.9240
69	0.4860	0.8180	0.7560	0.8080	1.0000

			Transform: Untransformed					1-Tailed			Isotonic	
Conc-%	Mean	SD	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Mean	N-Mean
Pooled	0.9836	0.1131	0.9836	0.8120	1.1700	11.503	10				0.9836	1.0000
4.3	0.9100	0.1503	0.9100	0.7540	1.0780	16.519	5	1.021	2.462	0.1775	0.9100	0.9252
8.6	0.8704	0.1426	0.8704	0.7260	1.0980	16.389	5	1.570	2.462	0.1775	0.8704	0.8849
*17.3	0.7832	0.1363	0.7832	0.5960	0.9440	17.397	5	2.780	2.462	0.1775	0.8398	0.8538
34.5	0.8964	0.0307	0.8964	0.8540	0.9240	3.425	5	1.209	2.462	0.1775	0.8398	0.8538
*69	0.7736	0.1854	0.7736	0.4860	1.0000	23.961	5	2.913	2.462	0.1775	0.7736	0.7865

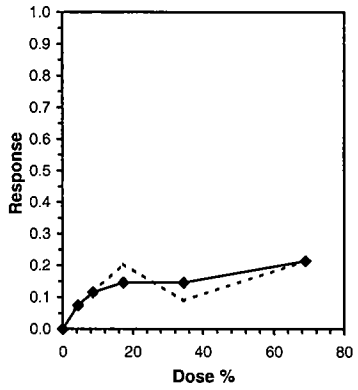
Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.97705	0.91	-0.0216	-0.1535
Bartlett's Test indicates equal variances (p = 0.11)	8.86442	15.0863		
The control means are not significantly different (p = 0.93)	0.08436	2.30601		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Bonferroni t Test	8.6	17.3	12.1975	11.6279	0.1775	0.18046	0.04318	0.01733	0.05389	5, 29

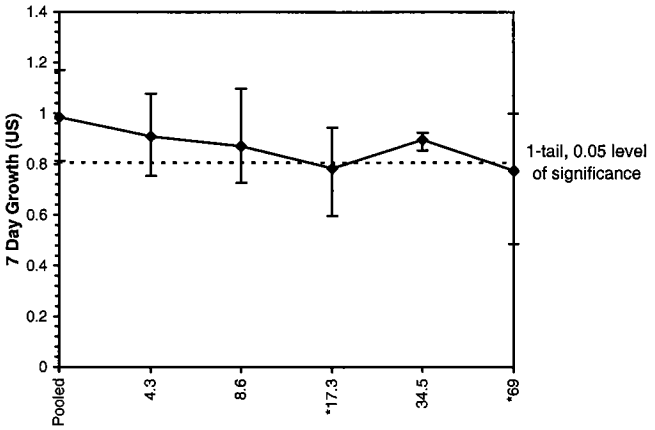
Linear Interpolation (200 Resamples)

Point	%	SD	95% CL(Exp)		Skew
IC05*	2.873	2.982	0.771	15.235	1.2072
IC10	6.989				
IC15	36.449				
IC20	62.079				
IC25	>69				
IC40	>69				
IC50	>69				

* indicates IC estimate less than the lowest concentration



Dose-Response Plot



Statistic comparisons were against the pooled control.

EVS ENVIRONMENT CONSULTANTS
7-d *Atherinops affinis* SURVIVAL AND GROWTH TEST DATA SUMMARY

Client Azimuth (Polaris) EVS Analysts JLS, AWD
EVS Project No. 09-0302-54
EVS Work Order No. 0400339 Test Initiation Date July 30, 2004

Sample	Initial Sample	Refresh Samples	
	Day 0	Day 2	Day 4
Identification	04-Cu-001		
Amount ~~Received~~	1 L		
Date ~~Collected~~ Prepared	March-15, 04		
Date Received			
Temperature (°C)			
pH			
DO (mg/L)			
Conductivity (µmhos/cm)			
Salinity (ppt)			
Ammonia (mg/L N)			
Chlorine (mg/L Cl)			
Other			

DILUTION/CONTROL WATER (initial water quality)
Water Type UV sterilized, filtered SW
Temperature (°C) 20.0
pH 8.1
Dissolved Oxygen (mg/L) 7.4
Salinity 28 ppt

TEST SPECIES INFORMATION
Source Aquatic Biosystems (ABS)
Date Received July 29, 2004
Age (on Day 0) 10-d
Reference Toxicant Cu
Current Reference Toxicant Result (incl. 95% CL)
Reference Toxicant Test Date July 30, 04
7-d survival LC50 130 (115-147) mg/L Cu
7-d growth IC50 ~~119 (89-138)~~ 124 (87-144) mg/L Cu
Reference Toxicant Warning Limits (mean ± 2SD) and CV
7-d survival LC50 129 ± 48 mg/L Cu. CV = 19%
7-d growth IC50 130 ± 52 mg/L Cu. CV = 20%

TEST CONDITIONS
Temperature Range (°C) 20.0 - 20.5
pH Range 7.8 - 8.1
Dissolved Oxygen Range (mg/L) 6.4 - 7.6
Salinity (ppt) 28
Photoperiod (L:D h) 16:8
Aeration Provided? NA
Other —

TEST RESULTS

Endpoint	Conc. Units	NOEC	LOEC	LC50 (95% CL)	IC50 (95% CL)	IC25 (95% CL)
Survival	mg/L Cu	100	180	130 (115-147)		
Growth		56	100		~~119 (89-138)~~ 124 (87-144)	~~82 (0.4-124)~~ 85 (~~127~~ 73.6-127)

Other

Data Verified By [signature] Date Verified Sept. 13/04

EVS ENVIRONMENT CONSULTANTS
7-d *Atherinops affinis* SURVIVAL AND GROWTH TEST – WATER QUALITY DATA

Client: Azimuth (Polaris) | Sample ID: Cu reftox

EVS Project No.: 09-0302-54 | Test Initiation Date/Time: July 30/04 / 1430 h

EVS Work Order No.: 0400339 | Source/Date Received: ABS / July 29, 2004

Concentration Cu mg/L	Temperature (°C)													
	0	old 1	new	2		3		4		5		6		7
Neg. CTL.	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5
32	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5
56	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5
100	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5
180	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5
320	20.0	20.5	20.0	20.5	20.0									
Tech. Initials	JW	~	~	~	~	~	~	~	~	~	~	~	~	~

Concentration Cu mg/L	pH													
	0	1		2		3		4		5		6		7
Neg. CTL	8.1	8.0	7.9	7.9	8.0	7.9	8.0	7.8	8.0	7.8	8.0	8.0	7.9	7.8
32	8.1	8.0	7.9	7.9	8.0	7.9	8.1	7.8	8.0	7.8	8.1	8.0	7.9	7.8
56	8.1	7.9	7.9	7.9	8.0	7.9	8.1	7.8	8.0	7.8	8.1	8.0	7.9	7.9
100	8.1	7.9	7.9	7.9	8.0	7.9	8.1	7.8	7.9	7.8	8.0	8.0	7.8	7.9
180	8.1	7.9	7.9	7.9	8.0	7.9	8.1	7.8	7.9	7.8	8.1	8.0	7.9	7.9
320	8.1	7.9	7.9	7.9	8.0									
Tech. Initials	JW	~	~	~	~	~	~	~	~	~	~	~	~	~

WQ Instruments Used: Temp. Calibrated Hg thermometer pH II-A-51

Comments

Test Set Up By: JW/AS Data Verified By: [signature] Date Verified: Sept. 10/04

EVS ENVIRONMENT CONSULTANTS
7-d *Atherinops affinis* SURVIVAL AND GROWTH TEST – WATER QUALITY DATA

Client Azimuth | Sample ID Cu · reftox

EVS Project No. 09-0302-54 | Test Initiation Date/Time July 30, 2004 / 1430 h

EVS Work Order No. 0400339 | Source/Date Received ABS / July 29, 04

Concentration Cu mg/L	Salinity (ppt)							
	0	1	2	3	4	5	6	7
Neg. CTL	28	28	28	28	28	28	28	28
32	28	28	28	28	28	28	28	28
56	28	28	28	28	28	28	28	28
100	28	28	28	28	28	28	28	28
180	28	28	28	28	28	28	28	28
320	28	28	28	—	—	—	—	—
Tech. Initials	JKS	~	~	~	~	~	~	

