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**Pulsed Exposure Toxicity Testing:
Method Development and Initial Evaluation
for Stormwater Compliance**

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ADMINISTRATIVE INFORMATION

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EXECUTIVE SUMMARY

This report describes a preliminary research effort to modify whole effluent toxicity (WET) testing protocols designed for continuous flow discharges for application to episodic and/or ephemeral discharges such as those associated with storm water runoff. The effort was undertaken in response to a Naval Base San Diego industrial stormwater National Pollutant Discharge Elimination System (NPDES) permit (R9-2013-0064) condition that allows the Navy to assess and propose alternative testing parameters. This report's research (at the time it was conducted) was done for Naval Base San Diego by environmental toxicologists at the Navy's Space and Naval Warfare Systems Center Pacific (SSC Pacific).

The technical approach taken was to modify the WET testing method to simulate a range of exposure conditions found at the end-of-pipe. The test conditions matrix included: acute and chronic endpoints with commonly used test organisms; copper, zinc, and a combination of the two toxicants at various concentrations found to cause toxicity under standard WET testing; and short-term exposure conditions representing the 50th, 75th, and 95th percentile historical rainfall durations observed in San Diego over the past 55 years. The initial testing culminated in its application to multiple stormwater samples collected from Naval Base San Diego outfalls during a single rain event in March 2016. All testing was conducted concurrently with standard test method durations for comparison.

Chronic toxicity tests with purple sea urchin (*Strongylocentrotus purpuratus*) embryos and acute toxicity tests with the mysid shrimp (*Americamysis bahia*) were performed using standard Environmental Protection Agency (EPA) 96-hr continuous exposures alongside pulsed exposures of 3, 6 and 12-hr toxicant exposures, followed by transfer to uncontaminated seawater for the remainder of the 96 hr. Copper, zinc and a combination of the two were tested at concentrations ranging from 5.8 to 3,200 µg/L and 20 to 20,880 µg/L for copper and zinc, respectively. Copper and zinc were selected as these are commonly elevated constituents and often the cause of toxicity in stormwater at San Diego Naval Bases (Katz et al. 2006) and other Non-Navy stormwater discharges (Kayhanian et al. 2008). Additionally, stormwater samples collected from Naval Base San Diego were tested in a similar manner using the standard and modified EPA methods.

Toxicity tests with single and mixed metals, and stormwater samples, resulted in progressively lower toxicity with reduced contact time to the sample when compared to standard static 96-hr exposures. The effect was more pronounced for zinc than copper for both test species. Median effective concentrations (EC50) ranged from a factor of 2 to 186 higher (less toxic) under the pulsed conditions relative to the standard 96-hr exposure. Stormwater samples collected from NBSD consisted of a wide range of copper and zinc concentrations. As with the copper and zinc tests, the stormwater results also showed a consistent progressively lower toxicity with reduced contact time to the sample.

The results of this study showed that modifying standard WET test methods is a feasible approach to accurately access short-term exposure conditions. The tests, which were conducted over a range of realistic conditions for both a chronic and acute endpoint presented consistent results lending confidence in their application. All the tests displayed a significant progressive reduction in toxicity with decreasing exposure time. The toxicity determined with standard 96-hr static tests overestimated that of short-term exposures over a wide range (<1 to 2 orders of magnitude) depending on the exposure duration, toxicant, and endpoint evaluated. The implication is that exposure duration is as critical a testing condition as the exposure concentration when evaluating toxicity. Although the test procedures focused on exposure conditions likely to occur at the end-of-pipe, those conditions are

still conservative in comparison to actual exposures that occur once the stormwater is discharged to, and mixes with, receiving waters. Though these initial results are highly promising, additional testing and evaluation is required prior to implementation of a pulse-based methodology for compliance testing.

ACRONYMS

BMP	Best Management Practices
CETIS	Comprehensive Environmental Toxicity Information System
Cu	Copper
DO	Dissolved Oxygen
EC ₅₀	Median Effective Concentration
ELAP	Environmental Laboratory Accreditation Program
EMA	EnviroMatrix Analytical, Inc.
FSW	Filtered Seawater
HDPE	High Density Polyethylene
HSB	Hypersaline brine
ICP-AES	Inductively Coupled Plasma Atomic Emission Spectroscopy
ICP-MS	Inductively Coupled Plasma Mass Spectrometry
LC ₅₀	Median Lethal Concentration
LCL	Lower Confidence Limit
NBSD	Naval Base San Diego
ND	Non-Detect
NIWC Pacific	Naval Information Warfare Center Pacific
NPDES	National Pollutant Discharge Elimination System
SPAWAR	Space and Naval Warfare
SSC Pacific	SPAWAR Systems Center Pacific
TST	Test for Significant Toxicity
TU	Toxic Unit
UCL	Upper Confidence Limit
USEPA	Environmental Protection Agency
Weck	Weck Laboratories
WET	Whole Effluent Toxicity
Zn	Zinc

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CONTENTS

EXECUTIVE SUMMARY	v
ACRONYMS.....	viii
1. INTRODUCTION.....	1
1.1 BACKGROUND.....	1
1.2 TECHNICAL APPROACH	2
2. MATERIALS AND METHODS.....	3
2.1 SELECTION OF PULSED EXPOSURE DURATIONS	3
2.2 SELECTION OF TEST ORGANISMS.....	5
2.3 TEST MATERIAL	5
2.3.1 Selection of Stock Solutions.....	5
2.3.2 Stormwater Sample Collection	8
2.4 CHRONIC TOXICITY TEST METHODS.....	9
2.5 ACUTE TOXICITY TEST METHODS	12
3. RESULTS	15
3.1 QA/QC.....	15
3.1.1 Single Metal Exposures	15
3.1.2 Mixed Metal Exposures.....	18
3.1.3 Stormwater Exposures.....	19
3.2 COPPER EXPOSURES	20
3.3 ZINC EXPOSURES.....	22
3.4 MIXED METALS EXPOSURES.....	23
3.5 STORMWATER EXPOSURES.....	26
4. DISCUSSION AND CONCLUSIONS.....	31
REFERENCES	33

APPENDICES

A: TEST DATA AND STATISTICAL SUMMARIES: SINGLE METAL EXPOSURES	A-1
B: TEST DATA AND STATISTICAL SUMMARIES: MIXED METAL EXPOSURES	B-1
C: TEST DATA AND STATISTICAL SUMMARIES: STORMWATER EXPOSURES	C-1
D: GLOSSARY OF QUALIFIER CODES.....	D-1

Figures

2-1. Cumulative frequency of rainfall duration over 24 hr periods when rain >0.1” was recorded between 1951 and 2006 (N= 2,284). The 50 th , 75 th and 95 th percentiles were used to derive the pulsed exposure regimes for this study.....	3
2-2. Example of rainfall and runoff during a storm event measured at NBSD Outfall 73 (parking area) showing runoff and rainfall durations are virtually the same.....	4
2-3. Pulsed exposure experimental design.	5
2-4. Test set up for sea urchin embryo exposures.	9
2-5. Generalized diagram comparing static 96-hr exposure and pulsed exposures during which test organisms were transferred from test solution (red) to uncontaminated seawater (blue) at designated time.....	10
3-1. Median effective concentrations (EC ₅₀ , labeled at each bar) and 95% confidence intervals for copper derived from the purple sea urchin embryo-larval development test. *96-hr static data are from the mean Cu EC ₅₀ value of 14.8 µg/L from three peer-reviewed studies (see section 3.1).	21
3-2. Median lethal concentrations (LC ₅₀ , labeled at each bar) and 95% confidence intervals for copper derived from the mysid survival test.....	21
3-3. Median effective concentrations (EC ₅₀ , labeled at each bar) and 95% confidence intervals for zinc derived from the purple sea urchin embryo-larval development test.	22
3-4. Median lethal concentrations (LC ₅₀ , labeled at each bar) and 95% confidence intervals for zinc derived from the mysid survival test.	23
3-5. Median lethal concentrations (LC ₅₀ , labeled at each bar) and 95% confidence intervals for copper and zinc derived from the mysid survival test with mixed metals.....	24
3-6. Toxic Units (TU) for copper and zinc derived from the mysid survival test with mixed metals.	25
3-7. Mean percent normal (±SD) for chronic sea urchin embryo-larval development test on stormwater samples collected from NBSD on March 7, 2016 for the 12 hr pulsed exposure and the 96 hr static exposure.	27
3-8. Mean percent survival for acute mysid test on stormwater samples collected from NBSD on March 7, 2016 for the 3, 6, and 12 hr pulsed exposures and the 96 hr static exposure.	29
3-9. Mean percent survival for acute mysid test on stormwater samples Pier 13 Mid and Pier 13 End collected from NBSD on March 7, 2016 for the 3, 6, and 12 hr pulsed exposures and the 96 hr static exposure.....	29

Tables

2-1. Analytical Methods, Detection and Reporting Limits for Copper and Zinc.....	6
2-2. Experimental Design, Test Concentrations and Testing Dates for Static and Pulsed Exposures.....	7
2-3. Collection and Receipt Times of Stormwater Samples from NBSD	8
2-4. Purple Sea Urchin Embryo-Larval Development Toxicity Test Specifications.....	11
2-5. Mysid Survival Toxicity Test Specifications.....	13
3-1. Summary of Nominal and Verified Copper Concentrations from Static and Pulsed Exposures.....	16
3-2. Summary of Nominal and Verified Zinc Concentrations from Static and Pulsed Exposures.....	17
3-3. Summary of Nominal and Verified Copper and Zinc Concentrations for Mysid survival mixed metal static and pulsed exposures.	18
3-4. Water Quality Parameters Measured Upon Receipt at NIWC Pacific from NBSD Stormwater Samples Collected on March 7, 2016.	19
3-5. Total and Dissolved Cu and Zn Concentrations in NBSD Stormwater Samples Collected on March 7, 2016.	19
3-6. Results Summary for the Copper Reference Toxicant Tests Concurrently Conducted with the NBSD Stormwater Samples Collected on March 7, 2016.....	20
3-7. Summary of Median Lethal (LC ₅₀) Copper and Zinc Concentrations for the Single Metal Mysid Survival Test with Corresponding 95% Upper (UCL) and Lower Confidence Limits (LCL).....	24
3-8. Results Summary for Chronic Purple Sea Urchin Embryo-Larval Development Test on NBSD Stormwater Samples Collected on March 7, 2016 for the 12 hr Pulsed Exposure and the 96 hr Static Exposure.....	26
3-9. Results Summary for Acute Mysid Survival Test on NBSD Stormwater Samples Collected on March 7, 2016 for the 3, 6, and 12 hr Pulsed Exposures, and the 96 hr Static Exposure.	28

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1. INTRODUCTION

This report describes a preliminary research effort to modify Whole Effluent Toxicity (WET) testing protocols designed for continuous flow discharges for application to episodic and/or ephemeral discharges such as those associated with storm water runoff. The research for this report was conducted in response to a Naval Base San Diego (NBSD) industrial National Pollutant Discharge Elimination System (NPDES) permit (Permit R9-2013-0064) condition that allows the Navy to assess an alternative approach to evaluating stormwater discharges and propose alternative toxicity testing parameters. Current compliance requirements for San Diego Navy installations apply standard acute (lethal) WET testing to first-flush stormwater collected directly from the end-of-pipe. The Navy's permits indicate that there may be a potential transition to the use of chronic (sub-lethal) WET testing in future permits. These requirements are in contrast to the State's toxicity draft guidance document (SWRCB, 2012) that applies WET testing to effluents once they are fully mixed in receiving waters. While the Navy supports that approach and has considerable scientific data that warrant setting the point-of-compliance in receiving waters, the Regional Water Quality Control Board (RWQCB), San Diego has mandated end-of-pipe testing with no consideration for mixing. Thus, this research effort focused on developing methods that could be applied to end-of-pipe samples while addressing more realistic exposure conditions generated by these types of episodic short-lived discharges.

The underlying rationale for addressing a modification to the standard WET protocol is that standard WET testing protocols expose test organisms for substantially longer periods of time (48 hours to 7 days) than the discharges themselves are present at the end-of-pipe (almost always less than 24 hours). The hypothesis is that this approach significantly overestimates the potential toxic impact. If applied properly, a modification to generate more realistic exposure conditions will still provide an appropriate level of protection, particularly given that the exposure at the end-of-pipe will be further reduced once it mixes in the receiving environment.

This research was conducted in 2015-2016 by environmental toxicologists at the Naval Information Warfare Center Pacific (NIWC Pacific). The report describes the background and rationale for the research, results of laboratory and stormwater testing, and a discussion of, and recommendations for, additional method development to ensure the efficacy of these methods in future compliance monitoring.

1.1 BACKGROUND

Toxicity testing for compliance monitoring of industrial storm water discharges was first introduced by the RWQCB, San Diego in 1997 and applied to Navy permits in 2002. At that time stormwater monitoring required that first-flush (first hour of flow) end-of-pipe samples meet a 90% survival 50% of the time, and 70% survival 90% of the time, requirement. As part of the permit conditions, the Navy undertook an extensive assessment of stormwater runoff chemistry and toxicity from its facilities discharging to San Diego Bay starting in 2002. Results of the Navy's study (Katz et al., 2006) showed that while stormwater was acutely toxic in ~30% of samples, caused primarily by copper and zinc, receiving waters were found to be non-toxic for acute and chronic tests 100 and 98% of the time, respectively. The Navy concluded that toxicity testing at the end-of-pipe overestimated the toxic impacts found in receiving waters because the testing did not take into account the exposure conditions found there. The Navy recommended that future testing be conducted in receiving waters or by adjusting end of pipe tests for mixing or shorter toxicity testing durations to provide a more accurate prediction of the toxic effect. The RWQCB, San Diego did not agree with this approach, stating that they were required to monitor the discharge.

Several iterations of the toxicity requirements were promulgated in the ensuing years in other industrial NPDES permits. The California State Water Resources Control Board developed a draft toxicity guidance that applied chronic WET testing to samples fully mixed in receiving waters (SWRCB, 2012). However, the guidance provided a caveat that allowed regional boards to apply the exact same testing on 100% effluent samples. The outcome is that Navy NPDES permits since 2013 require acute WET tests on end-of-pipe samples with the potential for eventually applying chronic tests in the same way. The permits also allowed the Navy to re-evaluate alternative approaches to testing including addressing the role of mixing in receiving waters.

1.2 TECHNICAL APPROACH

The technical approach taken in this study was to modify the WET testing method to simulate a range of exposure conditions found at the end-of-pipe. The range of conditions was derived from historical rain duration data, industrial stormwater runoff data associated with San Diego Naval Facilities, and toxicological test results evaluated for various organisms and endpoints. The test conditions matrix included: an acute and chronic endpoint for sensitive species typically used for toxicity evaluations; copper, zinc, and a combination of the two toxicants at various concentrations found to cause toxicity under standard WET testing; and short-term pulsed exposure conditions representing the 50th, 75th, and 95th percentile historical rainfall durations observed in San Diego over the past 55 years. The initial testing culminated in its application to multiple stormwater samples collected from Naval Base San Diego outfalls during a single rain event in March 2016. All testing was conducted concurrently with standard test method durations for comparison.

2. MATERIALS AND METHODS

2.1 SELECTION OF PULSED EXPOSURE DURATIONS

Experimental pulsed exposure times were derived from a National Oceanic and Atmospheric Administration database of San Diego International Airport rainfall recorded over the 55-year period between 1951 and 2006. The dataset included 2,284 days of precipitation values ≥ 0.1 inch measured on an hourly basis. The total number of hours measured each day were tabulated and assessed for their cumulative probabilities. These results are shown in Figure 2-1. The 50th, 75th, and 95th percentile rainfall durations of 3, 6 and 12 hours, respectively were chosen to span the range of reasonable testing conditions. Runoff durations are observed to be virtually the same as rainfall durations at Navy facilities because the drainages there are relatively small with a high percentage of impervious surfaces. An example of this rainfall-runoff relationship is shown in Figure 2-2 for a recent storm event at NBSD.

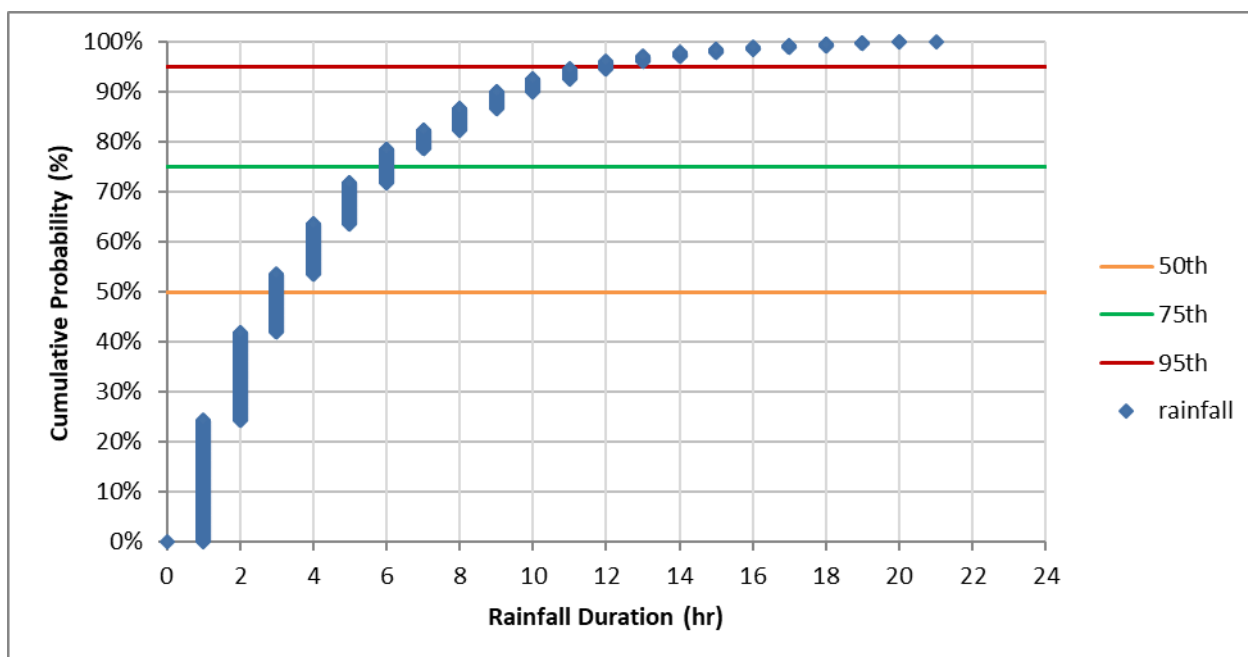


Figure 2-1. Cumulative frequency of rainfall duration over 24 hr periods when rain >0.1 " was recorded between 1951 and 2006 (N= 2,284). The 50th, 75th and 95th percentiles were used to derive the pulsed exposure regimes for this study.

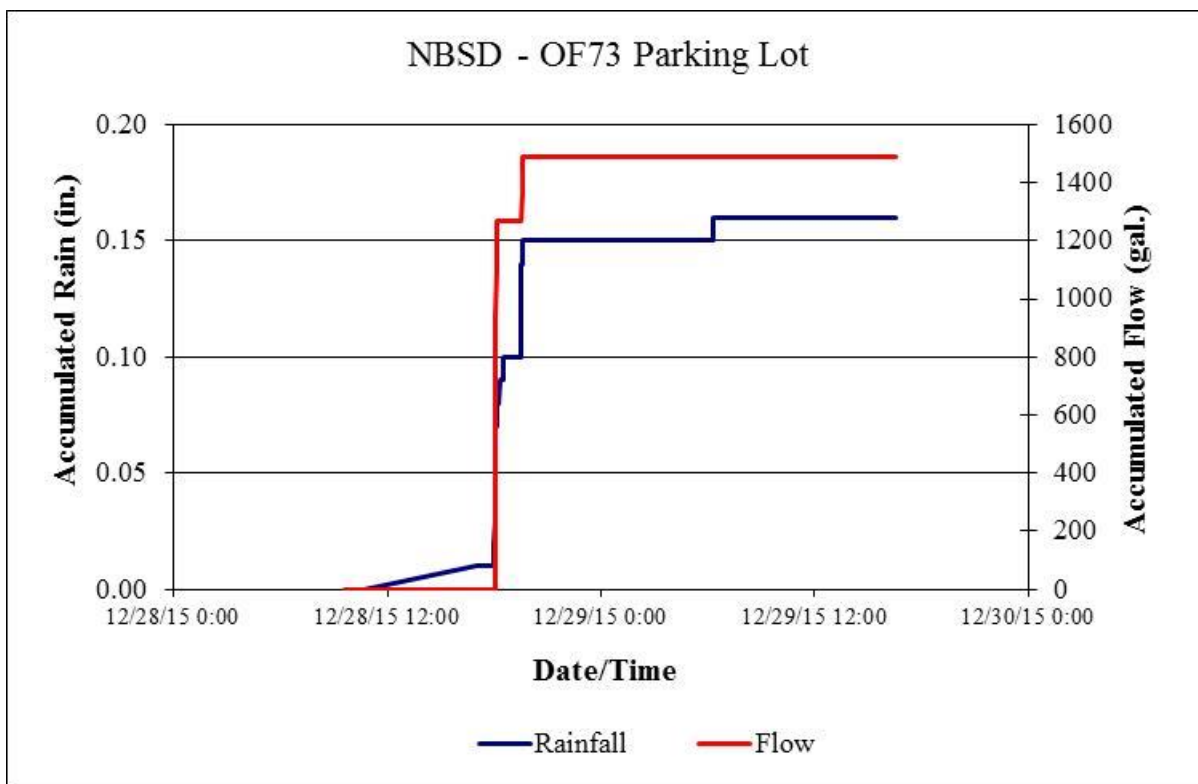


Figure 2-2. Example of rainfall and runoff during a storm event measured at NBSD Outfall 73 (parking area) showing runoff and rainfall durations are virtually the same.

The pulsed exposure experimental design was modified from standard USEPA methods (USEPA 1995, 2002a) and is shown graphically in Figure 2-3. Standard testing with reference toxicant materials or effluent samples typically requires the exposure of the test population to the undiluted sample under a static or static-renewal (replacement of test solution at one or more time points with the same stored test solution) conditions for the duration of the experiment. Modifications to this testing regime were made so that the organism exposures to either the reference toxicants (in this case copper or zinc, or both) or the effluent samples (stormwater) were made at the beginning of the exposure period followed by transfer to NIWC Pacific laboratory dilution water (uncontaminated 0.45 μm filtered seawater (FSW) collected near the mouth of San Diego Bay) for the remainder of the test. This exposure design ensured that all testing was conducted for the full 96-hr duration of the standard WET test.