Concentration Cu mg/L	Dissolved Oxygen (mg/L)													
	0	1		2 new old		3		4		5		6		7
Neg. CTL	7.4	7.0	7.4	7.5	6.7	7.0	7.4	7.0	7.5	6.8	7.6	6.4	7.~~6~~	6.7
32	7.4	6.9	7.4	7.5	6.7	6.8	7.4	6.9	7.5	6.9	7.6	6.6	7.6	6.8
56	7.4	6.9	7.4	7.5	6.8	6.8	7.4	6.7	7.5	7.0	7.6	6.7	7.6	6.7
100	7.4	6.8	7.4	7.5	6.8	6.7	7.4	6.5	7.5	6.9	7.6	6.4	7.6	6.8
180	7.4	6.8	7.4	7.5	6.7	6.7	7.4	6.4	7.5	6.8	7.6	6.6	7.6	6.8
320	7.4	6.8	7.4	7.5	6.7	~~6.8~~	~~7.4~~	—	—	—	—	—	—	—
Tech. Initials	JKS	~	~	~	~	~	~	~	~	~	~	~	~	~

WQ Instruments Used: Salinity II-A030304 | DO II-A-011202

Comments

Test Set Up By JKS/AWD | Data Verified By Qualich | Date Verified Sept. 10/04

EVS ENVIRONMENT CONSULTANTS
7-d *Atherinops affinis* TOXICITY TEST – DAILY SURVIVAL DATA

Client: Azimuth (Polaris Mine)
EVS Project No.: 09-0302-54
EVS Work Order No.: 0400339

Sample ID: Cu (Reflox)
Test Species/Batch: A. affinis / July 29, 2004
Test Initiation Date/Time: July 30, 2004 / 1430 h
No. of Organisms/Volume: 5/200ml

Cu ug/L Concentration	Rep.	Pan No.	Number of Survivors – Day of Test							Comments
			1	2	3	4	5	6	7	
Neg. CTL	A	A 36	5	5	5	5	5	5	5	
	B	37	5	5	5	5	5	5	5	
	C	38	5	5	5	5	5	5	5	
	D	39	5	5	5	5	5	5	5	
	E	40	5	5	5	5	5	5	5	
32	A	41	5	5	5	5	5	5	5	
	B	42	5	5	5	5	5	5	5	
	C	43	5	5	5	4	4	4	4	
	D	44	5	5	5	5	5	5	M/5	
	E	45	5	5	5	5	5	5	5	
56	A	46	5	5	5	5	5	5	5	
	B	47	5	5	5	5	5	4	4	
	C	49	5	5	5	5	5	5	5	
	D	50	5	5	5	5	5	5	5	
	E	51	5	5	5	5	5	5	5	
100	A	52	4	3	3	3	3	3	3	
	B	53	4	4	4	4	4	4	4	
	C	54	5	5	5	5	5	5	5	
	D	55	5	5	5	5	5	5	5	
	E	56	5	5	5	4	4	4	4	
Technician Initials										

Sample Description: clear, colorless
Data Verified By: [signature]
Date Verified: Sept. 13/04

EVS ENVIRONMENT CONSULTANTS
7-d *Atherinops affinis* TOXICITY TEST – DAILY SURVIVAL DATA

Client Azimuth (Polaris Mine)
EVS Project No. 09-0302-54
EVS Work Order No. 0400339

Sample ID Cu reflux
Test Species/Batch A. affinis / July 29, 2004
Test Initiation Date/Time July 30, 04/1430 h
No. of Organisms/Volume 5/200ml

Cu µg/L Concentration	Rep.	Pan No.	Number of Survivors – Day of Test							Comments
			1	2	3	4	5	6	7	
180	A	~~A5~~	2	1	0	—	—	—	—	
	B	—	2	2	1	1	0	—	—	
	C	A58	4	4	2	2	2	2	2	
	D	A59	2	1	1	1	1	1	1	
	E	—	2	2	2	1	0	—	—	
320	A	—	1	0	—	—	—	—	—	
	B	—	0	—	—	—	—	—	—	
	C	—	0	—	—	—	—	—	—	
	D	—	0	—	—	—	—	—	—	
	E	—	0	—	—	—	—	—	—	
	A									
	B									
	C									
	D									
	E									
	A									
	B									
	C									
	D									
	E									
Technician Initials										

Sample Description
Data Verified By Ralph H Date Verified Sept 13/04

EVS ENVIRONMENT CONSULTANTS
7-d *Atherinops affinis* SURVIVAL AND GROWTH TOXICITY TEST – DRY WEIGHT DATA

Client: Azimuth (Polaris)
EVS Project No.: 09-0302-54
EVS Work Order No.: 0400339

Start Date (Day 0): July 30, 2004
Sample ID: Cu - reftox
Balance Type/Serial Number: Sartorius BP211D

Sample ID (Cu µg/L)	Rep.	Pan No.	Pan Weight (mg) [1]	Final Weight (mg) (pan + biomass) [1]	Number of Survivors	Number Weighed	Comments (e.g., confirmation weights, organisms lost in transfer)	Tech. Init.
Neg. CTL	A	A36	1225.46	1231.37	5	5		JDS/AD
	B	A37	1223.00	1227.74	5	5		
	C	A38	1227.28	1232.01	5	5		
	D	A39	1225.60	1232.35	5	5		
	E	A40	1231.361	1238.39	5	5	confirmed 1238.42 ✓	
32	A	A41	1223.15	1228.32	5	5		
	B	A42	1232.24	1238.17	5	5		
	C	A43	1228.15 (1228.29 TKD)	1232.39	4	4		
	D	A44	1228.67	1233.67	5	5		
	E	A45	1223.92	1228.14	5	5	Confirmed 1228.16 ✓	
56	A	A46	1224.29	1229.51	5	5		
	B	A47	1219.34	1223.14	4	4		
	C	A48	1223.19	12			RD	
	~~C~~ D	~~A49~~ A51	1224.29	1229.03	5	5		"
	~~ED~~	~~A50~~	1228.49	1234.94	5	5		"

1. Re-confirm weights for 10% of final weights and record under "Comments"; relative percent difference (RPD) between pairs of weights should be ≤10% of organism weight.

Data Verified By: [signature]
Date Verified: Sept. 13/04

Forms\Lab\Datasheets\Larvalfish\Topsmelt\7D-DRYWEIGHT.DOC August 26, 2002

concentration	Pan #	pan wt	Final pan wt	# Survival	# Weighed
56 µg/L E	A51	1228.55	1233.48	5	5

EVS ENVIRONMENT CONSULTANTS

7-d *Atherinops affinis* SURVIVAL AND GROWTH TOXICITY TEST – DRY WEIGHT DATA

Client: Azimuth
EVS Project No.: 09-0302-54
EVS Work Order No.: 0400339
Start Date (Day 0): July 30-04
Sample ID: Cu Effluent
Balance Type/Serial Number: Sartorius BP 211D

Sample ID Cu µg/L	Rep.	Pan No.	Pan Weight (mg) [1]	Final Weight (mg) (pan + biomass) [1]	Number of Survivors	Number Weighed	Comments (e.g., confirmation weights, organisms lost in transfer)	Tech. Init.
100	A	A52	1229.80	1231.98	3	3		JAS µ
	B	A53	1230.92	1234.72	4	4		
	C	A54	1226.04	1230.33	5	5		
	D	A55	1228.91	1234.05	5	5	confirmed 1234.07 ✓	
	E	A56	1226.61	1231.21	4	4		
180	C	~~A58~~ A63 ^	~~1230.23~~ 1214.44 ^	1215.67	2	2		
	D	~~A59~~ A64 ^	~~1225.91~~ 1229.90 ^	1230.26	1	1		✓

1. Re-confirm weights for 10% of final weights and record under "Comments"; relative percent difference (RPD) between pairs of weights should be ≤10% of organism weight.

Data Verified By: [signature]
Date Verified: Sept - 13/04

Test: LF-Larval Fish Growth and Survival Test | Test ID: RTAACu37
Species: AA-Atherinops affinis | Protocol: EPAW 95-EPA West Coast
Sample ID: REF-Ref Toxicant | Sample Type: CU-Copper
Start Date: 7/30/2004 End Date: 8/6/2004 | Lab ID: BCEVS-EVS Environment Consultants

Pos	ID	Rep	Group	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	No. Fish Weighed	Total Wgt(mg)	Tare Wgt(mg)
	1	1	D-Control	5							5	5	1231.37	1225.46
	2	2	D-Control	5							5	5	1227.74	1223
	3	3	D-Control	5							5	5	1232.01	1227.28
	4	4	D-Control	5							5	5	1232.35	1225.6
	5	5	D-Control	5							5	5	1238.39	1231.61
	6	1	32.000	5							5	5	1228.32	1223.15
	7	2	32.000	5							5	5	1238.17	1232.24
	8	3	32.000	5							4	4	1232.39	1228.15
	9	4	32.000	5							5	5	1233.67	1228.67
	10	5	32.000	5							5	5	1228.14	1223.92
	11	1	56.000	5							5	5	1229.51	1224.29
	12	2	56.000	5							4	4	1223.14	1219.34
	13	3	56.000	5							5	5	1229.03	1224.29
	14	4	56.000	5							5	5	1234.94	1228.49
	15	5	56.000	5							5	5	1233.48	1228.55
	16	1	100.000	5							3	3	1231.98	1229.8
	17	2	100.000	5							4	4	1234.72	1230.92
	18	3	100.000	5							5	5	1230.33	1226.04
	19	4	100.000	5							5	5	1234.05	1228.91
	20	5	100.000	5							4	4	1231.21	1226.61
	21	1	180.000	5							0	0	0	0
	22	2	180.000	5							0	0	0	0
	23	3	180.000	5							2	2	1215.67	1214.44
	24	4	180.000	5							1	1	1230.26	1229.9
	25	5	180.000	5							0	0	0	0
	26	1	320.000	5							0	0	0	0
	27	2	320.000	5							0	0	0	0
	28	3	320.000	5							0	0	0	0
	29	4	320.000	5							0	0	0	0
	30	5	320.000	5							0	0	0	0

Comments: 09-0302-54, 0400339

Reviewed by: 8/12/04

Larval Fish Growth and Survival Test-7 Day Survival

Start Date:	7/30/2004	Test ID:	RTAACu37	Sample ID:	REF-Ref Toxicant
End Date:	8/6/2004	Lab ID:	BCEVS-EVS Environment Cc	Sample Type:	CU-Copper
Sample Date:		Protocol:	EPAW 95-EPA West Coast	Test Species:	AA-Atherinops affinis
Comments:	09-0302-54, 0400339				

Conc-ug/L	1	2	3	4	5
D-Control	1.0000	1.0000	1.0000	1.0000	1.0000
32	1.0000	1.0000	0.8000	1.0000	1.0000
56	1.0000	0.8000	1.0000	1.0000	1.0000
100	0.6000	0.8000	1.0000	1.0000	0.8000
180	0.0000	0.0000	0.4000	0.2000	0.0000
320	0.0000	0.0000	0.0000	0.0000	0.0000

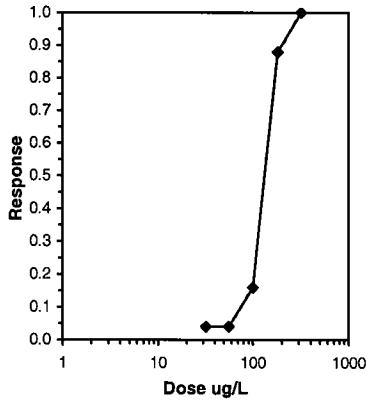
			Transform: Arcsin Square Root					Rank	1-Tailed	Number	Total
Conc-ug/L	Mean	SD	Mean	Min	Max	CV%	N	Sum	Critical	Resp	Number
D-Control	1.0000	0.0000	1.3453	1.3453	1.3453	0.000	5			0	25
32	0.9600	0.0894	1.2977	1.1071	1.3453	8.207	5	25.00	17.00	1	25
56	0.9600	0.0894	1.2977	1.1071	1.3453	8.207	5	25.00	17.00	1	25
100	0.8400	0.1673	1.1582	0.8861	1.3453	16.679	5	20.00	17.00	4	25
*180	0.1200	0.1789	0.3650	0.2255	0.6847	56.537	5	15.00	17.00	22	25
320	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	5			25	25

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.94287	0.888	0.10595	0.6692
Equality of variance cannot be confirmed				

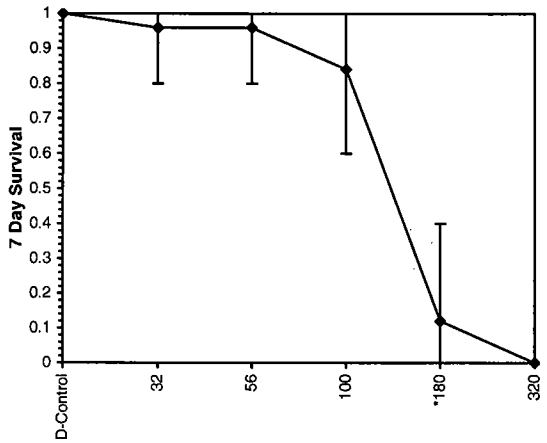
Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Steel's Many-One Rank Test	100	180	134.164	

Trimmed Spearman-Karber

Trim Level	EC50	95% CL		
0.0%				
5.0%	129.88	114.75	146.99	
10.0%	130.93	116.99	146.54	
20.0%	131.99	121.77	143.08	
Auto-4.0%	129.69	114.60	146.77	ug/L Cu



Dose-Response Plot



Reviewed by: Galfit
Sept. 13/04

Larval Fish Growth and Survival Test-7 Day Growth (US)

Start Date:	7/30/2004	Test ID:	RTAACu37	Sample ID:	REF-Ref Toxicant
End Date:	8/6/2004	Lab ID:	BCEVS-EVS Environment C	Sample Type:	CU-Copper
Sample Date:		Protocol:	EPAW 95-EPA West Coast	Test Species:	AA-Atherinops affinis
Comments:	09-0302-54, 0400339				

Conc-ug/L	1	2	3	4	5
D-Control	1.1820	0.9480	0.9460	1.3500	1.3560
32	1.0340	1.1860	0.8480	1.0000	0.8440
56	1.0440	0.7600	0.9480	1.2900	0.9860
100	0.4360	0.7600	0.8580	1.0280	0.9200
180	0.0000	0.0000	0.2460	0.0720	0.0000
320	0.0000	0.0000	0.0000	0.0000	0.0000

			Transform: Untransformed					1-Tailed			Isotonic	
Conc-ug/L	Mean	SD	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Mean	N-Mean
D-Control	1.1564	0.2035	1.1564	0.9460	1.3560	17.599	5				1.1564	1.0000
32	0.9824	0.1429	0.9824	0.8440	1.1860	14.543	5	1.534	2.300	0.2608	0.9940	0.8596
56	1.0056	0.1913	1.0056	0.7600	1.2900	19.023	5	1.330	2.300	0.2608	0.9940	0.8596
*100	0.8004	0.2257	0.8004	0.4360	1.0280	28.204	5	3.139	2.300	0.2608	0.8004	0.6921
*180	0.0636	0.1066	0.0636	0.0000	0.2460	167.649	5	9.636	2.300	0.2608	0.0636	0.0550
320	0.0000	0.0000	0.0000	0.0000	0.0000	0.000	5				0.0000	0.0000

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.97311	0.888	-0.2174	-0.3474
Bartlett's Test indicates equal variances (p = 0.67)	2.36564	13.2767		