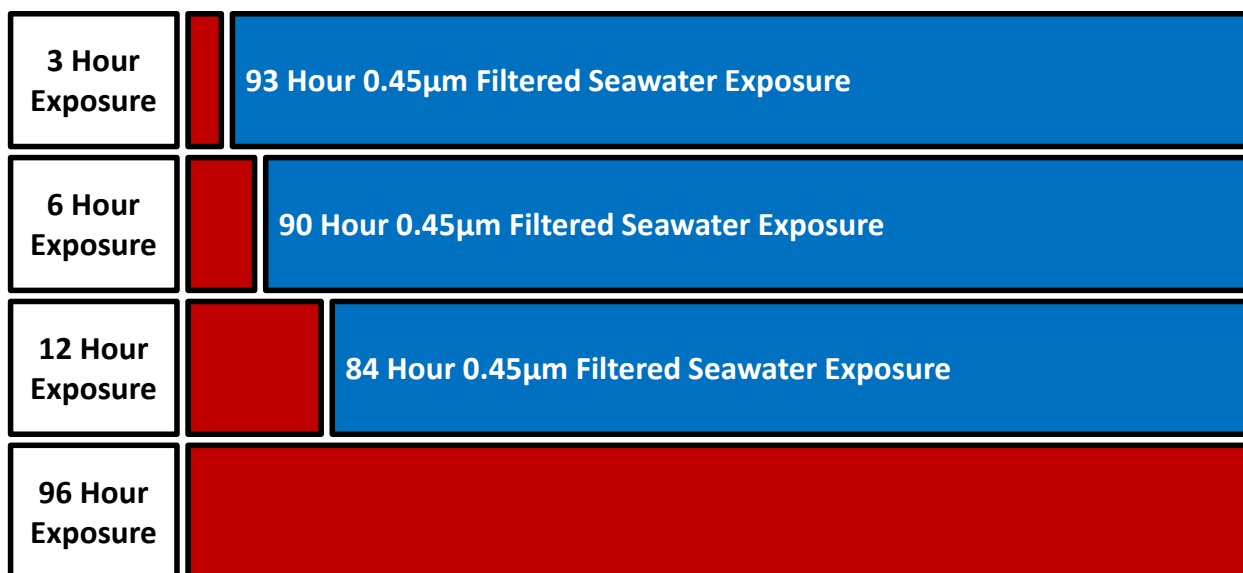


Figure 2-3. Pulsed exposure experimental design.

2.2 SELECTION OF TEST ORGANISMS

The toxicity testing species for this study were selected because they are permit-relevant species representing both acute and chronic endpoints (USEPA 1995, 2002a). The test species included opossum (mysid) shrimp (*Americamysis bahia*) and purple sea urchins (*Strongylocentrotus purpuratus*). The test endpoints included 96-hr survival and 96-hr embryo-larval development for mysids and sea urchins, respectively.

2.3 TEST MATERIAL

2.3.1 Selection of Stock Solutions

All test dilutions were made using NIWC Pacific laboratory filtered seawater (0.45 µm FSW collected from the mouth of San Diego Bay, CA). Test concentrations were prepared by volumetric addition of reagent grade copper and/or zinc stocks directly into FSW. All stock solutions and test concentrations were sub-sampled for verification and were analyzed by State of California Environmental Laboratory Accreditation Program (ELAP) certified laboratories, including either EnviroMatrix Analytical, Inc. (EMA) in San Diego, CA or Weck Laboratories (Weck), in the City of Industry, CA using USEPA method 6010 or by USEPA method 1640, respectively (USEPA 2007, 1996).

Analytical methods, method detection limits and reporting limits for copper and zinc are provided in Table 2-1.

Table 2-1. Analytical Methods, Detection and Reporting Limits for Copper and Zinc.

Study Type	Analyte	Test Method	MDL* (µg/L)	RL* (µg/L)	Laboratory
Stormwater	Copper	ICP-MS; EPA 1640	0.007	0.02	NIWC Pacific
Stormwater	Zinc	ICP-MS; EPA 1640	0.23	0.77	NIWC Pacific
Mixed Metal	Copper	ICP-MS; EPA 1640	0.004	0.01	Weck
Single & Mixed Metal	Zinc	ICP-MS; EPA 1640	0.04	0.20	Weck
Single Metal	Copper and Zinc	ICP-AES; EPA 6010	2	100	EMA

MDL – Method detection limit

RL – Reporting limit

* Note that the MDL and RL can change based on the dilution made for a given sample. See Appendix A through C for analytical reports from the laboratories.

Table 2-2 summarizes the experimental design and copper (Cu) and zinc (Zn) test concentrations that were tested for each species and pulse duration in single metal pulsed toxicity exposures. These concentrations were selected based on results from preliminary “range-finding” experiments using similar test methods, values found in peer-reviewed literature and historical laboratory results generated at NIWC Pacific. Concentrations were established in order to elicit a dose response in the species tested over the short exposure periods. Laboratory controls (uncontaminated 0.45 µm FSW from the mouth of San Diego Bay) were conducted concurrently for all experiments.

The mixed metal (copper and zinc) portion of this study was conducted only for the mysid acute survival test. It was assumed that Cu and Zn would contribute equally to the total toxicity due to similar mechanism of toxicity (Bellas et al. 2008). Using the Philips et al. (2003) Toxic Unit (TU) method ($TU = \text{concentration} / LC_{50}$) single metal TU were considered a baseline, yielding TUs of 1. Using data generated from the single metal pulsed and static exposures, exposure concentrations for the mixed metal exposure were determined. Half of a TU for both Cu and Zn as determined from the single metal exposures we used as the basis concentration for the mixed metal exposure. Assuming equal contribution from Cu and Zn, $0.5 TU_{Cu} + 0.5 TU_{Zn}$ should elicit the same toxic response as each metal did individually at one TU each. To ensure that a dose response was observed, additional concentrations above and below the combined $0.5 TU_{Cu} + 0.5 TU_{Zn}$ were included.

For the stormwater samples, the highest concentration tested for the echinoderm embryo-larval development test was 64‰, due to the addition of hypersaline brine (HSB) to bring the final salinity to 34 parts-per-thousand (ppt) (USEPA 1995). For the mysid survival test, stormwater sample salinity was increased to 34 ± 2 ppt by the addition of synthetic sea salts (Crystal Sea Marine Mix®) (USEPA 2002a), resulting in an undiluted stormwater sample. Concurrent brine and salt controls were tested for the embryo-larval development and mysid survival test, respectively.

Table 2-2. Experimental Design, Test Concentrations and Testing Dates for Static and Pulsed Exposures.

Test	Test Initiation Date	Test Species	Exposure Duration (hr)	Nominal Test Concentrations
Copper Exposures	15 Nov 2015	<i>S. purpuratus</i>	96 (Static)	0, 5.8, 8.4, 12, 17.2, 24, 31.3 µg/L
			3, 6, & 12	0, 31.3, 62.5, 125, 250, 500 µg/L
	28 Oct 2015	<i>A. bahia</i>	96 (Static)	0, 50, 100, 200, 400, 800 µg/L
			3, 6, & 12	0, 200, 400, 800, 1600, 3200 µg/L
Zinc Exposures	25 Mar 2016	<i>S. purpuratus</i>	96 (Static)	0, 20, 40, 80, 160, 320 µg/L
			3, 6, & 12	0, 1280, 2560, 5120, 10240, 20480 µg/L
	10 Dec 2015	<i>A. bahia</i>	96 (Static)	0, 125, 250, 500, 1000, 2000 µg/L
			3, 6, & 12	0, 500, 1000, 2000, 4000, 8000, 16000 µg/L
Mixed Metals Exposures	29 Apr 2016	<i>A. bahia</i>	96 (Static)	Cu: 16.9, 33.8, 67.6, 135, 270 µg/L Zn: 63.8, 128, 255, 510, 1020 µg/L
			3	Cu: 184,369,738, 1475, 2950 µg/L Zn: 1305, 2610, 5220, 10440, 20880 µg/L
			6	Cu: 99.4, 199, 398, 795, 1590 µg/L Zn: 489, 979, 1957, 3914, 7828 µg/L
			12	Cu: 30.0, 59.9, 120, 240.6, 479 µg/L Zn: 258, 515, 1030, 2060, 4120 µg/L
Stormwater Exposures	8 Mar 2016	<i>S. purpuratus</i>	96 (Static)	64%*
			3, 6, & 12	64%*
		<i>A. bahia</i>	96 (Static)	100%
			3, 6, & 12	100%

* Highest concentration tested due to the addition of hypersaline brine to adjust salinity to 34 ppt.

2.3.2 Stormwater Sample Collection

Stormwater samples consisted of runoff grab samples collected from industrial areas in Naval Base San Diego (NBSD) on March 7th, 2016 by NIWC Pacific personnel. Precipitation prior to and during the collection period was approximately an hour. Samples were collected in 1 L HDPE cubitainers and hand carried in insulated coolers with blue ice to the NIWC Pacific Bioassay Laboratory. Sample collection and receipt times are summarized in Table 2-3. Copies of chain of custody forms are provided in Appendix C. Water quality parameters including pH, dissolved oxygen (DO), salinity and temperature were measured immediately upon receipt at the Bioassay Lab and prior to testing. Additionally, total and dissolved copper and zinc were analyzed in the stormwater samples in-house by NIWC Pacific (ICP-MS; USEPA 1996; Table 2-1).

Table 2-3. Collection and Receipt Times of Stormwater Samples from NBSD

Station ID	Matrix	Type	Sample Collection Date/Time	Sample Receipt Date/Time
Outfall 73	Stormwater	Grab	3/7/2016 1045	3/7/2016 1130
Pier 10 Influent	Stormwater	Grab	3/7/2016 0935	3/7/2016 1130
Pier 10 Effluent	Stormwater	Grab	3/7/2016 0943	3/7/2016 1130
Pier 13 Base	Stormwater	Grab	3/7/2016 0853	3/7/2016 1130
Pier 13 Mid	Stormwater	Grab	3/7/2016 0902	3/7/2016 1130
Pier 13 End	Stormwater	Grab	3/7/2016 0916	3/7/2016 1130

2.4 CHRONIC TOXICITY TEST METHODS

As determined by the rainfall history observed (Figure 2-1), chronic testing was conducted using modified standard USEPA methods (USEPA 1995; Table 2-4) to conservatively estimate stormwater scenarios that are likely to be observed at the end-of-pipe. The purple sea urchin embryo-larval development tests were conducted in 25 µm Nitex screen polycarbonate tubes placed in 400 mL high density polyethylene (HPDE) tri-corner beakers at 15 ± 1 °C. Following the pulsed exposure duration, screen tubes (Figure 2-4 and Figure 2-5) were removed from metal or stormwater containing solutions, gently rinsed with FSW, and placed into clean tri-corner beakers containing FSW for the remainder of the 96-hr test period. As a quality control measure to ensure that the transfer methods did not negatively impact the embryos, a set of lab controls underwent transfers as well. At the end of the exposure period, the contents of the screen tubes were gently rinsed with FSW into 30 mL scintillation vials and preserved with 1 mL of 10% buffered formalin in seawater. The tests were then evaluated for normal larval development on an inverted microscope at 100x magnification. Statistical analyses to calculate median effective concentrations and confidence intervals were conducted with the statistical software Comprehensive Environmental Toxicity Information System (CETIS) v1.8.7.16 (Tidepool 2012). Stormwater data was analyzed using the Test of Significant Toxicity (TST) procedure to determine if there were significant differences relative to the controls. TST methods examine whether the results of a given sample relative to its respective control differs by an a priori prescribed amount rather than whether they are the same, as in traditional hypothesis testing (USEPA 2010). For the sea urchin test, the a priori critical percent difference is set at 25%.



Figure 2-4. Test set up for sea urchin embryo exposures.

Standard water quality measurements (DO, temperature, salinity and pH) were monitored daily. Concurrent reference toxicant tests using either Cu or Zn, as appropriate, were conducted as a quality control measure to assess the health of the organisms and technical performance of the method. Test specifications can be found in Table 2-4.

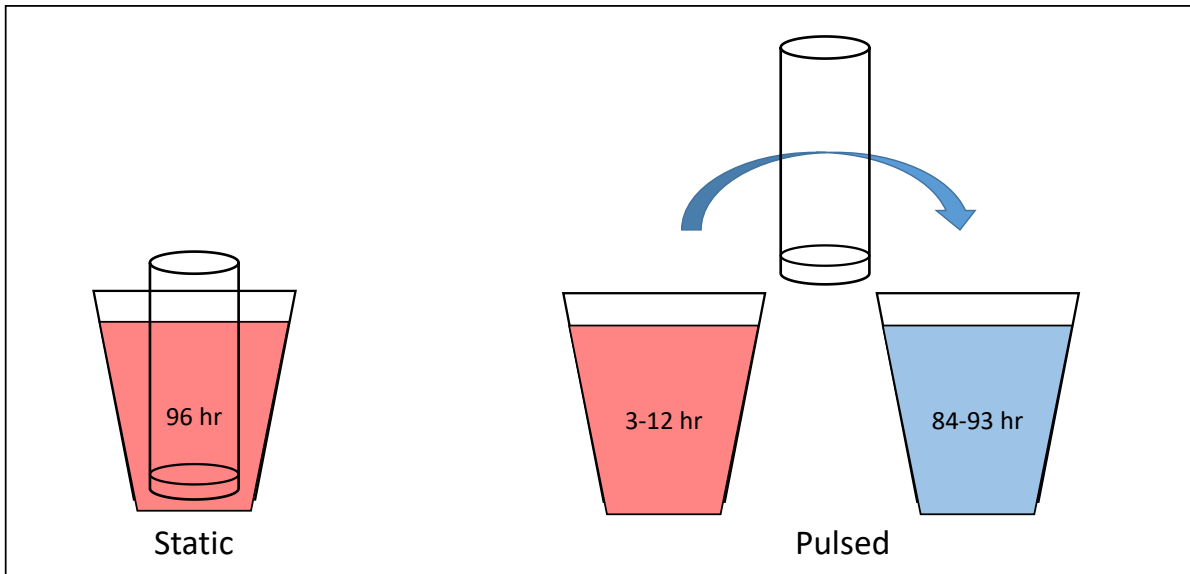


Figure 2-5. Generalized diagram comparing static 96-hr exposure and pulsed exposures during which test organisms were transferred from test solution (red) to uncontaminated seawater (blue) at designated time.

Table 2-4. Purple Sea Urchin Embryo-Larval Development Toxicity Test Specifications

Test organism	<i>Strongylocentrotus purpuratus</i> (purple sea urchin)
Test organism source	Field collected off of Point Loma, San Diego, CA
Test endpoints	96 hr Embryo-Larval Development Success (Proportion Normal)
Test solution renewal	None
Feeding	None
Test Chamber size/type	Pulsed Exposures: 400 mL polyethylene (HDPE) tri-corner containers with polycarbonate screen tubes with 25 μ m mesh Static Exposures: 30 mL scintillation vial
Test solution volume	Pulsed Exposures: 250 mL Static Exposures: 10 mL
Test temperature	15 $\pm$ 1 $^{\circ}$ C
Test salinity	34 $\pm$ 2 ppt
Light quality	Ambient laboratory illumination
Light intensity	10-20 μ E/m ² /s (Ambient laboratory levels)
Photoperiod	16 hr light/ 8 hr dark
Aeration	None.
No. of organisms per chamber	250 eggs, appropriate sperm density to provide > 90% fertilization success (determined in a pre-test trial).
No. of replicates	4 or 5
Dilution water	Filtered (0.45 μ m) natural seawater collected from near the mouth of San Diego Bay at NIWC Pacific Laboratory
Test duration	Exposure for 3, 6, or 12 hr followed by exposure to clean 0.45 μ m filtered seawater for the remainder of the 96 hr test period
Test acceptability criteria	$\geq$ 80% normal development in surviving controls; < 25% Minimum Significant Difference (MSD)
Reference toxicant	Copper sulfate Zinc Sulfate
Test protocol	EPA 600/R-95/136 (USEPA 1995), ASTM E1563-98 (2012)

2.5 ACUTE TOXICITY TEST METHODS

Similar to the chronic tests, acute testing was conducted using modified standard USEPA methods (USEPA 2002a; Table 2-5) to conservatively estimate stormwater scenarios that are likely to be observed at the end-of-pipe based on the historical rainfall data (Figure 2-1). Mysid exposures were conducted in 500 mL disposable plastic cups at 20 ± 1 °C. Following pulsed exposures, mysids were carefully poured onto an 80-µm Nitex screen and thoroughly rinsed with FSW. Mysids were then rinsed gently into new clean plastic cups containing FSW for the remainder of the exposure period. As a quality control measure to ensure that the transfer methods did not negatively impact the mysids, a set of lab controls underwent transfers as well. Statistical analyses to calculate median lethal concentrations and confidence intervals were conducted with the statistical software CETIS (Tidepool 2012). Stormwater data was analyzed using the TST procedure to determine if there were significant differences relative to the controls with the acute a priori critical percent difference set at 10% (USEPA 2010).

Daily survival counts in each replicate were conducted and standard water quality measurements (DO, temperature, salinity and pH) were monitored daily. Concurrent reference toxicant tests using either copper or zinc when appropriate were conducted as a quality control measure to assess the health of the organisms. Test specifications can be found in Table 2-5.

Table 2-5. Mysid Survival Toxicity Test Specifications

Test organism	<i>Americamysis bahia</i> (mysid shrimp)
Test organism source	Aquatic Research Organisms, Hampton, NH
Test endpoints	Survival
Test solution renewal	None
Feeding	Feed 40 newly hatched <i>Artemia</i> nauplii per larvae twice daily, morning and evening
Test Chamber size/type	500 mL Plastic Cups
Test solution volume	50 – 250 mL (dependent on exposure chamber volume)
Test temperature	20 ± 1 °C
Test salinity	34 ± 2 ppt
Light quality	Ambient laboratory illumination
Light intensity	10-20 µE/m ² /s (Ambient laboratory levels)
Photoperiod	16 hr light/ 8 hr dark
Aeration	None, unless DO concentrations fall below 4.0 mg/L, then aerate all chambers.
No. of organisms per chamber	5
Age of test organism	5 days; 24 hr range in size
No. of replicates	4
Dilution water	Filtered (0.45 µm) natural seawater (FSW) collected from near the mouth of San Diego Bay at NIWC Pacific Laboratory
Test duration	Exposure for 3, 6, & 12 hr followed by transfer to clean 0.45 µm filtered seawater (FSW) for remainder of the 96 hr test period
Test acceptability criteria	≥ 90% survival in controls
Reference toxicant	Copper sulfate Zinc Sulfate
Test protocol	EPA 821/R-02/012 (USEPA 2002)

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3. RESULTS

Test results for all lab controls met all test acceptability criteria of $\geq 80\%$ normal larval development or $\geq 90\%$ survival for the sea urchin and mysid tests, respectively. All water quality parameters measured were within the recommended ranges for the duration of the tests. Raw test data and bench water quality sheets are provided in Appendix A through C.

All data presented were deemed acceptable for reporting purposes. A few QA/QC deviations from EPA and internal protocols occurred and were noted on raw data sheets. A thorough review of the data and test procedures for the sea urchin embryo-larval development tests and the mysid survival tests did not identify any likely impacts on test results of these deviations. Explanations are provided below, and a glossary of the qualifier codes used on the test datasheets is provided in Appendix D.

3.1 QA/QC

3.1.1 Single Metal Exposures

The 96-hr static reference toxicant test for sea urchin embryo-larval development that was run concurrently with the Cu single-metal pulsed study did not result in a median effective concentration (EC_{50}). The mean Cu EC_{50} value of $14.8 \mu\text{g/L}$ from three peer reviewed studies was used for comparisons to pulsed exposures (literature based EC_{50} values: $14.8 \mu\text{g/L}$: Arnold et al. 2010, $15.3 \mu\text{g/L}$: Phillips et al. 1995, $14.3 \mu\text{g/L}$: Rosen et al. 2008; mean $EC_{50} = 14.8 \mu\text{g/L}$).

Table 3-1 and Table 3-2 summarize the nominal and verified copper and zinc concentrations that were used in both the purple sea-urchin embryo-larval development and the mysid survival tests, respectively.

Table 3-1. Summary of Nominal and Verified Copper Concentrations from Static and Pulsed Exposures.

Test Species	Exposure Duration (hr)	Nominal Copper Concentration (µg/L)	Verified Copper Concentration ^a (µg/L)
<i>S. purpuratus</i>	3, 6, & 12	0	ND
	3, 6, & 12	31.3	15.0
	3, 6, & 12	62.5	36.0
	3, 6, & 12	125	81.0
	3, 6, & 12	250	179
	3, 6, & 12	500	367
<i>A. bahia</i>	3, 6, & 12 96 (Static)	0	ND
	96 (Static)	50	44.4
	3, 6, & 12 96 (Static)	100	88.8
	3, 6, & 12 96 (Static)	200	178
	3, 6, & 12 96 (Static)	400	355
	3, 6, & 12 96 (Static)	800	693
	3, 6, & 12	1600	1390
	3, 6, & 12	3200	2970

^a USEPA method 6010 (EMA); ND=below method detection limit.

Table 3-2. Summary of Nominal and Verified Zinc Concentrations from Static and Pulsed Exposures.

Test Species	Exposure Duration (hr)	Nominal Zinc Concentration (µg/L)	Verified Zinc Concentration (µg/L) ^a
<i>S. purpuratus</i>	3, 6, & 12 96 (Static)	0	6.1
	96 (Static)	20	37
	96 (Static)	40	63
	96 (Static)	80	120
	96 (Static)	160	220
	96 (Static)	320	480
	3, 6, & 12	1280	1900
	3, 6, & 12	2560	3900
	3, 6, & 12	5120	7700
	3, 6, & 12	10240	15000
	3, 6, & 12	20180	31000
<i>A. bahia</i>	3, 6, & 12 96 (Static)	0	13
	96 (Static)	125	100
	96 (Static)	250	180
	3, 6, & 12 96 (Static)	500	398
	3, 6, & 12 96 (Static)	1000	753
	3, 6, & 12 96 (Static)	2000	1520
	3, 6, & 12	4000	3280
	3, 6, & 12	8000	5430
	3, 6, & 12	16000	16700

^aUSEPA method 1640 (Weck) for *S. purpuratus*, USEPA method 6010 (EMA) for *A. bahia*.