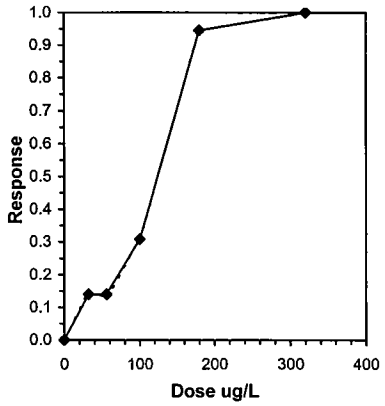
Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	56	100	74.8331		0.26083	0.22555	0.93104	0.03215	4.6E-08	4, 20

Linear Interpolation (200 Resamples)

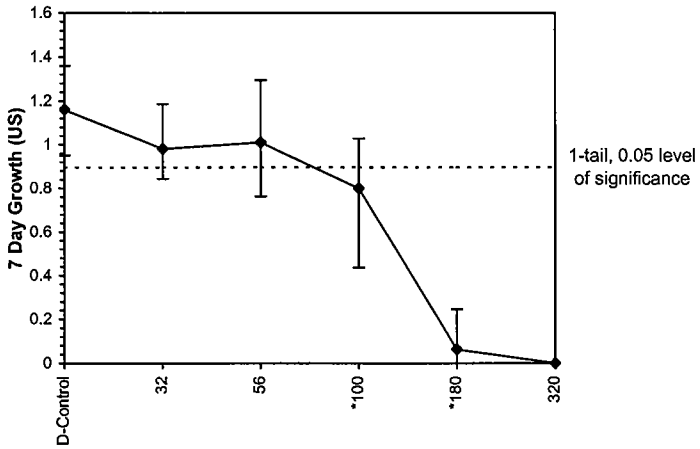
Point	ug/L	SD	95% CL(Exp)		Skew
IC05*	11.39	19.61	3.51	97.01	1.6113
IC10*	22.79	23.89	7.01	129.04	1.0634
IC15	58.51	26.81	0.00	126.48	0.4512
IC20	71.65	25.04	0.99	127.04	-0.1836
IC25	84.80	21.56	3.62	127.36	-0.5667
IC40	111.57	11.06	71.01	135.64	-0.6491
IC50	124.13	9.44	86.97	143.83	-0.7596

ug/L Cu

* indicates IC estimate less than the lowest concentration



Dose-Response Plot



Reviewed by Gail H 4 Sept. 13/04

APPENDIX B

Raw Data and Statistical Analyses:

Dendraster excentricus

EVS ENVIRONMENT CONSULTANTS
ECHINOID FERTILIZATION TOXICITY TEST DATA SUMMARY

Client: Azimuth Consulting Group
EVS Project No.: 09-0302-54
EVS Work Order No.: 0400340

EVS Analysts: KES ART
Test Initiation Date: 30 July 2004

SAMPLE

Identification: G-Creek Sublethal-270704
Amount Received: 5 x 20L
Date Collected: 27 July 2004
Date Received: 30 July 2004
Temperature (°C): 16.0 ① → 15.0
pH: 7.7 ① → 8.1
Dissolved Oxygen (mg/L): 9.6 ① → 8.5
Conductivity (µmhos/cm): 4940
Salinity (ppt): 2.6 ① → 28
Ammonia (mg/L N): –
Chlorine (mg/L Cl): –
Other: –

① Brine adjustment

TEST SPECIES

Organism: Dendraster excentricus
Source: Westwind Sealab Supplies
Date Received: 30 July 2004
Reference Toxicant: SDS
Current Reference Toxicant Result
Reference Toxicant Test Date: 30 July 2004
IC50 (and 95% CL): ~~2.2~~ 2.1 (1.9-2.4) mg/L SDS
Reference Toxicant Warning Limits (mean ± 2SD) and CV
4.2 ± 4.8 mg/L SDS, CV% = 57

DILUTION/CONTROL WATER (initial water quality)

Water Type: UV Steralized, 0.45µm filtered SW
Temperature (°C): 16.0
pH: 8.0
Dissolved Oxygen (mg/L): 8.2
Salinity (ppt): 28
Other: –

TEST CONDITIONS

Temperature Range (°C): 15.0 – 16.0
pH Range: 8.0 – 8.1
Dissolved Oxygen Range (mg/L): 8.2 – 8.5
Salinity Range (ppt): 28
Sperm:Egg Ratio: 1600:1
Test Duration: 10:10
Other: –

TEST RESULTS

IC 50: 37.3 (24.4 – 46.0) % v/v
IC 25: 8.7 (7.6 – 9.9) % v/v
NOEC: 4.6 % v/v
LOEC: 9.1 % v/v

Data Verified By: [signature]
Date Verified: Sept. 10/04

EVS ENVIRONMENT CONSULTANTS
ECHINOID FERTILIZATION TOXICITY TEST INITIAL WATER QUALITY

Client ~~09-0302-54~~ #kf AZIMUTH CONSULTING GROUP Test Initiation Date/Time 30 JULY 2004

EVS Project No. 09-0302-54 Test Species Dendraster excentricus

EVS Work Order No. 0400340 Source/Date Received #kf 30 JULY 2004 / Westwind Sealab Supplies

Logbook #13 Pages 50 – 53 Test Duration 10:10

Sample ID	Conc/Rep %. v/v	Temperature (°C)	pH	Salinity (ppt)	Dissolved Oxygen (mg/L)	Comments
CONTROL		16.0	8.0	28	8.2	
BRINE CONTROL		15.0	8.1	28	8.4	
G. CREEK #kf	4.6	15.5	8.0	28	8.2	
↓	9.1	15.5	8.0	28	8.3	
	18.3	15.0	8.0	28	8.3	
	36.6	15.0	8.1	28	8.4	
	73.1	15.0	8.1	28	8.5	
Tech. Init.	kf	kf	kf	kf	kf	

WQ Instruments Used: Temp. Calibrated Hg thermometer pH II-A-51 Salinity II-A-030303 DO II-A-011202

Data Verified By Qualified Date Verified Sept. 8, 2004

EVS ENVIRONMENT CONSULTANTS
ECHINOID FERTILIZATION TOXICITY TEST – EGG COUNT (SAMPLES)

Client: AZIMUTH CONSULTING GROUP
EVS Project No.: 09-0302-54
EVS Work Order No.: 0400340
Logbook: Echinoid #13 Pages: 50-53

Test Initiation Date/Time: 30 JULY 2004 @ 16:20
Test Species: Dendraster excentricus
Source/Date Received: Westwind Sealab Supplies/30 July 2004
Test Duration: 10:10
Sperm:Egg Ratio: 1600:1

Sample ID % (v/v)	Replicate	Number of Fertilized Eggs	Number of Unfertilized Eggs	Comments	Tech. Initials
CONTROL	A	59	41		KEF
	B	62	38		
	C	56	44		
	D	65	35		
4.6	A	60	40		KEF
	B	66	34		
	C	56	44		
	D	58	42		
9.1	A	46	54		KEF
	B	42	58		
	C	45	55		
	D	42	58		
18.3	A	39	61		KEF
	B	36	64		
	C	37	63		
	D	36	64		
36.6	A	31	69		KEF
	B	34	66		
	C	25	75		
	D	31	69		
73.1	A	19	81		KEF
	B	20	80		
	C	21	79		
	D	20	80		

Data Verified By: [signature]
Date Verified: 2/11-8/04

EVS ENVIRONMENT CONSULTANTS
ECHINOID FERTILIZATION TOXICITY TEST – EGG COUNT (SAMPLES)

Client: AZIMUTH CONSULTING GROUP
EVS Project No.: 09-0302-54
EVS Work Order No.: 0400340
Logbook: Echinoid #13 Pages: 50-53

Test Initiation Date/Time: 30 JULY 2004 @ 16:20
Test Species: Dendraster excentricus
Source/Date Received: Westwind Sealab Supplies / 30 July 2004
Test Duration: 10:10
Sperm:Egg Ratio: 1600:1