3.1.2 Mixed Metal Exposures

For the mysid survival test, concurrently conducted single metal (Cu & Zn) static exposures met test acceptability criteria of 90% survival in the controls and the LC₅₀ values generated for Cu and Zn both were within acceptable historical and/or literature ranges (Table 3-6).

Table 3-3 summarizes the nominal and verified concentrations of Cu and Zn in the mixed metal exposures for each of the pulsed time exposures, as each pulsed exposure had unique concentrations.

Table 3-3. Summary of Nominal and Verified Copper and Zinc Concentrations for Mysid survival mixed metal static and pulsed exposures.

Pulse Duration (hr)	Cu-Nominal Concentration (µg/L)	Cu-Verified Concentration ^a (µg/L)	Zn- Nominal Concentration (µg/L)	Zn- Verified Concentration ^a (µg/L)
Laboratory Control	0	1.6	0	6.4
3	184	190	1305	1800
	369	350	2610	3900
	738	880	5220	7400
	1475	1500	10440	15000
	2950	3100	20880	30000
6	99.4	99.0	489	850
	199	200	979	1500
	398	440	1957	2500
	795	770	3914	5200
	1590	1600	7828	11000
12	30	34	258	360
	59.9	72.0	515	910
	120	120	1030	1500
	240	340	2060	3100
	479	570	4120	5900
96 (Static)	16.9	21.0	63.8	81.0
	33.8	34.0	128	150
	67.6	71.0	255	320
	135	140	510	860
	270	280	1020	1600

^aUSEPA 1640 method (Weck)

3.1.3 Stormwater Exposures

All tests were conducted within the required 36-hour holding time. Samples were received within 3 hrs of collection and the temperatures of the samples were outside of the EPA recommended range of 0-6 °C upon receipt at the NIWC Pacific Laboratory; however, samples were in a state of cooling during transit, meeting ELAP requirements. Samples were stored at 4 °C in a refrigerator until test initiation.

Water quality parameters upon receipt of stormwater samples at NIWC Pacific are summarized in Table 3-4 and Appendix C. Sample temperatures reflect that the samples were brought to the lab very quickly after collection. Total and Dissolved Cu and Zn concentrations for the stormwater samples are shown in Table 3-5, along with the calculated difference based on highest concentration tested (64%) for sea urchin embryo-larval development tests due to the addition of hypersaline brine.

Table 3-4. Water Quality Parameters Measured Upon Receipt at NIWC Pacific from NBSD Stormwater Samples Collected on March 7, 2016.

Station/Sample ID	Temp (°C)	Dissolved Oxygen (mg/L)	pH (units)	Salinity (ppt)
Outfall 73	14.2	8.0	7.77	0.0
Pier 10 Influent	14.2	8.1	6.72	0.0
Pier 10 Effluent	14.2	8.2	7.27	0.1
Pier 13 Base	14.2	8.1	7.01	0.1
Pier 13 Mid	14.2	8.2	7.09	0.1
Pier 13 End	14.2	8.0	7.01	0.0

Table 3-5. Total and Dissolved Cu and Zn Concentrations in NBSD Stormwater Samples Collected on March 7, 2016.

Station/Sample ID	Cu – Total (µg/L) ^a	Cu - Dissolved (µg/L) ^a	64% Cu - Dissolved (µg/L) ^b	Zn - Total (µg/L) ^a	Zn - Dissolved (µg/L) ^a	64% Zn - Dissolved (µg/L) ^b
Outfall 73	56.7	48.9	31.3	384	343	219.5
Pier 10 Influent	24.2	17.2	11.0	220	162	103.7
Pier 10 Effluent	25.1	15.0	9.6	230	145	92.8
Pier 13 Base	21.0	0.23	0.1	350	34	21.8
Pier 13 Mid	83.6	51.4	32.9	994	600	384.0
Pier 13 End	75.4	55.9	35.8	2361	2137	1367.7

^a USEPA method 1640 (NIWC Pacific); ^b Calculated concentration based on highest concentration tested (64%) for sea urchin embryo-larval development tests due to the addition of hypersaline brine.

For the stormwater pulsed exposure study, the 3 hr and 6 hr pulsed exposure data for the sea urchin embryo-larval development test are not presented here. The data did not meet necessary requirements for TST analysis due to several outliers that reduced required replication. A single statistical outlier was observed in the 12-hr data for one of the replicates of the Pier 13 Mid sample (11% normal development) using Grubb's test with a significance level set at 0.01. This replicate was removed from analysis.

Standard reference toxicant tests with copper that were conducted concurrently with the stormwater evaluations for both species had median effective concentration (EC₅₀) value or median lethal concentration (LC₅₀) within two standard deviations of the internal historical mean, indicating sensitivity to copper was consistent with that historically observed for these organisms (Table 3-6).

Table 3-6. Results Summary for the Copper Reference Toxicant Tests Concurrently Conducted with the NBSD Stormwater Samples Collected on March 7, 2016.

Species & Endpoint	LC ₅₀ or EC ₅₀ (µg/L copper) ^a	Historical mean ± 2 SD (µg/L copper) ^a
Sea Urchin Embryo-Larval Development	18.0	18.6 ± 9.4
Mysid Shrimp Survival	253	259 ± 146

^a Reported values are based on nominal (unmeasured) concentrations.

3.2 COPPER EXPOSURES

For the chronic sea urchin embryo-larval development tests, all of the pulsed exposures with copper showed a reduction in toxicity relative to the static exposure. The EC₅₀ values and the 95% lower and upper confidence intervals for copper for the static and each pulsed exposure were calculated based on verified concentrations and are shown in Figure 3-1. EC₅₀ values for the pulsed exposures were 8-20 times greater than that of the published static exposure EC₅₀ value reported for this species (Figure 3-1).

For the acute mysid survival tests, a similar trend was observed in that the pulsed exposures with copper showed a reduction in toxicity relative to the static exposure with LC₅₀ values all greater than that observed (ranging from factor of 2 to 11) in the static exposure (Figure 3-2). The LC₅₀ values and the 95% lower and upper confidence intervals for copper for the static and each pulsed exposure were calculated based on verified concentrations and are shown in Figure 3-2.

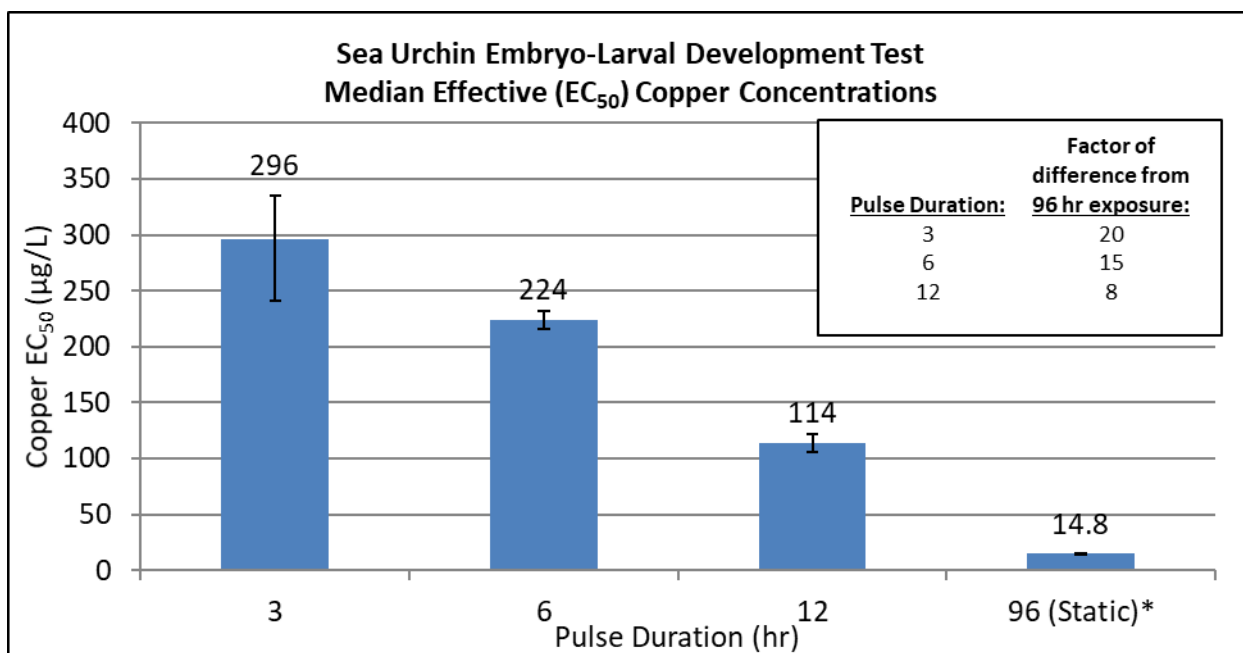


Figure 3-1. Median effective concentrations (EC₅₀, labeled at each bar) and 95% confidence intervals for copper derived from the purple sea urchin embryo-larval development test. *96-hr static data are from the mean Cu EC₅₀ value of 14.8 µg/L from three peer-reviewed studies (see section 3.1).

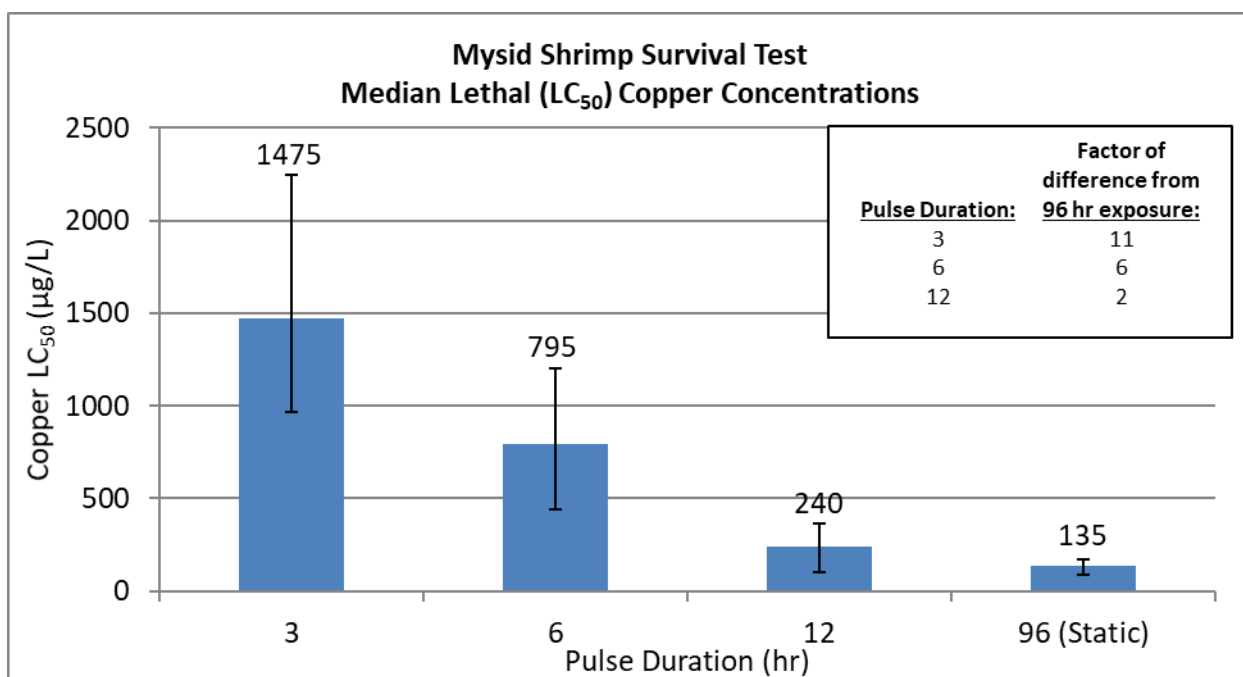


Figure 3-2. Median lethal concentrations (LC₅₀, labeled at each bar) and 95% confidence intervals for copper derived from the mysid survival test.

3.3 ZINC EXPOSURES

The EC_{50} values and the 95% lower and upper confidence intervals for zinc for the static and each pulsed exposure were calculated based on verified concentrations and are shown in Figure 3-3. For the chronic sea urchin embryo-larval development tests, the pulsed exposures with zinc showed a reduction in toxicity relative to the static exposures. EC_{50} values for the pulsed exposures were 112-186 times greater than that of the static exposure (Figure 3-3).

The LC_{50} values and the 95% lower and upper confidence intervals for zinc for the static and each pulsed exposure were calculated based on verified concentrations and are shown in Figure 3-4. For the acute mysid survival tests, a similar trend was observed in that the pulsed exposures with zinc showed a reduction in toxicity relative to the static exposures with LC_{50} values all greater than that observed from the 96-hr static exposure (Figure 3-4).

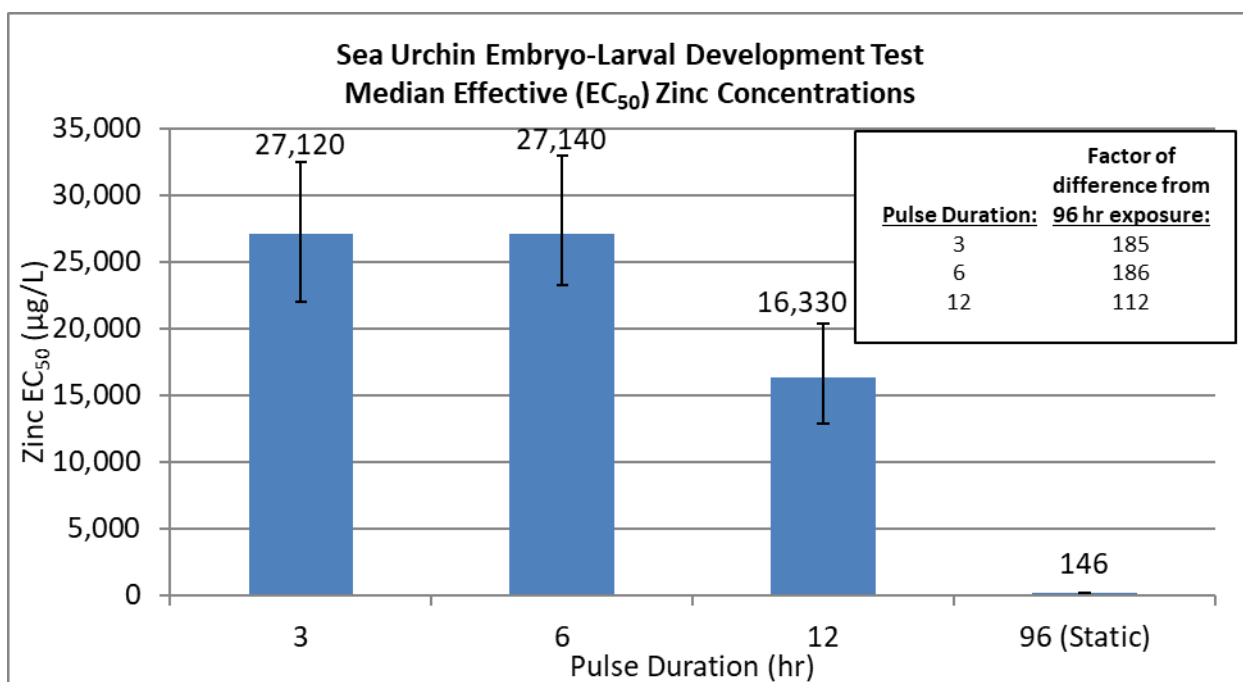


Figure 3-3. Median effective concentrations (EC_{50} , labeled at each bar) and 95% confidence intervals for zinc derived from the purple sea urchin embryo-larval development test.

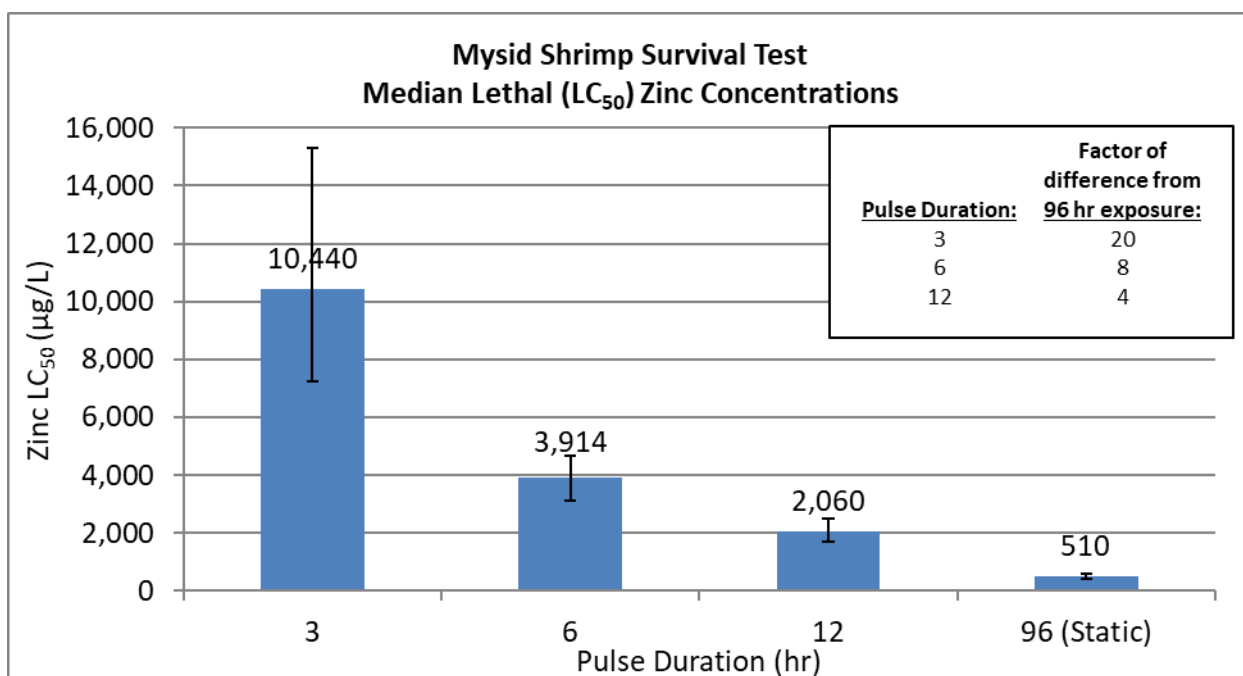


Figure 3-4. Median lethal concentrations (LC₅₀, labeled at each bar) and 95% confidence intervals for zinc derived from the mysid survival test.

3.4 MIXED METALS EXPOSURES

The LC₅₀ values and the 95% lower and upper confidence intervals for the single metal static exposures of copper and zinc were calculated and are shown in Table 3-7.

For the mixed metal exposures, the LC₅₀ values and associated 95% lower and upper confidence intervals were calculated based on verified concentrations for each metal individually for the static and each pulsed exposure and are shown in Figure 3-5. The mixed metals study shows consistent reduction in toxicity for both copper and zinc with shorter exposure periods as was seen with the single metal exposures.

Figure 3-6 summarizes the result of the Toxic Unit (TU) calculations. To calculate the Toxic Unit (TU), the LC₅₀ values determined for each metal in the mixture were divided by its LC₅₀ value determined during the single metal tests. The resulting TUs for each metal were then summed to generate a combined TU for the mixture. Since it was assumed that Cu and Zn would contribute equally to the total observed toxicity, a TU value greater than one indicates that a greater amount of Cu and Zn, in combination, was needed to elicit a toxic effect relative to their equivalent single metal exposures (Figure 3-6). The lower TUs observed for copper suggest that it was the primary toxicant in these tests.

Table 3-7. Summary of Median Lethal (LC₅₀) Copper and Zinc Concentrations for the Single Metal Mysid Survival Test with Corresponding 95% Upper (UCL) and Lower Confidence Limits (LCL).

Exposure Duration (hr)	Metal	LC ₅₀ (µg/L)	95 % LCL (µg/L)	95% UCL (µg/L)
96 (Static)	Cu	223	182	288
	Zn	689	575	825

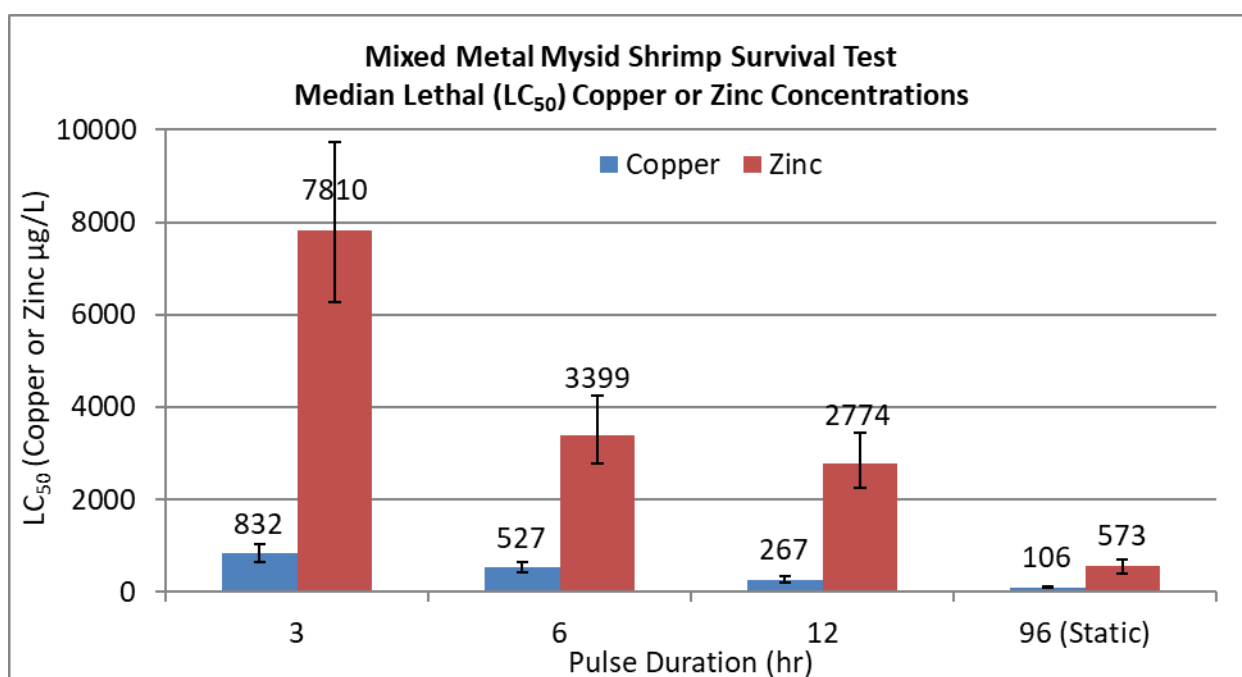


Figure 3-5. Median lethal concentrations (LC₅₀, labeled at each bar) and 95% confidence intervals for copper and zinc derived from the mysid survival test with mixed metals.

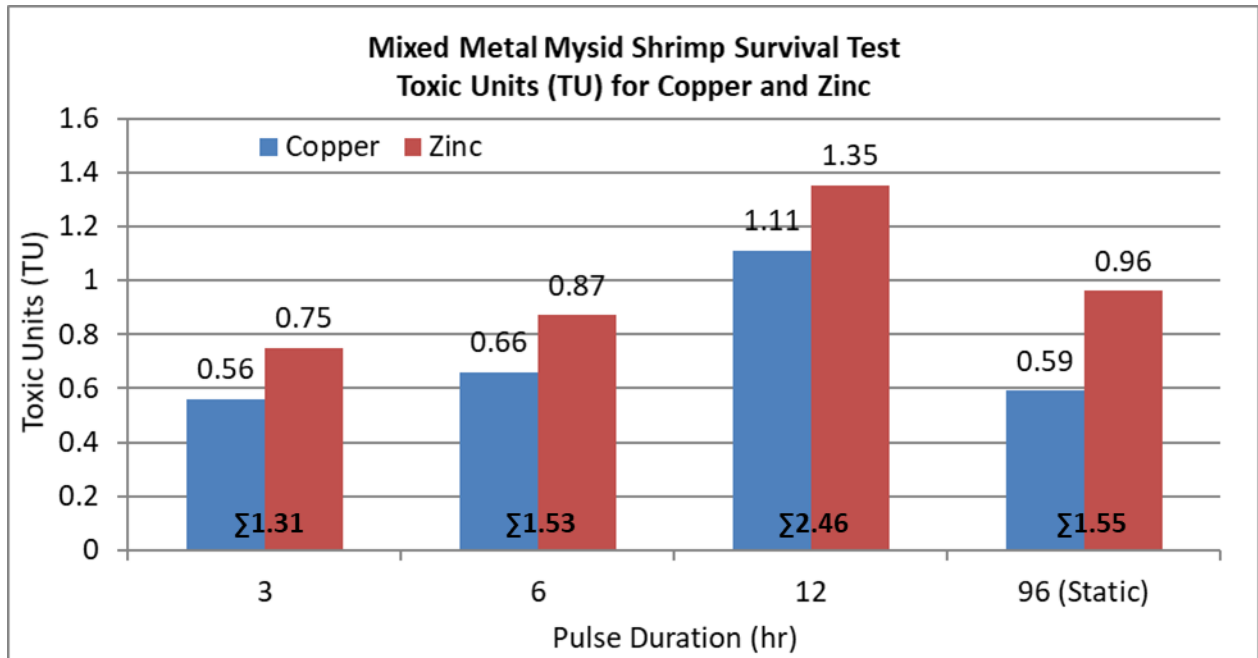


Figure 3-6. Toxic Units (TU) for copper and zinc derived from the mysid survival test with mixed metals.

3.5 STORMWATER EXPOSURES

Statistical analyses for the sea urchin embryo-larval development tests were performed against the brine control, as brine was added to increase the salinity of all of the samples. Statistical analyses were conducted using the TST method.

Table 3-8 and Figure 3-7 summarize the mean percent normal embryo-larval development for the 12 hr pulsed exposure and the 96 hr static exposure for the stormwater samples collected on March 7, 2016. Development values ranged from 0 to 91% of control in the 96 hr static tests and from 94 to 97% in the 12 hr pulsed exposure tests. Five of the six samples were identified as toxic in the 96 hr static exposure test, whereas no samples were identified as toxic in the 12 hr pulsed exposure test.

Table 3-8. Results Summary for Chronic Purple Sea Urchin Embryo-Larval Development Test on NBSD Stormwater Samples Collected on March 7, 2016 for the 12 hr Pulsed Exposure and the 96 hr Static Exposure.

Pulse Duration (hr)	Station/Sample ID	Mean % Normal ($\pm$ SD)	% Difference from Brine Control	TST Procedure Toxicity Decision
-	Lab Control	100 (0.0)	-	-
-	Brine Control	99 (1.0)	-	-
12	Outfall 73	94 (2.5)	5.5	Non-Toxic
	Pier 10 Influent	97 (1.9)	2.5	Non-Toxic
	Pier 10 Effluent	97 (3.0)	2.0	Non-Toxic
	Pier 13 Base	96 (3.0)	3.0	Non-Toxic
	Pier 13 Mid	94 (1.7)	5.3	Non-Toxic
	Pier 13 End	95 (2.5)	4.5	Non-Toxic
96 (Static)	Outfall 73	0 (0.0)	100	Toxic
	Pier 10 Influent	9.3 (6.1)	89.4	Toxic
	Pier 10 Effluent	11 (3.8)	90.7	Toxic
	Pier 13 Base	91 (3.0)	8.6	Non-Toxic
	Pier 13 Mid	0 (0.0)	100	Toxic
	Pier 13 End	0 (0.0)	100	Toxic

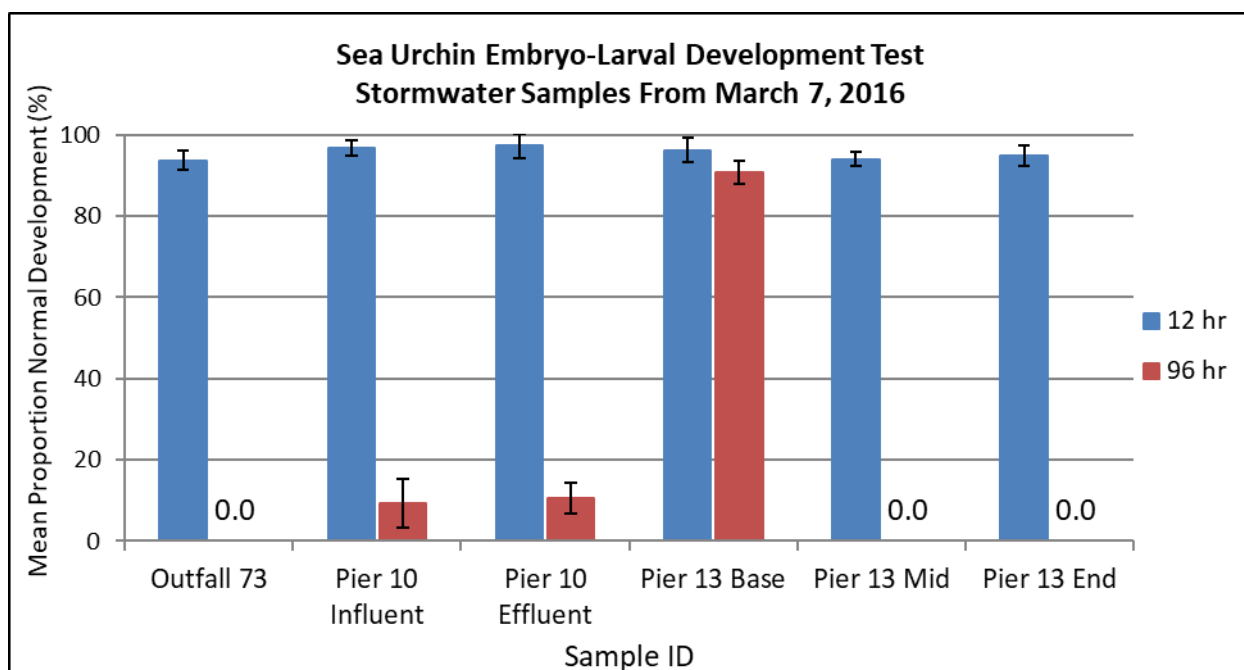


Figure 3-7. Mean percent normal ($\pm$ SD) for chronic sea urchin embryo-larval development test on stormwater samples collected from NBSD on March 7, 2016 for the 12 hr pulsed exposure and the 96 hr static exposure.

For the acute mysid survival test, statistical analyses were performed against the salt control, as artificial sea salts were added to increase the salinity of all of the samples. Statistical analyses were conducted using the USEPA TST Calculator Tool (USEPA 2010). Table 3-9 summarizes and Figure 3-8 graphically shows the mean percent survival for the 3, 6, and 12 hr pulsed exposures and the 96 hr static exposure for the stormwater samples collected on March 7, 2016. For the 96 hr static exposure, the samples Pier 13 Mid and Pier 13 End resulted in a toxic response compared to the salt control. All other samples were non-toxic. Under the 12 hr pulsed exposure method, the Pier 13 Mid and Pier 13 End samples continue to exhibit a toxic response compared to the salt control, while all other samples were non-toxic. For the 6 hr pulsed method, only the Pier 13 End sample continued to have a toxic response. For the 3 hr pulsed method, all samples were non-toxic relative to the salt control. Figure 3-9 shows the survival results for Pier 13 Mid and Pier 13 End with decreasing toxicity with decreased exposure time.

Table 3-9. Results Summary for Acute Mysid Survival Test on NBSD Stormwater Samples Collected on March 7, 2016 for the 3, 6, and 12 hr Pulsed Exposures, and the 96 hr Static Exposure.

Pulse Duration (hr)	Station/Sample ID	Mean % Survival ($\pm$ SD)	% Difference from Salt Control	TST Procedure Toxicity Decision
-	Lab Control	100 (0.0)	-	-
-	Salt Control	95 (10.0)	-	-
3	Outfall 73	95 (10.0)	0.0	Non-Toxic
	Pier 10 Influent	90 (11.5)	5.3	Non-Toxic
	Pier 10 Effluent	100 (0.0)	-5.3	Non-Toxic
	Pier 13 Base	95 (10.0)	0.0	Non-Toxic
	Pier 13 Mid	95 (10.0)	0.0	Non-Toxic
	Pier 13 End	90 (11.5)	5.3	Non-Toxic
6	Outfall 73	95 (10.0)	0.0	Non-Toxic
	Pier 10 Influent	100 (0.0)	-5.3	Non-Toxic
	Pier 10 Effluent	95 (10.0)	0.0	Non-Toxic
	Pier 13 Base	100 (0.0)	-5.3	Non-Toxic
	Pier 13 Mid	90 (11.5)	5.3	Non-Toxic
	Pier 13 End	65 (19.1)	31.6	Toxic
12	Outfall 73	100 (0.0)	-5.3	Non-Toxic
	Pier 10 Influent	90 (11.5)	5.3	Non-Toxic
	Pier 10 Effluent	90 (11.5)	5.3	Non-Toxic
	Pier 13 Base	100 (0.0)	-5.3	Non-Toxic
	Pier 13 Mid	75 (10.0)	21.1	Toxic
	Pier 13 End	55 (25.2)	42.1	Toxic
96 (Static)	Outfall 73	90 (11.5)	5.3	Non-Toxic
	Pier 10 Influent	90 (10.0)	5.3	Non-Toxic
	Pier 10 Effluent	95 (10.0)	0.0	Non-Toxic
	Pier 13 Base	100 (0.0)	-5.3	Non-Toxic
	Pier 13 Mid	75 (10.0)	21.1	Toxic
	Pier 13 End	25 (25.2)	73.7	Toxic

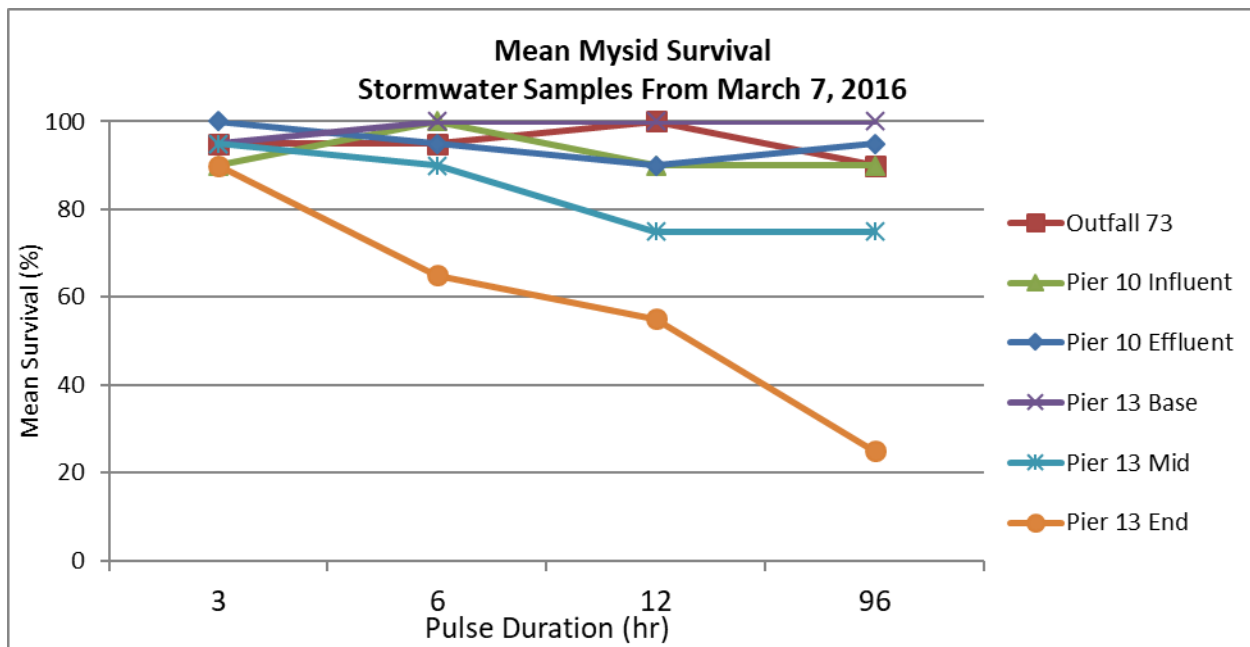


Figure 3-8. Mean percent survival for acute mysid test on stormwater samples collected from NBSD on March 7, 2016 for the 3, 6, and 12 hr pulsed exposures and the 96 hr static exposure.

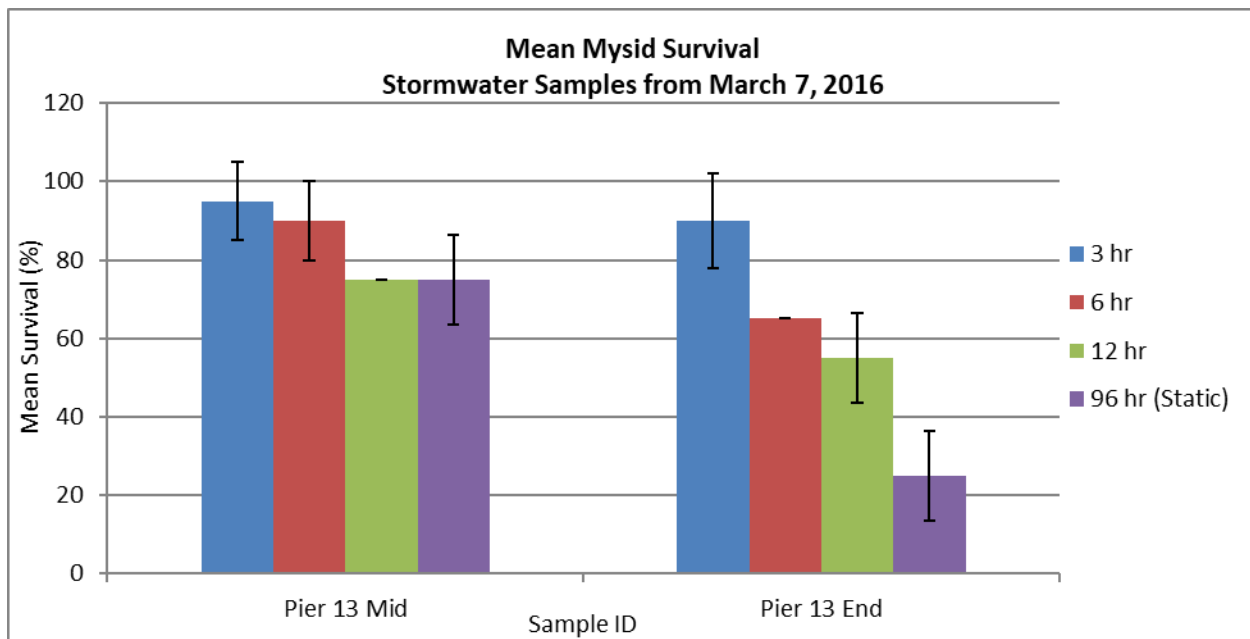


Figure 3-9. Mean percent survival for acute mysid test on stormwater samples Pier 13 Mid and Pier 13 End collected from NBSD on March 7, 2016 for the 3, 6, and 12 hr pulsed exposures and the 96 hr static exposure.

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4. DISCUSSION AND CONCLUSIONS

The results of this study showed that modifying standard WET test methods is a feasible approach to accurately assess short-term exposure conditions. The tests, which were conducted over a range of realistic conditions for both chronic and acute toxicity endpoints, presented consistent results lending confidence in their application. All the tests displayed a significant progressive reduction in toxicity with decreasing exposure time. The toxicity determined with standard 96 hr static tests overestimated the toxicity of short-term exposures by a factor of between 2 and 186, depending on the exposure duration, toxicant, and endpoint evaluated.

The higher effects concentrations from the short-term pulsed testing showed that the test organisms are relatively protected over shorter exposure intervals. This enhanced level of protection was observed in the sea urchin embryo-larval development test results, whereby even exceptionally high levels of zinc did not cause toxic effects in short term exposures. This outcome is consistent with other studies that found that the fertilization membrane may provide a level of protection during the earliest developmental life stages of the organism (Buznikov et al. 2007; AMEC, 2015). The implication is that exposure duration is as critical a testing condition as the exposure concentration when evaluating toxicity. It also suggests that further testing at various developmental life stages is important in evaluating the efficacy of the pulsed exposure method.

The laboratory pulsed testing procedures were conducted under conditions that reflected realistic stormwater conditions found at the end-of-pipe at San Diego Navy facilities. It included a range in the stormwater runoff durations expected as well as the type and magnitude of the toxicant concentrations. The observed level of toxicity in both laboratory and stormwater samples were consistent and repeatable with comparable results to other pulsed exposure studies with different toxicants and pulse durations (Dupuis and Kreutzberger 2003, Butcher et al. 2006, Diamond et al. 2006, Hoang et al 2007a, Hoang et al. 2007b, Hoang 2007c, AMEC, 2015). The simple modification of the standard WET procedure provides a reasonable logistical change that could easily be implemented in future testing.

Although the test procedures focused on exposure conditions likely to occur at the end-of-pipe, those conditions are still conservative in comparison to actual exposures that occur once the stormwater is discharged to, and mixes with, receiving waters. This is corroborated by repeated testing that consistently showed no adverse effects to similar toxicity test endpoints and near background chemical concentrations when samples were collected from the receiving environment immediately adjacent to stormwater outfalls (Katz et al. 2006).

Though these initial result are highly promising, additional testing and evaluation are recommended prior to implementation of a pulsed methodology for compliance testing. In particular, additional testing should include:

- Examining timing of the onset of the pulse during laboratory exposure
- Consideration of the effects of repeated pulses
- Evaluation of the most sensitive, not just earliest life stages of test organisms
- Potential for latent effects following the standard exposure duration
- Receiving water testing
- Inter-laboratory comparisons
- Comparison of costs of pulsed testing vs. static testing

We believe that this methodology can and should be implemented into stormwater testing compliance monitoring once the above testing is completed and there is a sufficient level of repetition to provide a statistical assessment.