Sample ID	Replicate	Number of Fertilized Eggs	Number of Unfertilized Eggs	Comments	Tech. Initials
BRINE CONTROL	A	60	40		KG
	B	57	43		↓
	C	59	41		
	D	62	38		↓
	A				
	B				
	C				
	D				
	A				
	B				
	C				
	D				
	A				
	B				
	C				
	D				
	A				
	B				
	C				
	D				
	A				
	B				
	C				
	D				

Data Verified By: [signature]
Date Verified: Sept. 8/04

Test: SC-Sperm Cell Fertilization test						Test ID: 0400340	
Species: DE-Dendraster excentricus						Protocol: EPS1/RM/27-EC 92 (Sperm Cell)	
Sample ID: G CREEK 270704E						Sample Type: EFF2-Industrial	
Start Date: 7/30/2004 16:20 (10:16)				End Date: 7/30/2004		Lab ID: BCEVS-EVS Environment Consultants	
Pos	ID	Rep	Group	Total Counted	Number Fertilized	Number Unfertilized	Notes
	1	1	D-Control	100	59	41	
	2	2	D-Control	100	62	38	
	3	3	D-Control	101	56	44	
	4	4	D-Control	100	65	35	
	5	1	B-Control	100	60	40	
	6	2	B-Control	100	57	43	
	7	3	B-Control	100	59	41	
	8	4	B-Control	100	62	38	
	9	1	4.6	100	60	40	
	10	2	4.6	100	66	34	
	11	3	4.6	100	56	44	
	12	4	4.6	100	58	42	
	13	1	9.1	100	46	54	
	14	2	9.1	100	42	58	
	15	3	9.1	100	45	55	
	16	4	9.1	100	42	58	
	17	1	18.3	100	39	61	
	18	2	18.3	100	36	64	
	19	3	18.3	100	37	63	
	20	4	18.3	100	36	64	
	21	1	36.6	100	31	69	
	22	2	36.6	100	34	66	
	23	3	36.6	100	25	75	
	24	4	36.6	100	31	69	
	25	1	73.1	100	19	81	
	26	2	73.1	100	20	80	
	27	3	73.1	100	21	79	
	28	4	73.1	100	20	80	

Comments: Azimuth Consulting Group (Polaris), 09-0302-54 (0400340)

Reviewed by: Qual 8/10/04

Sperm Cell Fertilization test-Proportion Fertilized

Start Date:	7/30/2004 10:10	Test ID:	400340	Sample ID:	G CREEK 270704E
End Date:	7/30/2004	Lab ID:	BCEVS-EVS Environment C	Sample Type:	EFF2-Industrial
Sample Date:	7/27/2004	Protocol:	EPS1/RM/27-EC 92 (Sperm	Test Species:	DE-Dendraster excentricus

Comments: Azimuth Consulting Group (Polaris), 09-0302-54 (0400340)

Conc-%	1	2	3	4
D-Control	0.5900	0.6200	0.5545	0.6500
B-Control	0.6000	0.5700	0.5900	0.6200
4.6	0.6000	0.6600	0.5600	0.5800
9.1	0.4600	0.4200	0.4500	0.4200
18.3	0.3900	0.3600	0.3700	0.3600
36.6	0.3100	0.3400	0.2500	0.3100
73.1	0.1900	0.2000	0.2100	0.2000

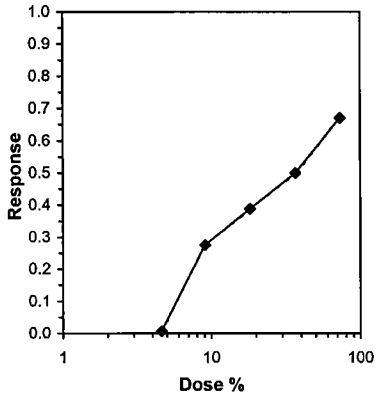
			Transform: Untransformed					1-Tailed			Isotonic	
Conc-%	Mean	SD	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Mean	N-Mean
D-Control	0.6036	0.0409	0.6036	0.5545	0.6500	6.778	4				0.6035	1.0000
B-Control	0.5950	0.0208	0.5950	0.5700	0.6200	3.499	4					
4.6	0.6000	0.0432	0.6000	0.5600	0.6600	7.201	4	0.166	2.410	0.0523	0.6000	0.9942
*9.1	0.4375	0.0206	0.4375	0.4200	0.4600	4.712	4	7.650	2.410	0.0523	0.4375	0.7249
*18.3	0.3700	0.0141	0.3700	0.3600	0.3900	3.822	4	10.759	2.410	0.0523	0.3700	0.6131
*36.6	0.3025	0.0377	0.3025	0.2500	0.3400	12.479	4	13.868	2.410	0.0523	0.3025	0.5013
*73.1	0.2000	0.0082	0.2000	0.1900	0.2100	4.082	4	18.589	2.410	0.0523	0.2000	0.3314

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.97262	0.884	0.10504	0.3504
Bartlett's Test indicates equal variances (p = 0.12)	8.83506	15.0863		
The control means are not significantly different (p = 0.72)	0.37528	2.44691		

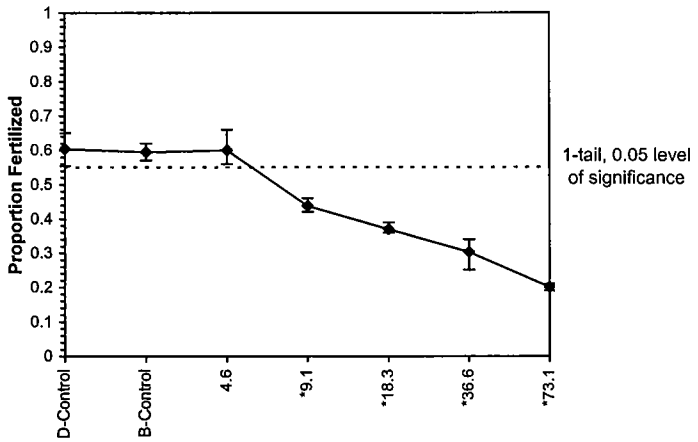
Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	4.6	9.1	6.46993	21.7391	0.05233	0.08669	0.1049	0.00094	6.9E-13	5, 18

Log-Linear Interpolation (200 Resamples)

Point	%	SD	95% CL(Exp)		Skew
IC05	5.169	1.017	0.000	5.397	-2.0092
IC10	5.883	0.366	4.155	6.252	-1.2685
IC15	6.680	0.367	5.002	7.221	-0.7933
IC20	7.569	0.396	5.813	8.353	-0.2936
IC25	8.561	0.492	6.881	9.883	0.8154
IC40	19.868	2.019	13.185	25.832	0.4117
IC50	36.788	4.538	22.468	46.940	-0.2718



Dose-Response Plot



Statistical comparisons were against the D-control

Reviewed by [signature] 10/04

Sperm Cell Fertilization test-Proportion Fertilized

Start Date:	7/30/2004 10:10	Test ID:	400340	Sample ID:	G CREEK 270704E
End Date:	7/30/2004	Lab ID:	BCEVS-EVS Environment Cc	Sample Type:	EFF2-Industrial
Sample Date:	7/27/2004	Protocol:	EPS1/RM/27-EC 92 (Sperm (	Test Species:	DE-Dendraster excentricus
Comments:	Azimuth Consulting Group (Polaris), 09-0302-54 (0400340)				

Conc-%	1	2	3	4
D-Control	0.5900	0.6200	0.5545	0.6500
B-Control	0.6000	0.5700	0.5900	0.6200
4.6	0.6000	0.6600	0.5600	0.5800
9.1	0.4600	0.4200	0.4500	0.4200
18.3	0.3900	0.3600	0.3700	0.3600
36.6	0.3100	0.3400	0.2500	0.3100
73.1	0.1900	0.2000	0.2100	0.2000