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APPENDIX A
TEST DATA AND STATISTICAL SUMMARIES
SINGLE METAL EXPOSURES

OVERVIEW

Items included are included in Appendix A:

1. Copper Exposures – Purple Urchin	A-2
2. Copper Exposures – Mysid Shrimp	A-28
3. Copper Exposures – Analytical Chemistry Reports	A-52
4. Zinc Exposures – Purple Urchin.....	A-70
5. Zinc Exposures – Mysid Shrimp	A-100
6. Zinc Exposures – Analytical Chemistry Reports.....	A-124

A.1. COPPER EXPOSURES – PURPLE URCHIN:

CETIS Summary Report

Report Date: 02 Jun-16 16:08 (p 1 of 1)
Test Code: 73912D09 | 19-3889-4089

Echinoid Embryo-Larval Development Test							SPAWAR Systems Center				
Batch ID:	07-7568-4302	Test Type:	Development-Survival				Analyst:	Jacob Munson-Decker			
Start Date:	05 Nov-15 08:50	Protocol:	EPA/600/R-95/136 (1995)				Diluent:	Laboratory Seawater			
Ending Date:	09 Nov-15 08:45	Species:	Strongylocentrotus purpuratus				Brine:	Not Applicable			
Duration:	96h	Source:	Field Collected				Age:				
Sample ID:	01-8242-6934	Code:	ADF9D36				Client:	SPAWAR			
Sample Date:	05 Nov-15 10:00	Material:	Copper sulfate				Project:	Pulsed Exposure			
Receive Date:		Source:	Pulsed Exposure								
Sample Age:	NA	Station:	3 Hour								
Comparison Summary											
Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method				
02-9521-1706	Proportion Normal	179	367	256.3	21.3%		Steel Many-One Rank Sum Test				
Point Estimate Summary											
Analysis ID	Endpoint	Level	µg/L	95% LCL	95% UCL	TU	Method				
06-1064-8139	Proportion Normal	EC50	295.9	241.3	334.7		Linear Regression (MLE)				
Proportion Normal Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	% Effect
0	Lab Control	4	0.9375	0.8774	0.9976	0.9	0.99	0.01887	0.03775	4.03%	0.0%
15		4	0.9225	0.8807	0.9643	0.9	0.96	0.01315	0.0263	2.85%	1.6%
36		4	0.965	0.9374	0.9926	0.94	0.98	0.00866	0.01732	1.8%	-2.93%
81		4	0.9175	0.8822	0.9528	0.89	0.94	0.01109	0.02217	2.42%	2.13%
179		4	0.8925	0.8245	0.9605	0.83	0.92	0.02136	0.04272	4.79%	4.8%
367		4	0.22	0	0.6893	0	0.63	0.1475	0.295	134.1%	76.53%
Proportion Normal Detail											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
0	Lab Control	0.93	0.99	0.9	0.93						
15		0.96	0.91	0.92	0.9						
36		0.97	0.97	0.98	0.94						
81		0.89	0.91	0.94	0.93						
179		0.92	0.83	0.9	0.92						
367		0	0.01	0.63	0.24						
Proportion Normal Binomials											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
0	Lab Control	93/100	99/100	90/100	93/100						
15		96/100	91/100	92/100	90/100						
36		97/100	97/100	98/100	94/100						
81		89/100	91/100	94/100	93/100						
179		92/100	83/100	90/100	92/100						
367		0/100	1/100	63/100	24/100						

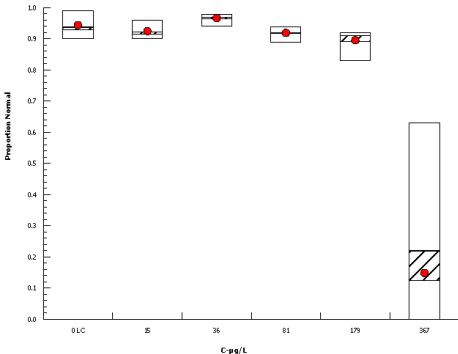
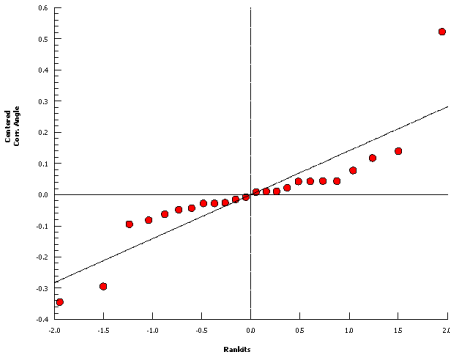
CETIS Analytical Report

Report Date: 02 Jun-16 16:08 (p 1 of 2)
Test Code: 73912D09 | 19-3889-4089

Echinoid Embryo-Larval Development Test						SPAWAR Systems Center					
Analysis ID: 02-9521-1706		Endpoint: Proportion Normal		CETIS Version: CETISv1.8.7							
Analyzed: 03 Feb-15 13:53		Analysis: Nonparametric-Control vs Treatments		Official Results: Yes							
Batch ID: 07-7568-4302		Test Type: Development-Survival		Analyst: Jacob Munson-Decker							
Start Date: 05 Nov-15 08:50		Protocol: EPA/600/R-95/136 (1995)		Diluent: Laboratory Seawater							
Ending Date: 09 Nov-15 08:45		Species: Strongylocentrotus purpuratus		Brine: Not Applicable							
Duration: 96h		Source: Field Collected		Age:							
Sample ID: 01-8242-6934		Code: ADF9D36		Client: SPAWAR							
Sample Date: 05 Nov-15 10:00		Material: Copper sulfate		Project: Pulsed Exposure							
Receive Date:		Source: Pulsed Exposure									
Sample Age: NA		Station: 3 Hour									
Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	NOEL	LOEL	TOEL	TU		
Angular (Corrected)	NA	C > T	NA	NA	21.3%	179	367	256.3			
Steel Many-One Rank Sum Test											
Control	vs	C-µg/L	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)		
Lab Control		15	15.5	10	1	6	0.5438	Asymp	Non-Significant Effect		
		36	22	10	0	6	0.9908	Asymp	Non-Significant Effect		
		81	16	10	1	6	0.6105	Asymp	Non-Significant Effect		
		179	12.5	10	1	6	0.1834	Asymp	Non-Significant Effect		
		367*	10	10	0	6	0.0417	Asymp	Significant Effect		
Auxiliary Tests											
Attribute	Test		Test Stat	Critical	P-Value	Decision(α:5%)					
Extreme Value	Grubbs Extreme Value		3.37	2.802	0.0019	Outlier Detected					
ANOVA Table											
Source	Sum Squares		Mean Square		DF	F Stat	P-Value	Decision(α:5%)			
Between	2.818988		0.5637977		5	18.38	<0.0001	Significant Effect			
Error	0.5520169		0.0306676		18						
Total	3.371005				23						
Distributional Tests											
Attribute	Test		Test Stat	Critical	P-Value	Decision(α:1%)					
Variances	Bartlett Equality of Variance		25.34	15.09	0.0001	Unequal Variances					
Distribution	Shapiro-Wilk W Normality		0.8123	0.884	0.0005	Non-normal Distribution					
Proportion Normal Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Lab Control	4	0.9375	0.8774	0.9976	0.93	0.9	0.99	0.01887	4.03%	0.0%
15		4	0.9225	0.8807	0.9643	0.915	0.9	0.96	0.01315	2.85%	1.6%
36		4	0.965	0.9374	0.9926	0.97	0.94	0.98	0.00866	1.8%	-2.93%
81		4	0.9175	0.8822	0.9528	0.92	0.89	0.94	0.01109	2.42%	2.13%
179		4	0.8925	0.8245	0.9605	0.91	0.83	0.92	0.02136	4.79%	4.8%
367		4	0.22	0	0.6893	0.125	0	0.63	0.1475	134.1%	76.53%
Angular (Corrected) Transformed Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Lab Control	4	1.331	1.178	1.485	1.303	1.249	1.471	0.04811	7.23%	0.0%
15		4	1.292	1.207	1.377	1.275	1.249	1.369	0.02673	4.14%	2.95%
36		4	1.386	1.315	1.458	1.397	1.323	1.429	0.02236	3.23%	-4.13%
81		4	1.281	1.217	1.345	1.285	1.233	1.323	0.02006	3.13%	3.77%
179		4	1.241	1.137	1.345	1.267	1.146	1.284	0.0327	5.27%	6.81%
367		4	0.3948	-0.2496	1.039	0.3061	0.05002	0.9169	0.2025	102.6%	70.35%

CETIS Analytical Report

Report Date: 02 Jun-16 16:08 (p 2 of 2)
 Test Code: 73912D09 | 19-3889-4089

Echinoid Embryo-Larval Development Test					SPAWAR Systems Center
Analysis ID: 02-9521-1706		Endpoint: Proportion Normal		CETIS Version: CETISv1.8.7	
Analyzed: 03 Feb-15 13:53		Analysis: Nonparametric-Control vs Treatments		Official Results: Yes	
Proportion Normal Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Control	0.93	0.99	0.9	0.93
15		0.96	0.91	0.92	0.9
36		0.97	0.97	0.98	0.94
81		0.89	0.91	0.94	0.93
179		0.92	0.83	0.9	0.92
367		0	0.01	0.63	0.24
Angular (Corrected) Transformed Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Control	1.303	1.471	1.249	1.303
15		1.369	1.266	1.284	1.249
36		1.397	1.397	1.429	1.323
81		1.233	1.266	1.323	1.303
179		1.284	1.146	1.249	1.284
367		0.05002	0.1002	0.9169	0.512
Proportion Normal Binomials					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Control	93/100	99/100	90/100	93/100
15		96/100	91/100	92/100	90/100
36		97/100	97/100	98/100	94/100
81		89/100	91/100	94/100	93/100
179		92/100	83/100	90/100	92/100
367		0/100	1/100	63/100	24/100
Graphics					
 					

CETIS Analytical Report

Report Date: 02 Jun-16 16:08 (p 1 of 2)
 Test Code: 73912D09 | 19-3889-4089

Echinoid Embryo-Larval Development Test							SPAWAR Systems Center				
Analysis ID: 06-1064-8139		Endpoint: Proportion Normal		CETIS Version: CETISv1.8.7							
Analyzed: 03 Feb-15 13:54		Analysis: Linear Regression (MLE)		Official Results: Yes							
Batch ID: 07-7568-4302		Test Type: Development-Survival		Analyst: Jacob Munson-Decker							
Start Date: 05 Nov-15 08:50		Protocol: EPA/600/R-95/136 (1995)		Diluent: Laboratory Seawater							
Ending Date: 09 Nov-15 08:45		Species: Strongylocentrotus purpuratus		Brine: Not Applicable							
Duration: 96h		Source: Field Collected		Age:							
Sample ID: 01-8242-6934		Code: ADF9D36		Client: SPAWAR							
Sample Date: 05 Nov-15 10:00		Material: Copper sulfate		Project: Pulsed Exposure							
Receive Date:		Source: Pulsed Exposure									
Sample Age: NA		Station: 3 Hour									
Linear Regression Options											
Model Function		Threshold Option	Threshold	Optimized	Pooled	Het Corr	Weighted				
Log-Normal [NED=A+B*log(X)]		Control Threshold	0.0625	Yes	No	Yes	Yes				
Regression Summary											
Iters	LL	AICc	BIC	Mu	Sigma	Adj R2	F Stat	Critical	P-Value	Decision(α:5%)	
7	-729.4	1466	1468	2.471	0.1296	0.8429	0.3041	3.16	0.8220	Non-Significant Lack of Fit	
Point Estimates											
Level	μg/L	95% LCL	95% UCL								
EC50	295.9	241.3	334.7								
Regression Parameters											
Parameter	Estimate	Std Error	95% LCL	95% UCL	t Stat	P-Value	Decision(α:5%)				
Threshold	0.06437	0.01803	0.02687	0.1019	3.569	0.0018	Significant Parameter				
Slope	7.715	1.839	3.89	11.54	4.195	0.0004	Significant Parameter				
Intercept	-19.07	4.635	-28.7	-9.426	-4.113	0.0005	Significant Parameter				
ANOVA Table											
Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)					
Model	1083.259	1083.259	1	125.4	<0.0001	Significant					
Lack of Fit	8.749746	2.916582	3	0.3041	0.8220	Non-Significant					
Pure Error	172.6161	9.589781	18								
Residual	181.3658	8.636467	21								
Residual Analysis											
Attribute	Method	Test Stat	Critical	P-Value	Decision(α:5%)						
Goodness-of-Fit	Pearson Chi-Sq GOF	181.4	32.67	<0.0001	Significant Heterogeneity						
	Likelihood Ratio GOF	200.5	32.67	<0.0001	Significant Heterogeneity						
Extreme Value	Grubbs Extreme Value	3.525	2.802	0.0006	Outlier Detected						
Variances	Mod Levene Equality of Variance	3.152	2.773	0.0323	Unequal Variances						
Distribution	Shapiro-Wilk W Normality	0.8215	0.9169	0.0007	Non-normal Distribution						
	Anderson-Darling A2 Normality	1.478	2.492	0.0002	Non-normal Distribution						
Proportion Normal Summary											
		Calculated Variate(A/B)									
C-μg/L	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
0	Lab Control	4	0.9375	0.9	0.99	0.01887	0.03775	4.03%	0.0%	375	400
15		4	0.9225	0.9	0.96	0.01315	0.0263	2.85%	1.6%	369	400
36		4	0.965	0.94	0.98	0.00866	0.01732	1.8%	-2.93%	386	400
81		4	0.9175	0.89	0.94	0.01109	0.02217	2.42%	2.13%	367	400
179		4	0.8925	0.83	0.92	0.02136	0.04272	4.79%	4.8%	357	400
367		4	0.22	0	0.63	0.1475	0.295	134.1%	76.53%	88	400

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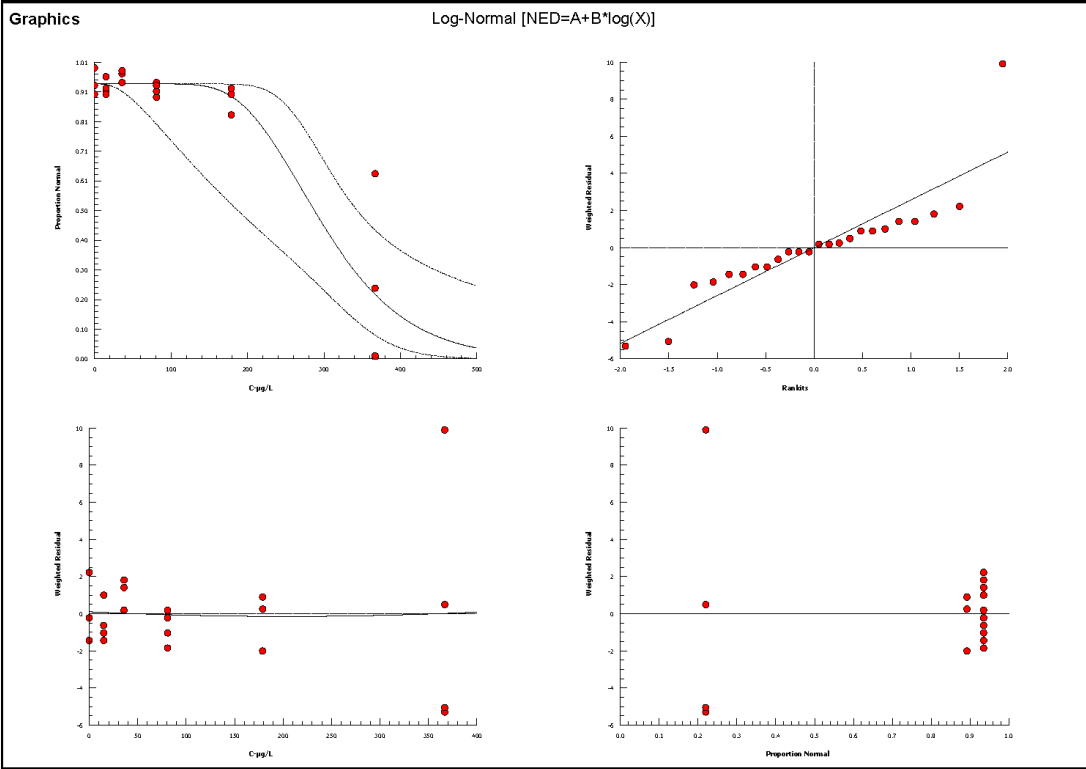
CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Analytical Report

Report Date: 02 Jun-16 16:08 (p 2 of 2)
Test Code: 73912D09 | 19-3889-4089

Echinoid Embryo-Larval Development Test					SPAWAR Systems Center
Analysis ID: 06-1064-8139		Endpoint: Proportion Normal		CETIS Version: CETISv1.8.7	
Analyzed: 03 Feb-15 13:54		Analysis: Linear Regression (MLE)		Official Results: Yes	
Proportion Normal Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Control	0.93	0.99	0.9	0.93
15		0.96	0.91	0.92	0.9
36		0.97	0.97	0.98	0.94
81		0.89	0.91	0.94	0.93
179		0.92	0.83	0.9	0.92
367		0	0.01	0.63	0.24
Proportion Normal Binomials					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Control	93/100	99/100	90/100	93/100
15		96/100	91/100	92/100	90/100
36		97/100	97/100	98/100	94/100
81		89/100	91/100	94/100	93/100
179		92/100	83/100	90/100	92/100
367		0/100	1/100	63/100	24/100



CETIS Summary Report

Report Date: 02 Jun-16 16:07 (p 1 of 1)
 Test Code: 43447F24 | 11-2856-2468

Echinoid Embryo-Larval Development Test							SPAWAR Systems Center				
Batch ID:	07-7568-4302	Test Type:	Development-Survival				Analyst:	Jacob Munson-Decker			
Start Date:	05 Nov-15 08:50	Protocol:	EPA/600/R-95/136 (1995)				Diluent:	Laboratory Seawater			
Ending Date:	09 Nov-15 08:45	Species:	Strongylocentrotus purpuratus				Brine:	Not Applicable			
Duration:	96h	Source:	Field Collected				Age:				
Sample ID:	11-1577-5855	Code:	4281636F				Client:	SPAWAR			
Sample Date:	05 Nov-15 08:50	Material:	Copper sulfate				Project:	Pulsed Exposure			
Receive Date:		Source:	Pulsed Exposure								
Sample Age:	NA	Station:	6 Hour								
Comparison Summary											
Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method				
14-9395-5559	Proportion Normal	36	81	54	6.96%		Dunnett Multiple Comparison Test				
Point Estimate Summary											
Analysis ID	Endpoint	Level	µg/L	95% LCL	95% UCL	TU	Method				
20-9663-9070	Proportion Normal	EC50	223.8	215.5	232.4		Trimmed Spearman-Kärber				
Proportion Normal Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	% Effect
0	Lab Control	4	0.9375	0.8774	0.9976	0.9	0.99	0.01887	0.03775	4.03%	0.0%
15		4	0.8975	0.8599	0.9351	0.88	0.93	0.01181	0.02363	2.63%	4.27%
36		4	0.91	0.865	0.955	0.89	0.95	0.01414	0.02828	3.11%	2.93%
81		4	0.8475	0.737	0.958	0.75	0.91	0.03473	0.06946	8.2%	9.6%
179		4	0.8225	0.7294	0.9156	0.76	0.89	0.02926	0.05852	7.12%	12.27%
367		4	0	0	0	0	0	0	0		100.0%
Proportion Normal Detail											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
0	Lab Control	0.93	0.99	0.9	0.93						
15		0.88	0.9	0.93	0.88						
36		0.91	0.89	0.95	0.89						
81		0.85	0.75	0.91	0.88						
179		0.79	0.85	0.76	0.89						
367		0	0	0	0						
Proportion Normal Binomials											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
0	Lab Control	93/100	99/100	90/100	93/100						
15		88/100	90/100	93/100	88/100						
36		91/100	89/100	95/100	89/100						
81		85/100	75/100	91/100	88/100						
179		79/100	85/100	76/100	89/100						
367		0/43	0/60	0/70	0/74						

000-010-187-1

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Analyst:_____ QA:_____

CETIS Analytical Report

Report Date: 02 Jun-16 16:07 (p 1 of 2)
 Test Code: 43447F24 | 11-2856-2468

Echinoid Embryo-Larval Development Test										SPAWAR Systems Center	
Analysis ID: 14-9395-5559		Endpoint: Proportion Normal		CETIS Version: CETISv1.8.7							
Analyzed: 03 Feb-15 13:55		Analysis: Parametric-Control vs Treatments		Official Results: Yes							
Batch ID: 07-7568-4302		Test Type: Development-Survival		Analyst: Jacob Munson-Decker							
Start Date: 05 Nov-15 08:50		Protocol: EPA/600/R-95/136 (1995)		Diluent: Laboratory Seawater							
Ending Date: 09 Nov-15 08:45		Species: Strongylocentrotus purpuratus		Brine: Not Applicable							
Duration: 96h		Source: Field Collected		Age:							
Sample ID: 11-1577-5855		Code: 4281636F		Client: SPAWAR							
Sample Date: 05 Nov-15 08:50		Material: Copper sulfate		Project: Pulsed Exposure							
Receive Date:		Source: Pulsed Exposure									
Sample Age: NA		Station: 6 Hour									
Data Transform		Zeta	Alt Hyp	Trials	Seed	PMSD	NOEL	LOEL	TOEL	TU	
Angular (Corrected)		NA	C > T	NA	NA	6.96%	36	81	54		
Dunnett Multiple Comparison Test											
Control	vs	C-µg/L	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)		
Lab Control		15	1.586	2.356	0.126	6	0.1797	CDF	Non-Significant Effect		
		36	1.163	2.356	0.126	6	0.3177	CDF	Non-Significant Effect		
		81*	2.907	2.356	0.126	6	0.0177	CDF	Significant Effect		
		179*	3.58	2.356	0.126	6	0.0047	CDF	Significant Effect		
Auxiliary Tests											
Attribute	Test			Test Stat	Critical	P-Value	Decision(α:5%)				
Extreme Value	Grubbs Extreme Value			2.07	2.708	0.5866	No Outliers Detected				
ANOVA Table											
Source	Sum Squares		Mean Square	DF	F Stat	P-Value	Decision(α:5%)				
Between	0.09249733		0.02312433	4	4.038	0.0204	Significant Effect				
Error	0.08590393		0.005726929	15							
Total	0.1784013			19							
Distributional Tests											
Attribute	Test			Test Stat	Critical	P-Value	Decision(α:1%)				
Variances	Bartlett Equality of Variance			2.597	13.28	0.6274	Equal Variances				
Distribution	Shapiro-Wilk W Normality			0.9679	0.866	0.7103	Normal Distribution				
Proportion Normal Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Lab Control	4	0.9375	0.8774	0.9976	0.93	0.9	0.99	0.01887	4.03%	0.0%
15		4	0.8975	0.8599	0.9351	0.89	0.88	0.93	0.01181	2.63%	4.27%
36		4	0.91	0.865	0.955	0.9	0.89	0.95	0.01414	3.11%	2.93%
81		4	0.8475	0.737	0.958	0.865	0.75	0.91	0.03473	8.2%	9.6%
179		4	0.8225	0.7294	0.9156	0.82	0.76	0.89	0.02926	7.12%	12.27%
367		4	0	0	0	0	0	0	0		100.0%
Angular (Corrected) Transformed Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Lab Control	4	1.331	1.178	1.485	1.303	1.249	1.471	0.04811	7.23%	0.0%
15		4	1.247	1.182	1.311	1.233	1.217	1.303	0.02028	3.25%	6.38%
36		4	1.269	1.185	1.354	1.249	1.233	1.345	0.02655	4.18%	4.67%
81		4	1.176	1.027	1.325	1.195	1.047	1.266	0.04691	7.98%	11.68%
179		4	1.14	1.015	1.264	1.134	1.059	1.233	0.03908	6.86%	14.39%
367		4	0.06472	0.05166	0.07777	0.0622	0.05816	0.07632	0.004103	12.68%	95.14%

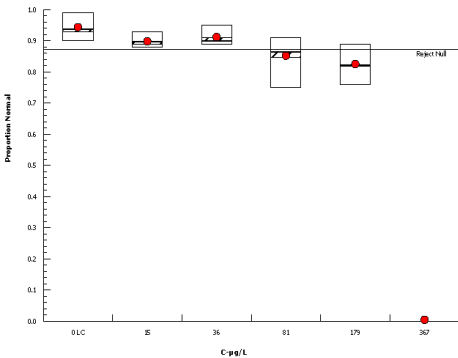
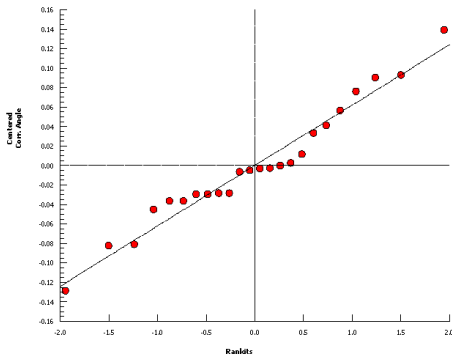
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Analyst:_____ QA:_____

CETIS Analytical Report

Report Date: 02 Jun-16 16:07 (p 2 of 2)
 Test Code: 43447F24 | 11-2856-2468

Echinoid Embryo-Larval Development Test					SPAWAR Systems Center
Analysis ID: 14-9395-5559		Endpoint: Proportion Normal		CETIS Version: CETISv1.8.7	
Analyzed: 03 Feb-15 13:55		Analysis: Parametric-Control vs Treatments		Official Results: Yes	
Proportion Normal Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Control	0.93	0.99	0.9	0.93
15		0.88	0.9	0.93	0.88
36		0.91	0.89	0.95	0.89
81		0.85	0.75	0.91	0.88
179		0.79	0.85	0.76	0.89
367		0	0	0	0
Angular (Corrected) Transformed Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Control	1.303	1.471	1.249	1.303
15		1.217	1.249	1.303	1.217
36		1.266	1.233	1.345	1.233
81		1.173	1.047	1.266	1.217
179		1.095	1.173	1.059	1.233
367		0.07632	0.06459	0.0598	0.05816
Proportion Normal Binomials					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Control	93/100	99/100	90/100	93/100
15		88/100	90/100	93/100	88/100
36		91/100	89/100	95/100	89/100
81		85/100	75/100	91/100	88/100
179		79/100	85/100	76/100	89/100
367		0/43	0/60	0/70	0/74
Graphics					
 					

CETIS Analytical Report

Report Date: 02 Jun-16 16:07 (p 1 of 2)
 Test Code: 43447F24 | 11-2856-2468

Echinoid Embryo-Larval Development Test					SPAWAR Systems Center						
Analysis ID:	20-9663-9070	Endpoint:	Proportion Normal		CETIS Version:	CETISv1.8.7					
Analyzed:	03 Feb-15 13:55	Analysis:	Trimmed Spearman-Kärber		Official Results:	Yes					
Batch ID:	07-7568-4302	Test Type:	Development-Survival		Analyst:	Jacob Munson-Decker					
Start Date:	05 Nov-15 08:50	Protocol:	EPA/600/R-95/136 (1995)		Diluent:	Laboratory Seawater					
Ending Date:	09 Nov-15 08:45	Species:	Strongylocentrotus purpuratus		Brine:	Not Applicable					
Duration:	96h	Source:	Field Collected		Age:						
Sample ID:	11-1577-5855	Code:	4281636F		Client:	SPAWAR					
Sample Date:	05 Nov-15 08:50	Material:	Copper sulfate		Project:	Pulsed Exposure					
Receive Date:		Source:	Pulsed Exposure								
Sample Age:	NA	Station:	6 Hour								
Trimmed Spearman-Kärber Estimates											
Threshold Option	Threshold	Trim	Mu	Sigma	EC50	95% LCL	95% UCL				
Control Threshold	0.0625	3.60%	2.35	0.008201	223.8	215.5	232.4				
Residual Analysis											
Attribute	Method	Test Stat	Critical	P-Value	Decision(α:5%)						
Extreme Value	Grubbs Extreme Value	2.275	2.802	0.3939	No Outliers Detected						
Proportion Normal Summary				Calculated Variate(A/B)							
C-μg/L	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
0	Lab Control	4	0.9375	0.9	0.99	0.01887	0.03775	4.03%	0.0%	375	400
15		4	0.8975	0.88	0.93	0.01181	0.02363	2.63%	4.27%	359	400
36		4	0.91	0.89	0.95	0.01414	0.02828	3.11%	2.93%	364	400
81		4	0.8475	0.75	0.91	0.03473	0.06946	8.2%	9.6%	339	400
179		4	0.8225	0.76	0.89	0.02926	0.05852	7.12%	12.27%	329	400
367		4	0	0	0	0	0		100.0%	0	247
Proportion Normal Detail											
C-μg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
0	Lab Control	0.93	0.99	0.9	0.93						
15		0.88	0.9	0.93	0.88						
36		0.91	0.89	0.95	0.89						
81		0.85	0.75	0.91	0.88						
179		0.79	0.85	0.76	0.89						
367		0	0	0	0						
Proportion Normal Binomials											
C-μg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
0	Lab Control	93/100	99/100	90/100	93/100						
15		88/100	90/100	93/100	88/100						
36		91/100	89/100	95/100	89/100						
81		85/100	75/100	91/100	88/100						
179		79/100	85/100	76/100	89/100						
367		0/43	0/60	0/70	0/74						

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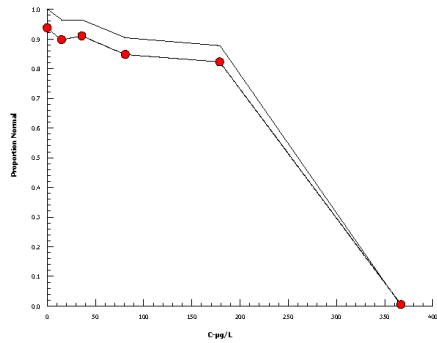
Analyst:_____ QA:_____

CETIS Analytical Report

Report Date: 02 Jun-16 16:07 (p 2 of 2)
Test Code: 43447F24 | 11-2856-2468

Echinoid Embryo-Larval Development Test			SPAWAR Systems Center
Analysis ID: 20-9663-9070	Endpoint: Proportion Normal	CETIS Version: CETISv1.8.7	
Analyzed: 03 Feb-15 13:55	Analysis: Trimmed Spearman-Kärber	Official Results: Yes	

Graphics



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CETIS™ v1.8.7.16

Analyst: _____ QA: _____

CETIS Summary Report

Report Date: 02 Jun-16 16:06 (p 1 of 1)
 Test Code: 3DBC6013 | 10-3575-5539

Echinoid Embryo-Larval Development Test								SPAWAR Systems Center			
Batch ID:	07-7568-4302	Test Type:	Development-Survival				Analyst:	Jacob Munson-Decker			
Start Date:	05 Nov-15 08:50	Protocol:	EPA/600/R-95/136 (1995)				Diluent:	Laboratory Seawater			
Ending Date:	09 Nov-15 08:45	Species:	Strongylocentrotus purpuratus				Brine:	Not Applicable			
Duration:	96h	Source:	Field Collected				Age:				
Sample ID:	07-9168-0289	Code:	2F301521				Client:	SPAWAR			
Sample Date:	05 Nov-15 08:50	Material:	Copper sulfate				Project:	Pulsed Exposure			
Receive Date:		Source:	Pulsed Exposure								
Sample Age:	NA	Station:	12 Hour								
Comparison Summary											
Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method				
08-0336-4843	Proportion Normal	81	179	120.4	4.65%		Dunnett Multiple Comparison Test				
Point Estimate Summary											
Analysis ID	Endpoint	Level	µg/L	95% LCL	95% UCL	TU	Method				
17-5820-2474	Proportion Normal	EC50	114.3	106.4	122		Linear Regression (MLE)				
Proportion Normal Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	% Effect
0	Lab Control	4	0.9375	0.8774	0.9976	0.9	0.99	0.01887	0.03775	4.03%	0.0%
15		4	0.935	0.8971	0.9729	0.91	0.96	0.0119	0.0238	2.55%	0.27%
36		4	0.935	0.9145	0.9555	0.92	0.95	0.006455	0.01291	1.38%	0.27%
81		4	0.9125	0.8853	0.9397	0.89	0.93	0.008539	0.01708	1.87%	2.67%
179		4	0.005	0	0.02091	0	0.02	0.005	0.01	200.0%	99.47%
367		4	0	0	0	0	0	0	0		100.0%
Proportion Normal Detail											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
0	Lab Control	0.93	0.99	0.9	0.93						
15		0.95	0.96	0.91	0.92						
36		0.93	0.95	0.94	0.92						
81		0.93	0.92	0.91	0.89						
179		0	0.02	0	0						
367		0	0	0	0						
Proportion Normal Binomials											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
0	Lab Control	93/100	99/100	90/100	93/100						
15		95/100	96/100	91/100	92/100						
36		93/100	95/100	94/100	92/100						
81		93/100	92/100	91/100	89/100						
179		0/100	2/100	0/100	0/100						
367		0/100	0/100	0/100	0/100						

CETIS Analytical Report

Report Date: 02 Jun-16 16:06 (p 1 of 2)
 Test Code: 3DBC6013 | 10-3575-5539

Echinoid Embryo-Larval Development Test										SPAWAR Systems Center	
Analysis ID: 08-0336-4843		Endpoint: Proportion Normal		CETIS Version: CETISv1.8.7							
Analyzed: 03 Feb-15 13:56		Analysis: Parametric-Control vs Treatments		Official Results: Yes							
Batch ID: 07-7568-4302		Test Type: Development-Survival		Analyst: Jacob Munson-Decker							
Start Date: 05 Nov-15 08:50		Protocol: EPA/600/R-95/136 (1995)		Diluent: Laboratory Seawater							
Ending Date: 09 Nov-15 08:45		Species: Strongylocentrotus purpuratus		Brine: Not Applicable							
Duration: 96h		Source: Field Collected		Age:							
Sample ID: 07-9168-0289		Code: 2F301521		Client: SPAWAR							
Sample Date: 05 Nov-15 08:50		Material: Copper sulfate		Project: Pulsed Exposure							
Receive Date:		Source: Pulsed Exposure									
Sample Age: NA		Station: 12 Hour									
Data Transform		Zeta	Alt Hyp	Trials	Seed		PMSD	NOEL	LOEL	TOEL	TU
Angular (Corrected)		NA	C > T	NA	NA		4.65%	81	179	120.4	
Dunnnett Multiple Comparison Test											
Control	vs	C-µg/L	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)		
Lab Control		15	0.3882	2.356	0.092	6	0.6529	CDF	Non-Significant Effect		
		36	0.4468	2.356	0.092	6	0.6277	CDF	Non-Significant Effect		
		81	1.53	2.356	0.092	6	0.1952	CDF	Non-Significant Effect		
		179*	32.1	2.356	0.092	6	<0.0001	CDF	Significant Effect		
Auxiliary Tests											
Attribute	Test			Test Stat	Critical	P-Value	Decision(α:5%)				
Extreme Value	Grubbs Extreme Value			2.826	2.708	0.0275	Outlier Detected				
ANOVA Table											
Source	Sum Squares		Mean Square		DF	F Stat	P-Value	Decision(α:5%)			
Between	4.890816		1.222704		4	397.9	<0.0001	Significant Effect			
Error	0.04609851		0.003073234		15						
Total	4.936914				19						
Distributional Tests											
Attribute	Test			Test Stat	Critical	P-Value	Decision(α:1%)				
Variances	Bartlett Equality of Variance			5.925	13.28	0.2048	Equal Variances				
Distribution	Shapiro-Wilk W Normality			0.9148	0.866	0.0788	Normal Distribution				
Proportion Normal Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Lab Control	4	0.9375	0.8774	0.9976	0.93	0.9	0.99	0.01887	4.03%	0.0%
15		4	0.935	0.8971	0.9729	0.935	0.91	0.96	0.0119	2.55%	0.27%
36		4	0.935	0.9145	0.9555	0.935	0.92	0.95	0.006455	1.38%	0.27%
81		4	0.9125	0.8853	0.9397	0.915	0.89	0.93	0.008539	1.87%	2.67%
179		4	0.005	0	0.02091	0	0	0.02	0.005	200.0%	99.47%
367		4	0	0	0	0	0	0	0		100.0%
Angular (Corrected) Transformed Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Lab Control	4	1.331	1.178	1.485	1.303	1.249	1.471	0.04811	7.23%	0.0%
15		4	1.316	1.238	1.394	1.315	1.266	1.369	0.02454	3.73%	1.14%
36		4	1.314	1.272	1.356	1.313	1.284	1.345	0.01318	2.01%	1.32%
81		4	1.271	1.224	1.319	1.275	1.233	1.303	0.01495	2.35%	4.5%
179		4	0.07299	-0.00011	0.1461	0.05002	0.05002	0.1419	0.02297	62.94%	94.52%
367		4	0.05002	0.05001	0.05003	0.05002	0.05002	0.05002	0	0.0%	96.24%

CETIS Analytical Report

Report Date: 02 Jun-16 16:06 (p 2 of 2)
Test Code: 3DBC6013 | 10-3575-5539

Echinoid Embryo-Larval Development Test					SPAWAR Systems Center
Analysis ID: 08-0336-4843		Endpoint: Proportion Normal		CETIS Version: CETISv1.8.7	
Analyzed: 03 Feb-15 13:56		Analysis: Parametric-Control vs Treatments		Official Results: Yes	
Proportion Normal Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Control	0.93	0.99	0.9	0.93
15		0.95	0.96	0.91	0.92
36		0.93	0.95	0.94	0.92
81		0.93	0.92	0.91	0.89
179		0	0.02	0	0
367		0	0	0	0
Angular (Corrected) Transformed Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Control	1.303	1.471	1.249	1.303
15		1.345	1.369	1.266	1.284
36		1.303	1.345	1.323	1.284
81		1.303	1.284	1.266	1.233
179		0.05002	0.1419	0.05002	0.05002
367		0.05002	0.05002	0.05002	0.05002
Proportion Normal Binomials					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Control	93/100	99/100	90/100	93/100
15		95/100	96/100	91/100	92/100
36		93/100	95/100	94/100	92/100
81		93/100	92/100	91/100	89/100
179		0/100	2/100	0/100	0/100
367		0/100	0/100	0/100	0/100
Graphics					

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CETIS™ v1.8.7.16

Analyst: _____ QA: _____

CETIS Analytical Report

Report Date: 02 Jun-16 16:06 (p 1 of 2)
Test Code: 3DBC6013 | 10-3575-5539

Echinoid Embryo-Larval Development Test							SPAWAR Systems Center				
Analysis ID:	17-5820-2474		Endpoint:	Proportion Normal			CETIS Version:	CETISv1.8.7			
Analyzed:	03 Feb-15 13:56		Analysis:	Linear Regression (MLE)			Official Results:	Yes			
Batch ID:	07-7568-4302		Test Type:	Development-Survival			Analyst:	Jacob Munson-Decker			
Start Date:	05 Nov-15 08:50		Protocol:	EPA/600/R-95/136 (1995)			Diluent:	Laboratory Seawater			
Ending Date:	09 Nov-15 08:45		Species:	Strongylocentrotus purpuratus			Brine:	Not Applicable			
Duration:	96h		Source:	Field Collected			Age:				
Sample ID:	07-9168-0289		Code:	2F301521			Client:	SPAWAR			
Sample Date:	05 Nov-15 08:50		Material:	Copper sulfate			Project:	Pulsed Exposure			
Receive Date:			Source:	Pulsed Exposure							
Sample Age:	NA		Station:	12 Hour							
Linear Regression Options											
Model Function			Threshold Option		Threshold	Optimized	Pooled	Het Corr	Weighted		
Log-Normal [NED=A+B*log(X)]			Control Threshold		0.0625	Yes	No	No	Yes		
Regression Summary											
Iters	LL	AICc	BIC	Mu	Sigma	Adj R2	F Stat	Critical	P-Value	Decision(α:5%)	
10	-417.2	841.6	844	2.058	0.07629	0.9899	-0.03479	3.16		Lack of Fit Not Tested	
Point Estimates											
Level	μg/L	95% LCL	95% UCL								
EC50	114.3	106.4	122								
Regression Parameters											
Parameter	Estimate	Std Error	95% LCL	95% UCL	t Stat	P-Value	Decision(α:5%)				
Threshold	0.06417	0.007074	0.0503	0.07803	9.071	<0.0001	Significant Parameter				
Slope	13.11	1.097	10.96	15.26	11.95	<0.0001	Significant Parameter				
Intercept	-26.98	2.299	-31.48	-22.47	-11.73	<0.0001	Significant Parameter				
ANOVA Table											
Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)					
Model	1935.078	1935.078	1	2265	<0.0001	Significant					
Lack of Fit	-0.10462	-0.03487	3	-0.03479							
Pure Error	18.04195	1.002331	18								
Residual	17.93733	0.854159	21								
Residual Analysis											
Attribute	Method	Test Stat	Critical	P-Value	Decision(α:5%)						
Goodness-of-Fit	Pearson Chi-Sq GOF	17.94	32.67	0.6530	Non-Significant Heterogeneity						
	Likelihood Ratio GOF	19.73	32.67	0.5386	Non-Significant Heterogeneity						
Extreme Value	Grubbs Extreme Value	2.503	2.802	0.1753	No Outliers Detected						
Variances	Mod Levene Equality of Variance	0.7524	2.773	0.5952	Equal Variances						
Distribution	Shapiro-Wilk W Normality	0.9097	0.9169	0.0347	Non-normal Distribution						
	Anderson-Darling A2 Normality	0.8486	2.492	0.0289	Non-normal Distribution						
Proportion Normal Summary											
			Calculated Variate(A/B)								
C-μg/L	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
0	Lab Control	4	0.9375	0.9	0.99	0.01887	0.03775	4.03%	0.0%	375	400
15		4	0.935	0.91	0.96	0.0119	0.0238	2.55%	0.27%	374	400
36		4	0.935	0.92	0.95	0.006455	0.01291	1.38%	0.27%	374	400
81		4	0.9125	0.89	0.93	0.008539	0.01708	1.87%	2.67%	365	400
179		4	0.005	0	0.02	0.005	0.01	200.0%	99.47%	2	400
367		4	0	0	0	0	0	100.0%	0	0	400

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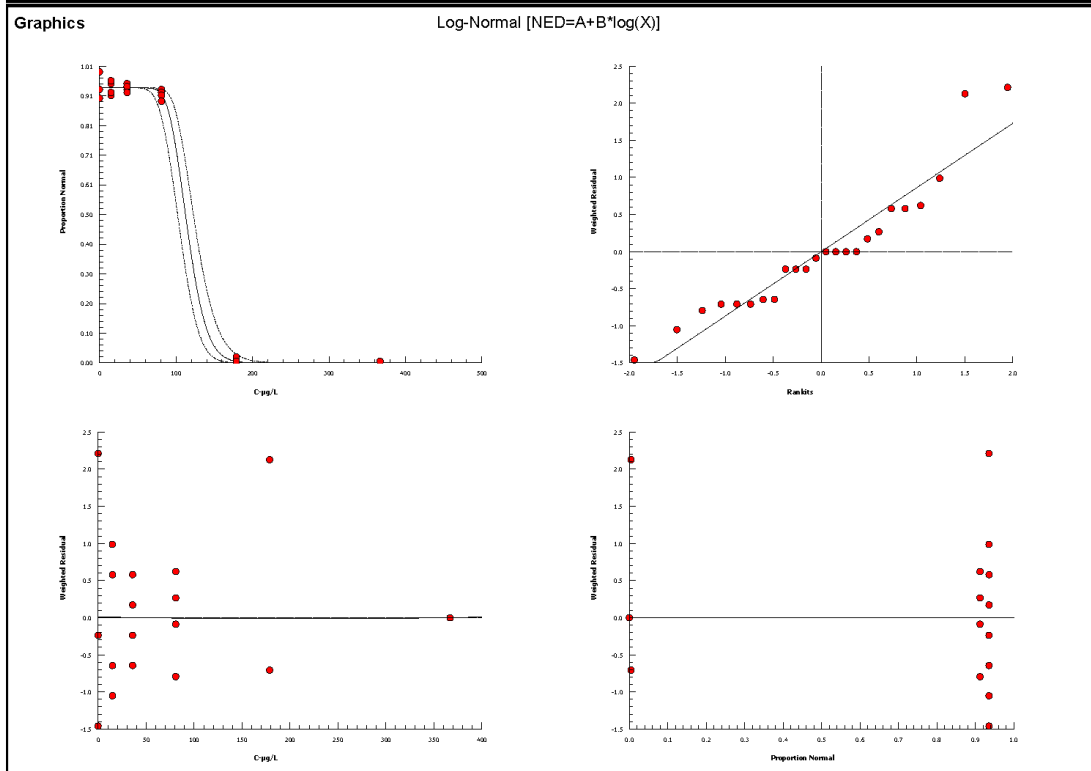
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Analyst:_____ QA:_____

CETIS Analytical Report

Report Date: 02 Jun-16 16:06 (p 2 of 2)
Test Code: 3DBC6013 | 10-3575-5539

Echinoid Embryo-Larval Development Test					SPAWAR Systems Center	
Analysis ID: 17-5820-2474		Endpoint: Proportion Normal			CETIS Version: CETISv1.8.7	
Analyzed: 03 Feb-15 13:56		Analysis: Linear Regression (MLE)			Official Results: Yes	
Proportion Normal Detail						
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	
0	Lab Control	0.93	0.99	0.9	0.93	
15		0.95	0.96	0.91	0.92	
36		0.93	0.95	0.94	0.92	
81		0.93	0.92	0.91	0.89	
179		0	0.02	0	0	
367		0	0	0	0	
Proportion Normal Binomials						
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	
0	Lab Control	93/100	99/100	90/100	93/100	
15		95/100	96/100	91/100	92/100	
36		93/100	95/100	94/100	92/100	
81		93/100	92/100	91/100	89/100	
179		0/100	2/100	0/100	0/100	
367		0/100	0/100	0/100	0/100	



000-010-187-1

CETIS™ v1.8.7.16

Analyst: _____ QA: _____

Embryo Larval Bioassay

96-Hour Development

Project: Definitive Cu Pulse Exposure TestTest Species: S. purpuratusSample ID: Start Date: Nov 9, 2015 0845Test No.: End Date: Nov 9, 2015 8:45AM