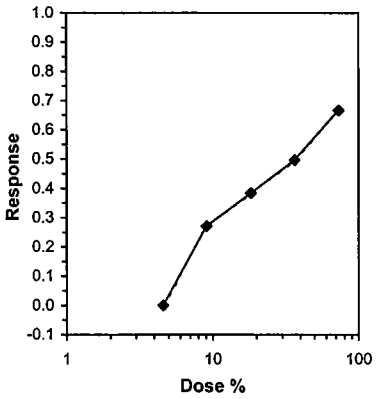
			Transform: Untransformed					1-Tailed			Isotonic	
Conc-%	Mean	SD	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Mean	N-Mean
Pooled	0.5993	0.0304	0.5993	0.5545	0.6500	5.073	8				0.5996	1.0000
4.6	0.6000	0.0432	0.6000	0.5600	0.6600	7.201	4	-0.039	2.508	0.0444	0.5996	1.0000
*9.1	0.4375	0.0206	0.4375	0.4200	0.4600	4.712	4	9.132	2.508	0.0444	0.4375	0.7296
*18.3	0.3700	0.0141	0.3700	0.3600	0.3900	3.822	4	12.941	2.508	0.0444	0.3700	0.6171
*36.6	0.3025	0.0377	0.3025	0.2500	0.3400	12.479	4	16.750	2.508	0.0444	0.3025	0.5045
*73.1	0.2000	0.0082	0.2000	0.1900	0.2100	4.082	4	22.535	2.508	0.0444	0.2000	0.3335

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.97514	0.896	0.207	0.38283
Bartlett's Test indicates equal variances (p = 0.14)	8.25726	15.0863		
The control means are not significantly different (p = 0.72)	0.37528	2.44691		

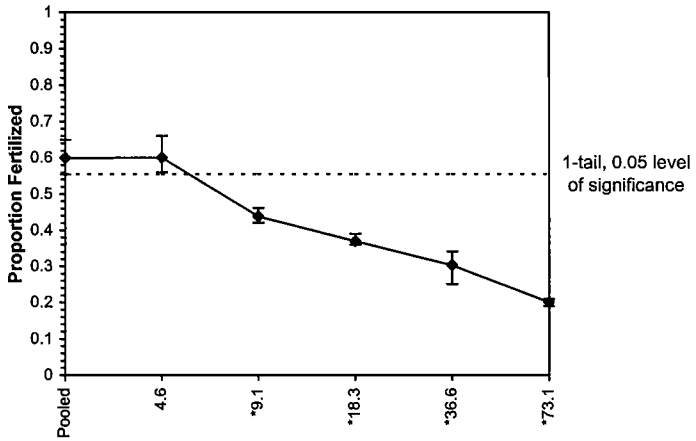
Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Bonferroni t Test	4.6	9.1	6.46993	21.7391	0.04445	0.07416	0.12612	0.00084	3.0E-16	5, 22

Log-Linear Interpolation (200 Resamples)

Point	%	SD	95% CL(Exp)		Skew	
IC05	5.245	0.437	3.010	5.322	-4.5891	
IC10	5.965	0.211	4.856	6.144	-1.3490	
IC15	6.768	0.218	5.712	7.144	-0.5439	
IC20	7.663	0.265	6.670	8.281	0.2881	
IC25	8.661	0.385	7.566	9.896	1.1053	
IC40	20.352	1.691	14.803	25.784	0.6254	
IC50	37.275	3.916	24.371	46.032	-0.2591	%v/v



Dose-Response Plot



Statistical comparisons were against the pooled controls

EVS ENVIRONMENT CONSULTANTS
ECHINOID FERTILIZATION TOXICITY TEST DATA SUMMARY

Client: Azimuth Consulting Group
EVS Project No.: 09-0302-54
EVS Work Order No.: 0400340

EVS Analysts: KES, ART
Test Initiation Date: 30 July 2004

SAMPLE

Identification: SDS RefTox Stock Sol^n #04-5-005
Amount ~~Received~~ Prep'd: 1 x 1L
Date ~~Collected~~ Prep'd: 26 April 2004
Date Received: n/a
Temperature (°C):
pH:
Dissolved Oxygen (mg/L):
Conductivity (µmhos/cm):
Salinity (ppt):
Ammonia (mg/L N):
Chlorine (mg/L Cl):
Other:

TEST SPECIES

Organism: Dendraster excentricus
Source: Westcoast Sealab Supplies
Date Received: 30 July 2004
Reference Toxicant: SDS
Current Reference Toxicant Result
Reference Toxicant Test Date: 30 July 2004
IC50 (and 95% CL): 2.1 (1.9-2.4) mg/L SDS
Reference Toxicant Warning Limits (mean ± 2SD) and CV
4.2 ± 4.8 mg/L SDS, CV% = 57

DILUTION/CONTROL WATER (initial water quality)

Water Type: UV Steralized, 0.45µm filtered SW
Temperature (°C): 16.0
pH: 8.0
Dissolved Oxygen (mg/L): 8.2
Salinity (ppt): 28
Other: —

TEST CONDITIONS

Temperature Range (°C): 16.0
pH Range: 8.0
Dissolved Oxygen Range (mg/L): 8.2
Salinity Range (ppt): 28
Sperm:Egg Ratio: 1600:1
Test Duration: 10:10
Other: —

TEST RESULTS

IC 50: ~~1/2~~ 2.1 (1.9-2.4) mg/L SDS
IC 25: ~~1/4~~ 1.3 (0.9-1.5) mg/L SDS
NOEC: <1 mg/L SDS
LOEC: 1 mg/L SDS

Data Verified By: [signature]
Date Verified: Sept-10/04

EVS ENVIRONMENT CONSULTANTS
ECHINOID FERTILIZATION TOXICITY TEST INITIAL WATER QUALITY

Client: AZIMUTH CONSULTING GROUP
EVS Project No.: 09-0302-54
EVS Work Order No.: 0400340
Logbook: ECHINOID #13 Pages: 50-53

Test Initiation Date/Time: 30 JULY 2004 @16:20
Test Species: Dendraster excentricus
Source/Date Received: 30 JULY
Test Duration: 10:10

Sample ID	Conc/Rep mg/L	Temperature (°C)	pH	Salinity (ppt)	Dissolved Oxygen (mg/L)	Comments
SDS	CONTROL	16.0	8.0	28	8.2	
	1.0	16.0	8.0	28	~~8.4~~ 8.2	
	1.8	16.0	8.0	28	8.2	
	3.2	16.0	8.0	28	8.2	
	5.6	16.0	8.0	28	8.2	
↓	10.0	16.0	8.0	28	8.2	
Tech. Init.	KEJ	KEJ	KEJ	KEJ	KEJ	

WQ Instruments Used: Temp. Calibrated Hg thermometer pH II-A-51 Salinity II-A-03-03 DO II-A-011202

Data Verified By: [signature] Date Verified: Sept 8/04

EVS ENVIRONMENT CONSULTANTS
ECHINOID FERTILIZATION TOXICITY TEST – EGG COUNTS (CONTROLS)

Client: AZIMUTH CONSULTING GROUP
EVS Project No.: 09 0302-54
EVS Work Order No.: 0400340
Logbook: ECHINOID #13 Pages: 50 – 53

Test Initiation Date/Time: 30 JULY 2004 @ 16:20
Test Species: Dendraster excentricus
Test Duration: 10:10
Sperm:Egg Ratio: ~~1:1600~~ KEF 1600:1

Concentration SDS mg/L	Replicate	No. Fertilized Eggs	No. Unfertilized Eggs	Comments	Tech. Initials
Reference Toxicant					
1.0	A	47	53		KEF
	B	55	45		↓
	C	50	50		↓
	D	48	52		↓
1.8	A	33	67		KEF
	B	36	64		↓
	C	39	61		↓
	D	35	65		↓
3.2	A	14	86		KEF
	B	11	89		↓
	C	~~KEF 15~~ 15	85		↓
	D	18	82		↓
5.6	A	5	~~KEF 95~~ 95		KEF
	B	8	92		↓
	C	7	93		↓
	D	5	~~482~~ 95		↓
10.0	A	2	98		KEF
	B	3	97		↓
	C	2	98		↓
	D	2	98		↓
Control Seawater					
	A	59	41		KEF
	B	62	38		↓
	C	56	44		↓
	D	65	35		↓