Sample ID	Number Counted	Number Normal	Technician Initials
36	100	63	Jm
37	100	94	JM
38	100	97	Jm
39	100	98	JM
40	100	24	Jm
41	100	1	Jm
42	100	96	Jm
43	100	97	Jm
44	100	90	Jm
45	100	99	JM
46	100	92	JM
47	100	91	JM
48	100	93	Jm
49	100	80	Jm
50	100	Jm 94 89	Jm
51	100	92	Jm
52	100	90	Jm
53	100	83	Jm
54	100	0	Jm
55	Jm 85 100	93	Jm
56	100	91	Jm
57	100	93	Jm
58	100	92	Jm
59	100	94	Jm
60	100	76	Jm
61	100	93	Jm
62	100	88	Jm
63	100	85	Jm
64	100	89	Jm
65	70	0	Jm
66	100	95	Jm
67	100	89	Jm
68	74	0	Jm
69	60	0	Jm
70	100	75	Jm

QC Check: Jm 8/1/16Final Review: LLC 4/2/16

SPAWAR Systems Center Pacific Bioassay Lab, 53475 Strothe Rd, Bldg 111 Rm 116, San Diego, CA 92152

96-Hour Development

Project: Definitive Cu Pulse Exposure Test **Test Species:** S. purpuratus

Sample ID: _____ **Start Date:** Nov 9, 2016 BHS Am

Test No.: _____ **End Date:** Nov 9, 2016 8:45 Am

[illegible]

QC Check: Jim 6/1/16 Final Review: lll 6/2/16

A-18

96-Hour Development

Project: Pulsed Experiment Definitive Test Species: *S. purpuratus*
Sample ID: 12 hour pulse Start Date: 11/5/2015 0845
Test No.: End Date: 11/9/2015 0845

[illegible]

SPAWAR Systems Center Pacific Bioassay Lab, 1111 Rm 116, San Diego, CA 92152

Embryo Larval Bioassay

96 HAT
48-Hour Development

Project: Definitive Pulse Study
Sample ID: C504 Rottax
Test No.: _____

Test Species: M. galloprovincialis
Start Date: 11/5/2015 0845
End Date: 11/9/2015 08145

Random #	Number Counted	Number Normal	Technician Initials
1	100	93	NH
2	100	91	NH
3	100	NH 82 97	NH
4	100	82	NH
5	100	95	NH
6	100	89	NH
7	100	80	NH
8	100	94	NH
9	100	90	NH
10	100	92	NH
11	100	89	NH
12	100	90	NH
13	100	93	NH
14	100	94 NH 93	NH
15	100	94	NH
16	100	97	NH
17	100	91	NH
18	100	68	NH
19	100	70	NH
20	100	91	NH
21	100	89	NH
22	100	93	NH
23	100	84	NH
24	100	89	NH
25	100	90	NH
26	100	95	NH
27	100	77	NH
28	100	68	NH
29	100	87	NH
30	100	90	NH
31	100	96	NH
32	100	96	NH
33	100	92	NH
34	100	94	NH
35	100	91	NH

QC Check: Jul 6/1/16

Final Review: llc 6/2/16 #15/16

SPAWAR Systems Center Pacific Bioassay Lab, 53475 Strothe Rd, Bldg 111 Rm 116, San Diego, CA 92152

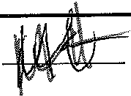
SPAWAR Pulsed Exposure Definitive Study

Echinoderm Development Tests

Test Initiation Date: 10/28/2015 ^{11/5/2015}

3 1-hour exposure

Copper Concentration (µg/L)	Rand#
Lab Control	48
	45
	52
	55
15.6 500 Mitt	54
	41
	36
	40
31.3	42
	56
	46
	49
62.5	38
	43
	39
	37
125	50
	47
	59
	57
250	58
	53
	44
	51

QC Check: 

SPAWAR Systems Center Pacific Bioassay Lab, 53475 Strothe Rd, Bldg 111 Rm 116, San Diego, CA 92152

SPAWAR Pulsed Exposure Definitive Study

Echinoderm Development Tests

Test Initiation Date: ~~10/20/2015~~ ^{N4H} 11/5/2015

6-hour exposure

Copper Concentration (µg/L)	Rand#
15.6 ^{N4H} 500	77 69 65 68
31.3	62 79 61 73
62.5	71 64 66 67
125	76 70 78 72
250	75 63 60 74

QC Check: 

SPAWAR Systems Center Pacific Bioassay Lab, 53475 Strothe Rd, Bldg 111 Rm 116, San Diego, CA 92152

SPAWAR Pulsed Exposure Definitive Study

Echinoderm Development Tests

Test Initiation Date: 10/28/2015

12-hour exposure

11/15/2015

Copper Concentration (µg/L)	Rand#
15.6 500 ^{NAH}	81 95 80 92
31.3	93 86 82 84
62.5	88 96 94 97
125	91 98 83 87
250	90 85 89 99

QC Check: NAH

SPAWAR Systems Center Pacific Bioassay Lab, 53475 Strothe Rd, Bldg 111 Rm 116, San Diego, CA 92152

SPAWAR Pulsed Exposure Definitive Study

Echinoderm Development Tests

Test Initiation Date: 10/28/2015

Copper Reference Toxicant

11/5/2015

Copper Concentration (µg/L)	Rand#
Lab Control	5
	30
	25
	2
	35
5.8	11
	22
	14
	31
	21
8.4	8
	1
	13
	32
	9
12	26
	10
	6
	15
	12
17.2	3
	17
	20
	29
	33
24	7
	16
	24
	23
	34
35	19
	18
	27
	4
	28

QC Check:

[Signature]

SPAWAR Systems Center Pacific Bioassay Lab, 53475 Strothe Rd, Bldg 111 Rm 116, San Diego, CA 92152

Marine Chronic Bioassay

Water Quality Measurements

Project: Pulsed Exposure Study
 Sample ID: 3, 6, 12 Pulses
 Test No.: _____

Test Species: S. purpuratus
 Start Date/Time: 11/5/2015 0845
 End Date/Time: 11/5/2015 0845

Concentration mL μ g/L	Salinity (ppt)					Temperature (°C)					Dissolved Oxygen (mg/L)					pH (pH units)				
	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96
Lab Control - 0	33.8	33.9	34.1	33.7	33.7	15.4	15.0	14.9	15.2	14.9	8.9	8.6	8.8	8.5	9.0	7.99	7.93	8.10	7.98	7.99
3hr 31	33.8	33.9	34.1	33.2	34.2	15.4	14.8	14.9	15.4	15.0	8.9	8.7	8.8	8.4	9.0	8.10	7.93	7.99	7.96	7.92
3hr 500	33.7	33.8	34.1	34.2	34.4	15.4	14.8	14.9	15.8	15.0	8.9	8.6	8.8	9.0	9.0	8.10	7.93	8.10	8.07	8.01
6hr 31	33.8	33.8	34.1	32.9	34.2	15.4	14.8	14.9	15.4	15.0	8.9	8.6	8.8	8.0	1.0	8.10	7.94	7.99	8.03	7.92
6hr 500	33.7	33.8	34.1	32.2	34.4	15.4	14.8	14.9	15.6	15.0	8.9	8.6	8.8	8.7	9.0	8.10	7.94	7.99	8.00	8.01
12hr 31	33.8	33.8	34.1	32.8	34.2	15.4	14.8	14.9	15.7	15.0	8.9	8.7	8.8	8.6	9.0	8.10	7.94	7.99	8.05	7.92
12hr 500	33.7	33.8	34.1	32.2	34.4	15.4	14.9	14.9	15.6	15.0	8.9	8.7	8.8	8.6	9.0	8.10	7.94	7.99	8.00	8.01

Technician Initials: _____

WQ Readings: MC MC MC MC MC
 Dilutions made by: MC MC MC MC MC

Animal Source/Date Received: Nautilus Environmental 11/5/2015

Comments: _____

0 hrs: _____

24 hrs: _____

48 hrs: _____

72 hrs: MC MC MC MC MC

QC Check: _____

Final Review: _____

Marine Chronic Bioassay

Water Quality Measurements

Project: Polished Exposure Study
 Sample ID: CuSO₄ Reference Toxicant
 Test No.: _____

Test Species: S. purpuratus

Start Date/Time: 11/5/2015 0845

End Date/Time: 11/9/2015 08450

Concentration mL % µg/L	Salinity (ppt)					Temperature (°C)					Dissolved Oxygen (mg/L)					pH (pH units)				
	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96
Lab Control: $\emptyset$	33.8	33.8	34.0	32.7	33.2	15.4	15.0	14.8	15.4	15.7	8.9	8.7	9.0	8.4	9.28	7.99	7.93	8.01	7.76	7.82
5.8	33.8	33.8	34.1	33.3	33.6	15.4	15.1	14.8	15.4	15.2	8.8	8.6	8.9	8.7	9.6	8.03	7.93	7.99	8.05	7.89
8.4	33.8	33.8	34.1	34.6	35.0	15.4	15.1	14.7	15.4	15.4	8.9	8.7	8.8	9.1	9.4	8.05	7.94	7.99	8.06	7.88
12.1	33.8	33.8	34.1	33.3	33.7	15.4	15.0	14.8	15.4	15.5	8.9	8.7	8.8	9.2	9.4	8.05	7.95	7.99	8.08	7.87
17.2	33.8	33.8	34.1	32.4	33.8	15.4	15.1	14.8	15.4	15.1	9.0	8.7	8.8	9.3	9.6	8.07	7.98	7.99	8.08	7.97
24	33.8	33.8	34.1	33.4	33.9	15.4	15.0	14.8	15.4	15.4	9.0	8.7	8.8	9.0	9.4	8.07	7.98	7.99	8.10	7.90
31	33.8	33.8	34.1	33.5	33.8	15.4	15.0	14.8	15.4	15.8	8.9	8.7	8.8	9.1	9.2	8.10	7.98	7.99	8.09	7.99

Technician Initials: _____

WQ Readings: _____

Dilutions made by: _____

Animal Source/Date Received: Nautilius Environmental 11/5/2015

Comments:

0 hrs: (A) = 0.22

24 hrs: _____

48 hrs: 0.22 mL

72 hrs: _____

QC Check: _____

Final Review: 11/12/2015

Embryo-Larval Development Test – SPAWNING CHECKLIST & CALCULATIONS

Batch ID: 110515Sp
Analyst: LL

Spawn/Test Date: 11/5/2015
Test Species: S. purpuratus

Task	Time
Spawning Inducement Initiated	0600
Spawning Begins	0601
Females/Males Isolated in Incubator	3 ♀ 2 ♂
Fertilization Initiated	0615
Fertilization Terminated/eggs rinsed	0635
Embryo Counts	0815
Embryo addition to vials	NL-083 0845

Embryo Counts:

Embryo Stock #1: 39, 42, 46 Mean = 42.3 / 20 uL * 1000 uL/mL = 2116 cells/mL
 1B Embryo Stock #2: 13, 105, 107 Mean = 75 / 20 uL * 1000 uL/mL = 4750 cells/mL
 Embryo Stock #3: 35, 34, 30 Mean = 33 / 20 uL * 1000 uL/mL = 1650 cells/mL

Adjust selected embryo stock to 2000 embryos/mL. Confirm density:

1B Selected Stock: 51, 58, 54 Mean = 54 / 20 uL * 1000 uL/mL = 2710 cells/mL

Add 100 µl of 2000 embryo/mL stock to obtain 20 embryos/mL in test vials.

Notes:

Egg stocks #1 & #3 look good; #2 - some irregular shaped / low density.
Sperm stocks both look good.

Fertilization checked @ 0625: #1 - ~80-90% fertilized @ 0630 - ~100%
 2 - 0%
 3 - 90% + " @ 063 - 100%

Stock 1B selected - 100% division @ 2 cell stage @ initiation
 Add 100µl of selected stock

A.2. COPPER EXPOSURES – MYSID SHRIMP:

CETIS Summary Report

Report Date: 02 Jun-16 16:04 (p 1 of 1)
Test Code: 16F09E6 | 00-2405-4246

Americamysis 96-h Acute Survival Test							SPAWAR Systems Center				
Batch ID:	00-4319-0877	Test Type: Survival (96h)				Analyst:		Jacob Munson-Decker			
Start Date:	28 Oct-15 09:45	Protocol: EPA/821/R-02-012 (2002)				Diluent:		Laboratory Seawater			
Ending Date:	01 Nov-15 08:30	Species: Americamysis bahia				Brine:		Not Applicable			
Duration:	95h	Source: Aquatic Research Organisms, NH				Age:		5			
Sample ID:	12-1527-4193	Code: 486F9CD1				Client:		SPAWAR			
Sample Date:	28 Oct-15	Material: Copper sulfate				Project:		Pulsed Exposure			
Receive Date:		Source: Pulsed Exposure									
Sample Age:	10h	Station: 3 Hour									
Comparison Summary											
Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method				
17-9286-0157	96h Survival Rate	693	1390	981.5	50.0%		Dunnett Multiple Comparison Test				
Point Estimate Summary											
Analysis ID	Endpoint	Level	µg/L	95% LCL	95% UCL	TU	Method				
05-2018-4188	96h Survival Rate	LC50	1475	967.6	2248		Trimmed Spearman-Kärber				
96h Survival Rate Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Lab Control	4	0.9	0.7163	1	0.8	1	0.05774	0.1155	12.83%	0.0%
177.5		4	0.65	0.3453	0.9547	0.4	0.8	0.09574	0.1915	29.46%	27.78%
355.1		4	0.75	0.4453	1	0.6	1	0.09574	0.1915	25.53%	16.67%
693		4	0.75	0.3496	1	0.4	1	0.1258	0.2517	33.55%	16.67%
1390		4	0.45	0	1	0	0.8	0.2062	0.4123	91.62%	50.0%
2970		4	0.25	0	0.7274	0	0.6	0.15	0.3	120.0%	72.22%
96h Survival Rate Detail											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
0	Lab Control	0.8	1	1	0.8						
177.5		0.4	0.8	0.6	0.8						
355.1		0.6	1	0.6	0.8						
693		0.8	0.4	1	0.8						
1390		0.8	0	0.2	0.8						
2970		0	0	0.4	0.6						
96h Survival Rate Binomials											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
0	Lab Control	4/5	5/5	5/5	4/5						
177.5		2/5	4/5	3/5	4/5						
355.1		3/5	5/5	3/5	4/5						
693		4/5	2/5	5/5	4/5						
1390		4/5	0/5	1/5	4/5						
2970		0/5	0/5	2/5	3/5						

000-010-187-1

CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Analytical Report

Report Date: 02 Jun-16 16:04 (p 1 of 2)
 Test Code: 16F09E6 | 00-2405-4246

Americamysis 96-h Acute Survival Test										SPAWAR Systems Center	
Analysis ID: 17-9286-0157		Endpoint: 96h Survival Rate					CETIS Version: CETISv1.8.7				
Analyzed: 05 May-16 11:48		Analysis: Parametric-Control vs Treatments					Official Results: Yes				
Batch ID: 00-4319-0877		Test Type: Survival (96h)					Analyst: Jacob Munson-Decker				
Start Date: 28 Oct-15 09:45		Protocol: EPA/821/R-02-012 (2002)					Diluent: Laboratory Seawater				
Ending Date: 01 Nov-15 08:30		Species: Americamysis bahia					Brine: Not Applicable				
Duration: 95h		Source: Aquatic Research Organisms, NH					Age: 5				
Sample ID: 12-1527-4193		Code: 486F9CD1					Client: SPAWAR				
Sample Date: 28 Oct-15		Material: Copper sulfate					Project: Pulsed Exposure				
Receive Date:		Source: Pulsed Exposure									
Sample Age: 10h		Station: 3 Hour									
Data Transform		Zeta	Alt Hyp	Trials	Seed		PMSD	NOEL	LOEL	TOEL	TU
Angular (Corrected)		NA	C > T	NA	NA		50.0%	693	1390	981.5	
Dunnett Multiple Comparison Test											
Control	vs	C-µg/L	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)		
Lab Control		177.5	1.374	2.407	0.491	6	0.2708	CDF	Non-Significant Effect		
		355.1	0.8346	2.407	0.491	6	0.4964	CDF	Non-Significant Effect		
		693	0.8104	2.407	0.491	6	0.5075	CDF	Non-Significant Effect		
		1390*	2.455	2.407	0.491	6	0.0456	CDF	Significant Effect		
		2970*	3.537	2.407	0.491	6	0.0050	CDF	Significant Effect		
ANOVA Table											
Source	Sum Squares		Mean Square		DF	F Stat	P-Value	Decision(α:5%)			
Between	1.369727		0.2739454		5	3.299	0.0274	Significant Effect			
Error	1.494823		0.08304574		18						
Total	2.86455				23						
Distributional Tests											
Attribute	Test			Test Stat	Critical	P-Value	Decision(α:1%)				
Variances	Bartlett Equality of Variance			4.34	15.09	0.5016	Equal Variances				
Distribution	Shapiro-Wilk W Normality			0.9573	0.884	0.3861	Normal Distribution				
96h Survival Rate Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Lab Control	4	0.9	0.7163	1	0.9	0.8	1	0.05774	12.83%	0.0%
177.5		4	0.65	0.3453	0.9547	0.7	0.4	0.8	0.09574	29.46%	27.78%
355.1		4	0.75	0.4453	1	0.7	0.6	1	0.09574	25.53%	16.67%
693		4	0.75	0.3496	1	0.8	0.4	1	0.1258	33.55%	16.67%
1390		4	0.45	0	1	0.5	0	0.8	0.2062	91.62%	50.0%
2970		4	0.25	0	0.7274	0.2	0	0.6	0.15	120.0%	72.22%
Angular (Corrected) Transformed Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Lab Control	4	1.226	1.007	1.445	1.226	1.107	1.345	0.06874	11.21%	0.0%
177.5		4	0.9463	0.623	1.27	0.9966	0.6847	1.107	0.1016	21.47%	22.83%
355.1		4	1.056	0.7075	1.405	0.9966	0.8861	1.345	0.1096	20.75%	13.87%
693		4	1.061	0.6237	1.498	1.107	0.6847	1.345	0.1374	25.91%	13.47%
1390		4	0.7259	0.008422	1.443	0.7854	0.2255	1.107	0.2254	62.12%	40.8%
2970		4	0.5055	-0.02528	1.036	0.4551	0.2255	0.8861	0.1668	65.99%	58.78%

000-010-187-1

CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Analytical Report

Report Date: 02 Jun-16 16:04 (p 2 of 2)
Test Code: 16F09E6 | 00-2405-4246

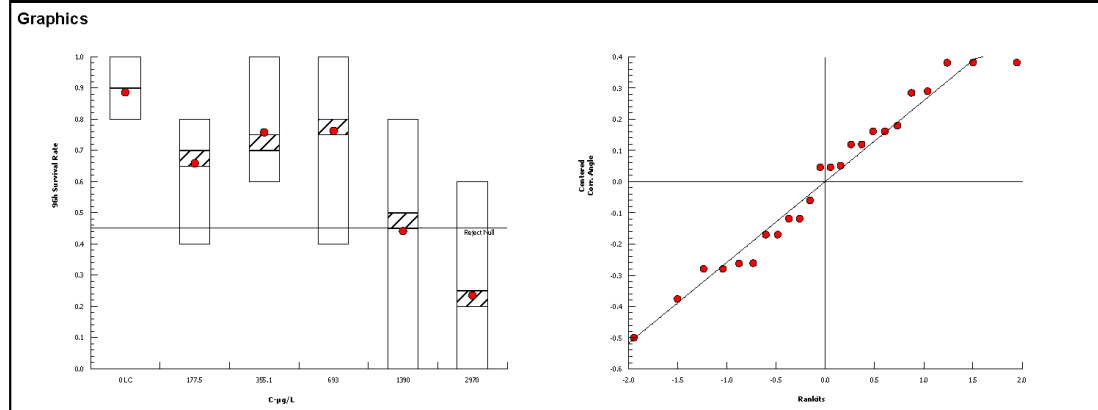
Americamysis 96-h Acute Survival Test SPAWAR Systems Center

Analysis ID: 17-9286-0157 Endpoint: 96h Survival Rate CETIS Version: CETISv1.8.7
Analyzed: 05 May-16 11:48 Analysis: Parametric-Control vs Treatments Official Results: Yes

96h Survival Rate Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Control	0.8	1	1	0.8
177.5		0.4	0.8	0.6	0.8
355.1		0.6	1	0.6	0.8
693		0.8	0.4	1	0.8
1390		0.8	0	0.2	0.8
2970		0	0	0.4	0.6

Angular (Corrected) Transformed Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Control	1.107	1.345	1.345	1.107
177.5		0.6847	1.107	0.8861	1.107
355.1		0.8861	1.345	0.8861	1.107
693		1.107	0.6847	1.345	1.107
1390		1.107	0.2255	0.4636	1.107
2970		0.2255	0.2255	0.6847	0.8861

96h Survival Rate Binomials					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Control	4/5	5/5	5/5	4/5
177.5		2/5	4/5	3/5	4/5
355.1		3/5	5/5	3/5	4/5
693		4/5	2/5	5/5	4/5
1390		4/5	0/5	1/5	4/5
2970		0/5	0/5	2/5	3/5