Data Verified By: [signature]
Date Verified: Sept. 10/04

Test: SC-Sperm Cell Fertilization test						Test ID: rtscsds8	
Species: DE-Dendraster excentricus						Protocol: EPS1/RM/27-EC 92 (Sperm Cell)	
Sample ID: REF-Ref Toxicant						Sample Type: SDS-Sodium dodecyl sulfate	
Start Date: 7/30/2003 10:10			End Date: 7/30/2003			Lab ID: BCEVS-EVS Environment Consultants	
Pos	ID	Rep	Group	Total Counted	Number Fertilized	Number Unfertilized	Notes
	1	1	D-Control	100	59	41	
	2	2	D-Control	100	62	38	
	3	3	D-Control	100	56	44	
	4	4	D-Control	100	65	35	
	5	1	1.0	100	47	53	
	6	2	1.0	100	55	45	
	7	3	1.0	100	50	50	
	8	4	1.0	100	48	52	
	9	1	1.8	100	33	67	
	10	2	1.8	100	36	64	
	11	3	1.8	100	39	61	
	12	4	1.8	100	35	65	
	13	1	3.2	100	14	86	
	14	2	3.2	100	11	89	
	15	3	3.2	100	15	85	
	16	4	3.2	100	18	82	
	17	1	5.6	100	5	95	
	18	2	5.6	100	8	92	
	19	3	5.6	100	7	93	
	20	4	5.6	100	5	95	
	21	1	10.0	100	2	98	
	22	2	10.0	100	3	97	
	23	3	10.0	100	2	98	
	24	4	10.0	100	2	98	

Comments: Azimuth Consulting Group 09-0302-54 (0400340)

Reviewed by: Qualified

Sperm Cell Fertilization test-Proportion Fertilized

Start Date:	7/30/2003 10:10	Test ID:	rtscsds8	Sample ID:	REF-Ref Toxicant
End Date:	7/30/2003	Lab ID:	BCEVS-EVS Environment C	Sample Type:	SDS-Sodium dodecyl sulfate
Sample Date:		Protocol:	EPS1/RM/27-EC 92 (Sperm	Test Species:	DE-Dendraster excentricus
Comments:	Azimuth Consulting Group 09-0302-54 (0400340)				

Conc-mg/L	1	2	3	4
D-Control	0.5900	0.6200	0.5600	0.6500
1	0.4700	0.5500	0.5000	0.4800
1.8	0.3300	0.3600	0.3900	0.3500
3.2	0.1400	0.1100	0.1300	0.1800
5.6	0.0500	0.0800	0.0700	0.0500
10	0.0200	0.0300	0.0200	0.0200

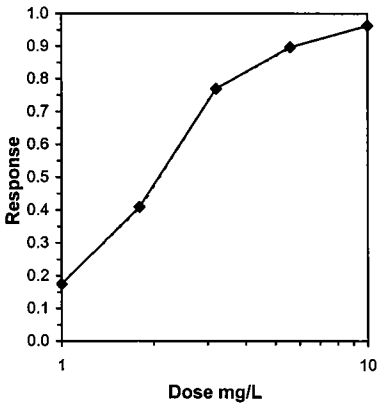
			Transform: Untransformed						1-Tailed		Isotonic	
Conc-mg/L	Mean	SD	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Mean	N-Mean
D-Control	0.6050	0.0387	0.6050	0.5600	0.6500	6.402	4				0.6050	1.0000
*1	0.5000	0.0356	0.5000	0.4700	0.5500	7.118	4	5.417	2.410	0.0467	0.5000	0.8264
*1.8	0.3575	0.0250	0.3575	0.3300	0.3900	6.993	4	12.769	2.410	0.0467	0.3575	0.5909
*3.2	0.1400	0.0294	0.1400	0.1100	0.1800	21.028	4	23.990	2.410	0.0467	0.1400	0.2314
*5.6	0.0625	0.0150	0.0625	0.0500	0.0800	24.000	4	27.989	2.410	0.0467	0.0625	0.1033
*10	0.0225	0.0050	0.0225	0.0200	0.0300	22.222	4	30.052	2.410	0.0467	0.0225	0.0372

Auxiliary Tests					Statistic		Critical		Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)					0.95924		0.884		0.47024	-0.048
Bartlett's Test indicates equal variances (p = 0.10)					9.12722		15.0863			
Hypothesis Test (1-tail, 0.05)	**NOEC**	**LOEC**	**ChV**	**TU**	**MSDu**	**MSDp**	**MSB**	**MSE**	**F-Prob**	**df**
Dunnett's Test	<1	1			0.04671	0.07721	0.23459	0.00075	7.9E-17	5, 18

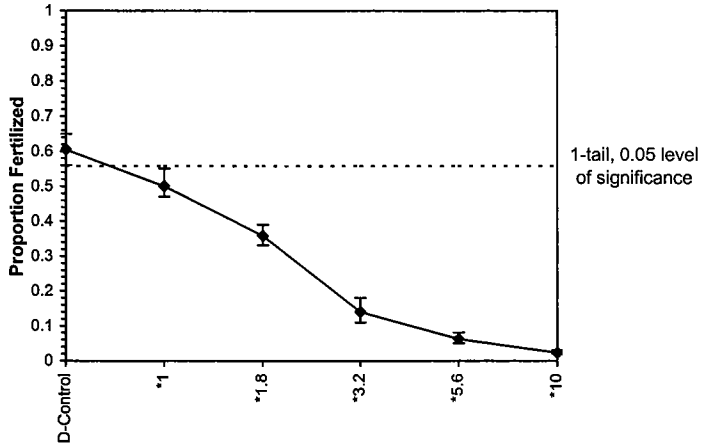
Log-Linear Interpolation (200 Resamples)

Point	mg/L	SD	95% CL(Exp)		Skew
IC05*	0.2210	0.0598	0.1215	0.4427	1.9998
IC10*	0.4909	0.1376	0.2541	1.0631	1.4199
IC15*	0.8204	0.1664	0.3977	1.2636	0.1322
IC20	1.0770	0.1112	0.6393	1.3408	-0.5478
IC25	1.2308	0.0881	0.9462	1.4744	0.0167
IC40	1.7639	0.0892	1.4812	2.0222	0.0823
IC50	2.1023	0.0768	1.8738	2.3581	0.1963 mg/L SDS

* indicates IC estimate less than the lowest concentration



Dose-Response Plot



Reviewed by: Sent. 15/06

APPENDIX C

Chain-of-Custody Form

Please see instructions for completion on back. Shaded areas to be completed by EVS Laboratory upon sample receipt.

EVS environment consultants
North Vancouver, BC
Canada V7P 2R4
Tel: 604-986-4331
Fax: 604-662-8548
www.evsenvironment.com

Client Name: Teck Cominco (Polaris) Client Contact Name: Cheryl. MacKintosh Ship to: _____

Address: Azimuth Consulting Group Phone: 604 730 1220

218-2902 West Broadway Fax: 604 739 8511

Vancouver B.C. Sampled By: Karlette Tinaley Attn: _____ Shipping Date: _____

Topsoil

Collection Date (dd/mmm/yy)	Time (24-h clock)	Sample Identification	1 Type of Each Sample	Material Safety Data Sheet Attached? (✓)	Sample Collection Method G = grab; C = composite	Number of Sample Containers x Volume of Sample Container (i.e., 1 x 20 L)	2 Sample Container Type by Code	Test(s) Requested					3 Notes? (e.g. preserved, saltwater, freshwater, may contain sewage)
For composite sample record date & time starting and ending								Fed Topsoil					
27/07/04	9:30AM	G-Creek_Sublethal_270704	E			2x20L	HDPE						POLARIS Proj
		G-Creek_Acute_270704	E			3x20L	HDPE						POLARIS Proj

PO/Reference No.:

Project Title:

Results Needed By:

Comments/Instructions:

A) Released By: Date:
Company: Time:
Courier name: _____
Shipping containers secured by: Tape Straps Lock Other _____ (circle one)
Custody seals used? Yes No

B) Received by: Ano Date: July 30-04
Company: EVS Time: 1200
Shipping containers received secure? Yes No
Custody seals intact? Yes No N/A

C) Released By: Date:
Company: Time:
Courier name: _____
Shipping containers secured by: Tape Straps Lock Other _____ (circle one)
Custody seals used? Yes No

D) Received by: Date:
Company: Time:
Shipping containers received secure? Yes No
Custody seals intact? Yes No N/A

1 Receiving Water (RW); Effluent (E); Elutriate (ELU); Sediment (SED); Chemical (CHEM); Stormwater (SW); Other (Please Specify)
2 Collapsible Carboy (CC); Glass Jar (GJ); Jerry Can (JC); Plastic HDPE (P); Plastic Bucket (PB); Other (Please Specify) HDPE Plastic
3 Please note any conditions the lab should be aware of for safety and storage concerns
4 Acceptable (A); Unacceptable (U). Please note specifics (e.g., broken, leaking, lid not on) under Comments/Instructions

Revision Date: Sept. 25, 2000

Distribution of copies:
White, yellow, pink - accompany the shipment
Orange - retained by consignor (e.g., shipper)
Yellow - retained by consignee (e.g., receiver)
Pink - for use as needed
White - returned to consignor by consignee

Photocopy of original because 3 coolers.

-54

Please see instructions for completion on back. Shaded areas to be completed by EVS Laboratory upon sample receipt.

EVS environment consultants
North Vancouver, BC
Canada V7P 2R4
Tel: 604-986-4331
Fax: 604-662-8548
www.evsenvironment.com

Client Name: Teck Cominco (Polaris) Client Contact Name: Cheryl. MacKintosh Ship to: _____

Address: ~~Azimuth Consulting Group~~ Phone: 604 730 7220

218-2902 West Broadway Fax: 604 739 8511

Vancouver B.C. Sampled By: Karlette Tinsley Attn: _____

Shipping Date: _____ Kathyrn

Collection Date (dd/mmm/yy)	Time (24-h clock)	Sample Identification	1 Type of Each Sample	Material Safety Data Sheet Attached? (✓)	Sample Collection Method G = grab; C = composite	Number of Sample Containers x Volume of Sample Container (i.e., 1 x 20 L)	2 Sample Container Type by Code	Test(s) Requested						3 Notes? (e.g. preserved, saltwater, freshwater, may contain sewage)
For composite sample record date & time starting and ending														
27/07/04	9:30PM	G-Creek_Sublethal_270704	E			2x20L	HDPE							POLARIS PROJ
		G-Creek_Acute_270704	E			3x20L	HDPE							POLARIS PROJ

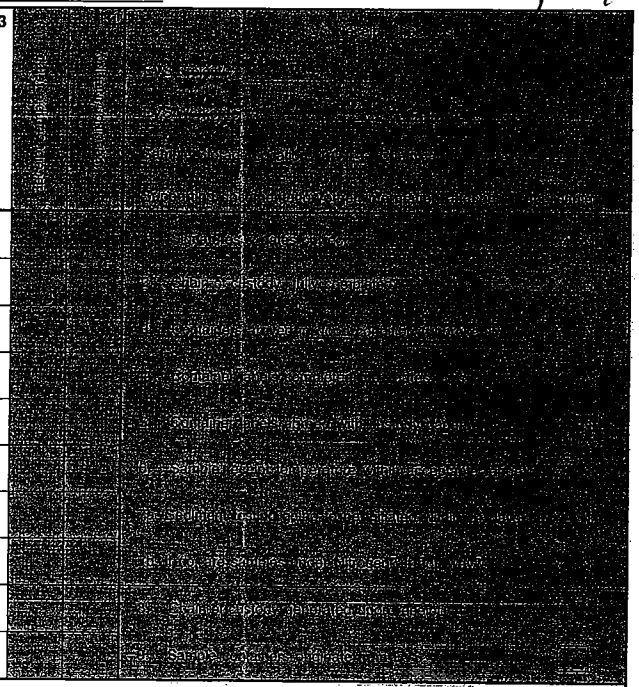


Photo copy of orginal because 3 coolers

PO/Reference No.:

Project Title:

Results Needed By:

Comments/Instructions:

A) Released By: Date:
Company: Time:
Courier name: _____
Shipping containers secured by: Tape Straps Lock Other _____ (circle one)
Custody seals used? Yes No

B) Received by: AWD Date: 30 JULY 2004
Company: EVS Time: 12:00
Shipping containers received secure? (Yes) No
Custody seals intact? (Yes) No ~~N/A~~

C) Released By: Date:
Company: Time:
Courier name: _____
Shipping containers secured by: Tape Straps Lock Other _____ (circle one)
Custody seals used? Yes No

D) Received by: Date:
Company: Time:
Shipping containers received secure? Yes No
Custody seals intact? Yes No N/A

1 Receiving Water (RW); Effluent (E); Elutriate (ELU); Sediment (SED); Chemical (CHEM); Stormwater (SW); Other (Please Specify)
2 Collapsible Carboy (CC); Glass Jar (GJ); Jerry Can (JC); Plastic HDPE (P); Plastic Bucket (PB); Other (Please Specify) HDPE Plastic
3 Please note any conditions the lab should be aware of for safety and storage concerns
4 Acceptable (A); Unacceptable (U). Please note specifics (e.g., broken, leaking, lid not on) under Comments/Instructions

Revision Date: Sept. 25, 2000

Distribution of copies:
White, yellow, pink - accompany the shipment
Orange - retained by consignor (e.g., shipper)
Yellow - retained by consignee (e.g., receiver)
Pink - for use as needed
White - returned to consignor by consignee

October 2004

LABORATORY REPORT

Azimuth Consulting Group

POLARIS MINE

ENVIRONMENTAL EFFECTS MONITORING PROGRAM

August 24, 2004

PREPARED FOR:

Azimuth Consulting Group
Vancouver, BC

PREPARED BY:

EVS environment consultants
A Member of the Golder Group of Companies
North Vancouver, BC

AZIMUTH CONSULTING GROUP

POLARIS MINE ENVIRONMENTAL EFFECTS MONITORING PROGRAM

August 24, 2004

LABORATORY REPORT

Prepared for

Azimuth Consulting Group
218-2902 W. Broadway
Vancouver, BC
V6K 2G8

Prepared by

EVS Environment Consultants - A Member of the Golder Group of Companies
195 Pemberton Avenue
North Vancouver, BC
Canada V7P 2R4

EVS Project No.

09-0302-54

October 2004

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ACKNOWLEDGEMENTS

The *A. affinis* toxicity test was conducted by Andy Diewald, Anja Fouche and Jenny Shao. Kathryn Sentance and Ann-Marie Norris performed the *D. excentricus* fertilization toxicity test. Statistical analyses were performed by Jenny Shao and Kathryn Sentance. The report was written by Kathryn Sentance and reviewed by Edmund Canaria. Quality Assurance/Quality Control (QA/QC) review was conducted by Julianna Kalokai.

1. INTRODUCTION

EVS Environment Consultants conducted sublethal Metal Mining Effluent Regulations (MMER) toxicity testing for Azimuth Consulting Group as part of the Environmental Effects Monitoring (EEM) program for Polaris Mine.

A sample, identified as G Creek-082404, was collected from the Polaris Mine Site on August 24, 2004 in 20-L collapsible polyethylene containers. It was received at the EVS laboratory on August 27, 2004 and was stored in the dark at 4°C prior to test initiation. The sample was evaluated for toxicity using the 7-d topsmelt (*Atherinops affinis*) survival and growth toxicity test and the echinoderm (*Dendraster excentricus*) fertilization toxicity test. Toxicity testing was initiated on the day of initial sample receipt.

This report describes the methods and results of the 7-d topsmelt (*Atherinops affinis*) toxicity test and the echinoderm (*Dendraster excentricus*) fertilization toxicity test. The raw data and statistical analyses are provided in Appendix A and B respectively, and the chain-of-custody form is provided in Appendix C.