000-010-187-1

CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Analytical Report

Report Date: 02 Jun-16 16:04 (p 1 of 2)
Test Code: 16F09E6 | 00-2405-4246

Americamysis 96-h Acute Survival Test						SPAWAR Systems Center					
Analysis ID: 05-2018-4188		Endpoint: 96h Survival Rate				CETIS Version: CETISv1.8.7					
Analyzed: 05 May-16 11:48		Analysis: Trimmed Spearman-Kärber				Official Results: Yes					
Batch ID: 00-4319-0877		Test Type: Survival (96h)				Analyst: Jacob Munson-Decker					
Start Date: 28 Oct-15 09:45		Protocol: EPA/821/R-02-012 (2002)				Diluent: Laboratory Seawater					
Ending Date: 01 Nov-15 08:30		Species: Americamysis bahia				Brine: Not Applicable					
Duration: 95h		Source: Aquatic Research Organisms, NH				Age: 5					
Sample ID: 12-1527-4193		Code: 486F9CD1				Client: SPAWAR					
Sample Date: 28 Oct-15		Material: Copper sulfate				Project: Pulsed Exposure					
Receive Date:		Source: Pulsed Exposure									
Sample Age: 10h		Station: 3 Hour									
Trimmed Spearman-Kärber Estimates											
Threshold Option		Threshold	Trim	Mu	Sigma	LC50	95% LCL	95% UCL			
Control Threshold		0.1	27.78%	3.169	0.09154	1475	967.6	2248			
96h Survival Rate Summary						Calculated Variate(A/B)					
C-µg/L	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
0	Lab Control	4	0.9	0.8	1	0.05774	0.1155	12.83%	0.0%	18	20
177.5		4	0.65	0.4	0.8	0.09574	0.1915	29.46%	27.78%	13	20
355.1		4	0.75	0.6	1	0.09574	0.1915	25.53%	16.67%	15	20
693		4	0.75	0.4	1	0.1258	0.2517	33.55%	16.67%	15	20
1390		4	0.45	0	0.8	0.2062	0.4123	91.62%	50.0%	9	20
2970		4	0.25	0	0.6	0.15	0.3	120.0%	72.22%	5	20
96h Survival Rate Detail											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
0	Lab Control	0.8	1	1	0.8						
177.5		0.4	0.8	0.6	0.8						
355.1		0.6	1	0.6	0.8						
693		0.8	0.4	1	0.8						
1390		0.8	0	0.2	0.8						
2970		0	0	0.4	0.6						
96h Survival Rate Binomials											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
0	Lab Control	4/5	5/5	5/5	4/5						
177.5		2/5	4/5	3/5	4/5						
355.1		3/5	5/5	3/5	4/5						
693		4/5	2/5	5/5	4/5						
1390		4/5	0/5	1/5	4/5						
2970		0/5	0/5	2/5	3/5						

000-010-187-1

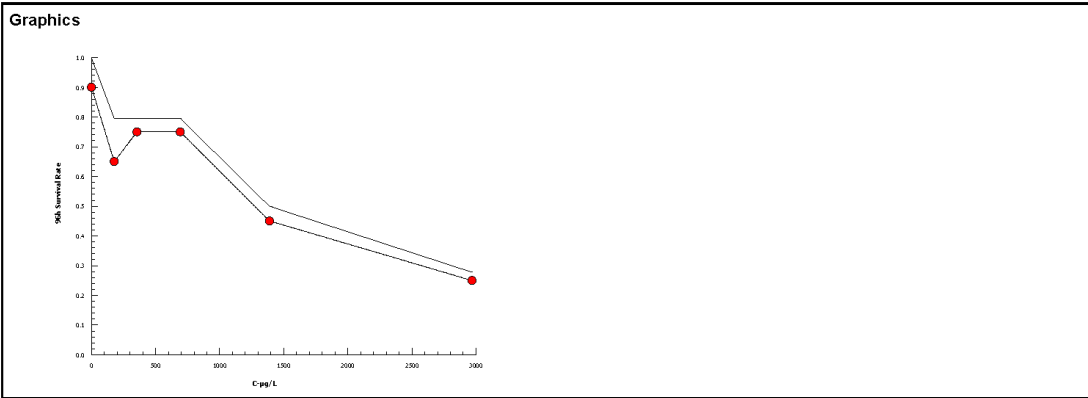
CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Analytical Report

Report Date: 02 Jun-16 16:04 (p 2 of 2)
Test Code: 16F09E6 | 00-2405-4246

Americamysis 96-h Acute Survival Test		SPAWAR Systems Center
Analysis ID: 05-2018-4188	Endpoint: 96h Survival Rate	CETIS Version: CETISv1.8.7
Analyzed: 05 May-16 11:48	Analysis: Trimmed Spearman-Kärber	Official Results: Yes



CETIS Summary Report

Report Date: 02 Jun-16 16:04 (p 1 of 1)
Test Code: 33BE39A1 | 08-6810-4609

Americamysis 96-h Acute Survival Test							SPAWAR Systems Center				
Batch ID:	00-4319-0877	Test Type:	Survival (96h)				Analyst:	Jacob Munson-Decker			
Start Date:	28 Oct-15 09:45	Protocol:	EPA/821/R-02-012 (2002)				Diluent:	Laboratory Seawater			
Ending Date:	01 Nov-15 08:30	Species:	Americamysis bahia				Brine:	Not Applicable			
Duration:	95h	Source:	Aquatic Research Organisms, NH				Age:	5			
Sample ID:	01-3892-7066	Code:	847DBDA				Client:	SPAWAR			
Sample Date:	28 Oct-15 09:35	Material:	Copper sulfate				Project:	Pulsed Exposure			
Receive Date:		Source:	Pulsed Exposure								
Sample Age:	10m	Station:	6 Hour								
Comparison Summary											
Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method				
17-1319-0763	96h Survival Rate	355.1	693	496.1	31.4%		Dunnett Multiple Comparison Test				
Point Estimate Summary											
Analysis ID	Endpoint	Level	µg/L	95% LCL	95% UCL	TU	Method				
04-7838-3697	96h Survival Rate	LC50	795.2	437.5	1202		Linear Regression (MLE)				
96h Survival Rate Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Lab Control	4	0.9	0.7163	1	0.8	1	0.05774	0.1155	12.83%	0.0%
177.5		4	0.85	0.6909	1	0.8	1	0.05	0.1	11.76%	5.56%
355.1		4	0.65	0.2496	1	0.4	1	0.1258	0.2517	38.72%	27.78%
693		4	0.55	0.1496	0.9504	0.2	0.8	0.1258	0.2517	45.76%	38.89%
1390		4	0.25	0.09088	0.4091	0.2	0.4	0.05	0.1	40.0%	72.22%
2970		4	0.1	0	0.2837	0	0.2	0.05774	0.1155	115.5%	88.89%
96h Survival Rate Detail											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
0	Lab Control	0.8	1	1	0.8						
177.5		0.8	1	0.8	0.8						
355.1		0.6	0.4	0.6	1						
693		0.6	0.8	0.6	0.2						
1390		0.2	0.2	0.4	0.2						
2970		0	0	0.2	0.2						
96h Survival Rate Binomials											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
0	Lab Control	4/5	5/5	5/5	4/5						
177.5		4/5	5/5	4/5	4/5						
355.1		3/5	2/5	3/5	5/5						
693		3/5	4/5	3/5	1/5						
1390		1/5	1/5	2/5	1/5						
2970		0/5	0/5	1/5	1/5						

000-010-187-1

CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Analytical Report

Report Date: 02 Jun-16 16:03 (p 1 of 2)
Test Code: 33BE39A1 | 08-6810-4609

Americamysis 96-h Acute Survival Test							SPAWAR Systems Center				
Analysis ID:	17-1319-0763		Endpoint:	96h Survival Rate			CETIS Version:	CETISv1.8.7			
Analyzed:	05 May-16 11:49		Analysis:	Parametric-Control vs Treatments			Official Results:	Yes			
Batch ID:	00-4319-0877		Test Type:	Survival (96h)			Analyst:	Jacob Munson-Decker			
Start Date:	28 Oct-15 09:45		Protocol:	EPA/821/R-02-012 (2002)			Diluent:	Laboratory Seawater			
Ending Date:	01 Nov-15 08:30		Species:	Americamysis bahia			Brine:	Not Applicable			
Duration:	95h		Source:	Aquatic Research Organisms, NH			Age:	5			
Sample ID:	01-3892-7066		Code:	847DBDA			Client:	SPAWAR			
Sample Date:	28 Oct-15 09:35		Material:	Copper sulfate			Project:	Pulsed Exposure			
Receive Date:			Source:	Pulsed Exposure							
Sample Age:	10m		Station:	6 Hour							
Data Transform	Zeta	Alt Hyp	Trials	Seed			PMSD	NOEL	LOEL	TOEL	TU
Angular (Corrected)	NA	C > T	NA	NA			31.4%	355.1	693	496.1	
Dunnett Multiple Comparison Test											
Control	vs	C-µg/L	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)		
Lab Control		177.5	0.4449	2.407	0.322	6	0.6712	CDF	Non-Significant Effect		
		355.1	2.06	2.407	0.322	6	0.0940	CDF	Non-Significant Effect		
		693*	2.918	2.407	0.322	6	0.0182	CDF	Significant Effect		
		1390*	5.286	2.407	0.322	6	0.0001	CDF	Significant Effect		
		2970*	6.589	2.407	0.322	6	<0.0001	CDF	Significant Effect		
ANOVA Table											
Source	Sum Squares		Mean Square		DF	F Stat	P-Value	Decision(α:5%)			
Between	2.466622		0.4933245		5	13.78	<0.0001	Significant Effect			
Error	0.6445779		0.03580988		18						
Total	3.1112				23						
Distributional Tests											
Attribute	Test			Test Stat	Critical	P-Value	Decision(α:1%)				
Variances	Bartlett Equality of Variance			4.764	15.09	0.4453	Equal Variances				
Distribution	Shapiro-Wilk W Normality			0.9509	0.884	0.2832	Normal Distribution				
96h Survival Rate Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Lab Control	4	0.9	0.7163	1	0.9	0.8	1	0.05774	12.83%	0.0%
177.5		4	0.85	0.6909	1	0.8	0.8	1	0.05	11.76%	5.56%
355.1		4	0.65	0.2496	1	0.6	0.4	1	0.1258	38.72%	27.78%
693		4	0.55	0.1496	0.9504	0.6	0.2	0.8	0.1258	45.76%	38.89%
1390		4	0.25	0.09088	0.4091	0.2	0.2	0.4	0.05	40.0%	72.22%
2970		4	0.1	0	0.2837	0.1	0	0.2	0.05774	115.5%	88.89%
Angular (Corrected) Transformed Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Lab Control	4	1.226	1.007	1.445	1.226	1.107	1.345	0.06874	11.21%	0.0%
177.5		4	1.167	0.9772	1.356	1.107	1.107	1.345	0.05953	10.21%	4.86%
355.1		4	0.9505	0.5054	1.396	0.8861	0.6847	1.345	0.1399	29.43%	22.48%
693		4	0.8357	0.4076	1.264	0.8861	0.4636	1.107	0.1345	32.19%	31.84%
1390		4	0.5189	0.343	0.6948	0.4636	0.4636	0.6847	0.05527	21.3%	57.68%
2970		4	0.3446	0.1258	0.5634	0.3446	0.2255	0.4636	0.06874	39.9%	71.9%

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CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Analytical Report

Report Date: 02 Jun-16 16:03 (p 2 of 2)
Test Code: 33BE39A1 | 08-6810-4609

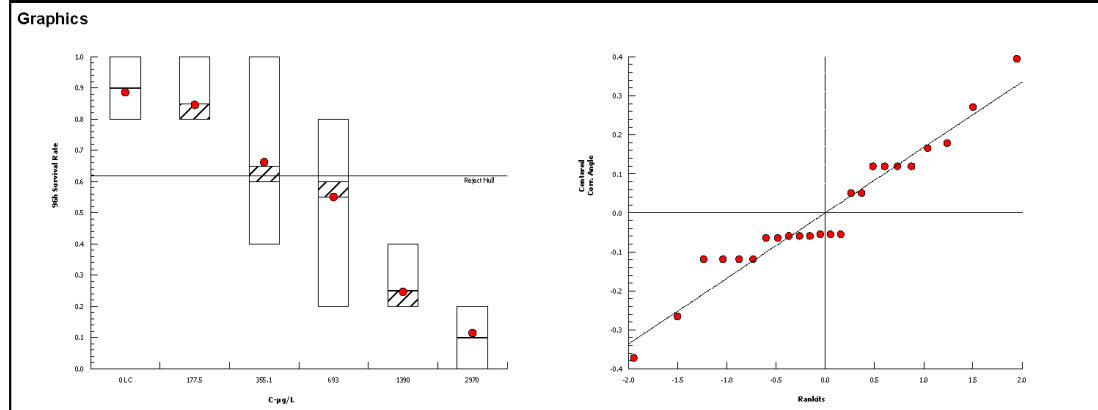
Americamysis 96-h Acute Survival Test SPAWAR Systems Center

Analysis ID: 17-1319-0763 Endpoint: 96h Survival Rate CETIS Version: CETISv1.8.7
Analyzed: 05 May-16 11:49 Analysis: Parametric-Control vs Treatments Official Results: Yes

96h Survival Rate Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Control	0.8	1	1	0.8
177.5		0.8	1	0.8	0.8
355.1		0.6	0.4	0.6	1
693		0.6	0.8	0.6	0.2
1390		0.2	0.2	0.4	0.2
2970		0	0	0.2	0.2

Angular (Corrected) Transformed Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Control	1.107	1.345	1.345	1.107
177.5		1.107	1.345	1.107	1.107
355.1		0.8861	0.6847	0.8861	1.345
693		0.8861	1.107	0.8861	0.4636
1390		0.4636	0.4636	0.6847	0.4636
2970		0.2255	0.2255	0.4636	0.4636

96h Survival Rate Binomials					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Control	4/5	5/5	5/5	4/5
177.5		4/5	5/5	4/5	4/5
355.1		3/5	2/5	3/5	5/5
693		3/5	4/5	3/5	1/5
1390		1/5	1/5	2/5	1/5
2970		0/5	0/5	1/5	1/5



000-010-187-1

CETIS™ v1.8.7.16

Analyst: _____ QA: _____

CETIS Analytical Report

Report Date: 02 Jun-16 16:04 (p 1 of 2)
 Test Code: 33BE39A1 | 08-6810-4609

Americamysis 96-h Acute Survival Test							SPAWAR Systems Center				
Analysis ID: 04-7838-3697		Endpoint: 96h Survival Rate			CETIS Version: CETISv1.8.7						
Analyzed: 05 May-16 11:49		Analysis: Linear Regression (MLE)			Official Results: Yes						
Batch ID: 00-4319-0877		Test Type: Survival (96h)			Analyst: Jacob Munson-Decker						
Start Date: 28 Oct-15 09:45		Protocol: EPA/821/R-02-012 (2002)			Diluent: Laboratory Seawater						
Ending Date: 01 Nov-15 08:30		Species: Americamysis bahia			Brine: Not Applicable						
Duration: 95h		Source: Aquatic Research Organisms, NH			Age: 5						
Sample ID: 01-3892-7066		Code: 847DBDA			Client: SPAWAR						
Sample Date: 28 Oct-15 09:35		Material: Copper sulfate			Project: Pulsed Exposure						
Receive Date:		Source: Pulsed Exposure									
Sample Age: 10m		Station: 6 Hour									
Linear Regression Options											
Model Function			Threshold Option		Threshold	Optimized	Pooled	Het Corr	Weighted		
Log-Normal [NED=A+B*log(X)]			Control Threshold		0.1	Yes	No	No	Yes		
Regression Summary											
Iters	LL	AICc	BIC	Mu	Sigma	Adj R2	F Stat	Critical	P-Value	Decision(α:5%)	
6	-59.69	126.6	128.9	2.9	0.4634	0.6797	0.3356	3.16	0.7998	Non-Significant Lack of Fit	
Point Estimates											
Level	μg/L	95% LCL	95% UCL								
LC50	795.2	437.5	1202								
Regression Parameters											
Parameter	Estimate	Std Error	95% LCL	95% UCL	t Stat	P-Value	Decision(α:5%)				
Threshold	0.09733	0.06288	-0.02592	0.2206	1.548	0.1366	Non-Significant Parameter				
Slope	2.158	0.5219	1.135	3.181	4.135	0.0005	Significant Parameter				
Intercept	-6.259	1.547	-9.291	-3.228	-4.047	0.0006	Significant Parameter				
ANOVA Table											
Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)					
Model	36.8787	36.8787	1	50.81	<0.0001	Significant					
Lack of Fit	0.807386	0.269129	3	0.3356	0.7998	Non-Significant					
Pure Error	14.43512	0.801951	18								
Residual	15.24251	0.725834	21								
Residual Analysis											
Attribute	Method	Test Stat	Critical	P-Value	Decision(α:5%)						
Goodness-of-Fit	Pearson Chi-Sq GOF	15.24	32.67	0.8106	Non-Significant Heterogeneity						
	Likelihood Ratio GOF	18.95	32.67	0.5881	Non-Significant Heterogeneity						
Variances	Bartlett Equality of Variance	2.92	11.07	0.7124	Equal Variances						
	Mod Levene Equality of Variance	0.6045	2.773	0.6974	Equal Variances						
Distribution	Shapiro-Wilk W Normality	0.9506	0.9169	0.2790	Normal Distribution						
	Anderson-Darling A2 Normality	0.6136	2.492	0.1114	Normal Distribution						
96h Survival Rate Summary											
C-μg/L	Control Type	Count	Calculated Variate(A/B)								
			Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
0	Lab Control	4	0.9	0.8	1	0.05774	0.1155	12.83%	0.0%	18	20
177.5		4	0.85	0.8	1	0.05	0.1	11.76%	5.56%	17	20
355.1		4	0.65	0.4	1	0.1258	0.2517	38.72%	27.78%	13	20
693		4	0.55	0.2	0.8	0.1258	0.2517	45.76%	38.89%	11	20
1390		4	0.25	0.2	0.4	0.05	0.1	40.0%	72.22%	5	20
2970		4	0.1	0	0.2	0.05774	0.1155	115.5%	88.89%	2	20

CETIS Analytical Report

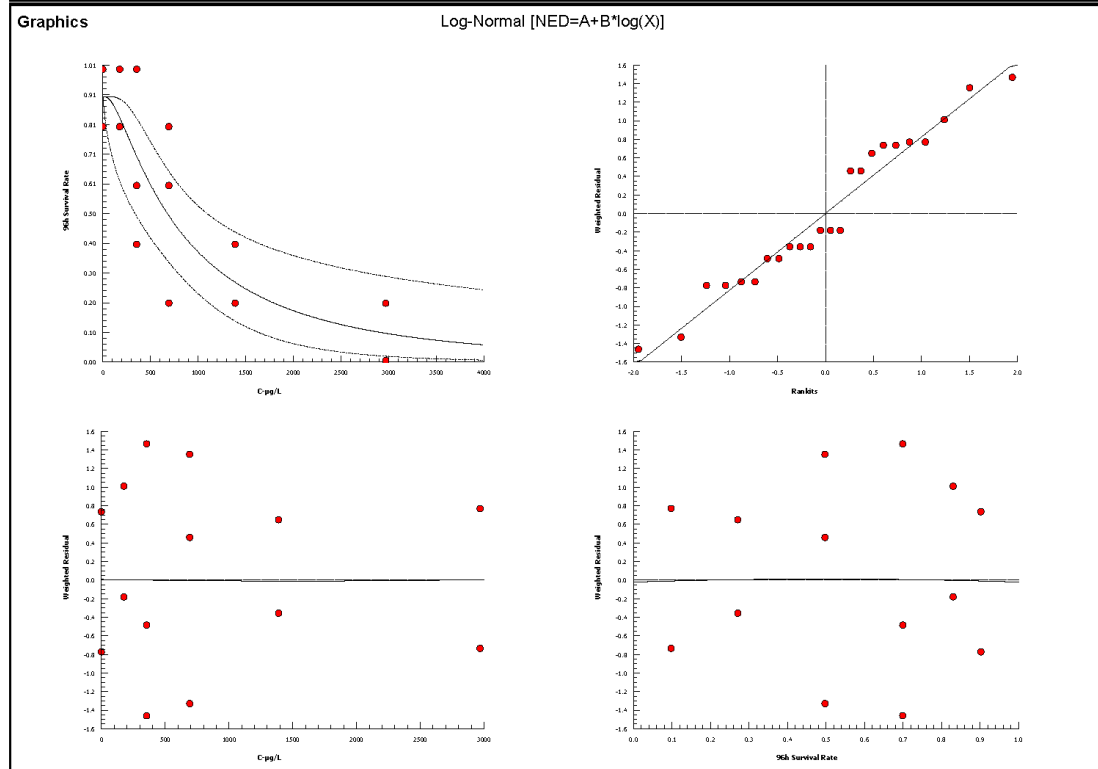
Report Date: 02 Jun-16 16:04 (p 2 of 2)
Test Code: 33BE39A1 | 08-6810-4609

Americamysis 96-h Acute Survival Test SPAWAR Systems Center

Analysis ID: 04-7838-3697 Endpoint: 96h Survival Rate CETIS Version: CETISv1.8.7
Analyzed: 05 May-16 11:49 Analysis: Linear Regression (MLE) Official Results: Yes

96h Survival Rate Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Control	0.8	1	1	0.8
177.5		0.8	1	0.8	0.8
355.1		0.6	0.4	0.6	1
693		0.6	0.8	0.6	0.2
1390		0.2	0.2	0.4	0.2
2970		0	0	0.2	0.2

96h Survival Rate Binomials					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Control	4/5	5/5	5/5	4/5
177.5		4/5	5/5	4/5	4/5
355.1		3/5	2/5	3/5	5/5
693		3/5	4/5	3/5	1/5
1390		1/5	1/5	2/5	1/5
2970		0/5	0/5	1/5	1/5



000-010-187-1

CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Summary Report

Report Date: 02 Jun-16 16:03 (p 1 of 1)
 Test Code: 7454A57A | 19-5170-4442

Americamysis 96-h Acute Survival Test								SPAWAR Systems Center			
Batch ID:	00-4319-0877	Test Type:	Survival (96h)					Analyst:	Jacob Munson-Decker		
Start Date:	28 Oct-15 09:45	Protocol:	EPA/821/R-02-012 (2002)					Diluent:	Laboratory Seawater		
Ending Date:	01 Nov-15 08:30	Species:	Americamysis bahia					Brine:	Not Applicable		
Duration:	95h	Source:	Aquatic Research Organisms, NH					Age:	5		
Sample ID:	20-6715-8179	Code:	7B3654A3					Client:	SPAWAR		
Sample Date:	28 Oct-15 09:35	Material:	Copper sulfate					Project:	Pulsed Exposure		
Receive Date:		Source:	Pulsed Exposure								
Sample Age:	10m	Station:	12 Hour								
Comparison Summary											
Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method				
11-7286-9114	96h Survival Rate	<177.5	177.5	NA	24.5%		Dunnett Multiple Comparison Test				
Point Estimate Summary											
Analysis ID	Endpoint	Level	µg/L	95% LCL	95% UCL	TU	Method				
13-0468-2566	96h Survival Rate	LC50	239.6	103.9	367.4		Linear Regression (MLE)				
96h Survival Rate Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Lab Control	4	0.9	0.7163	1	0.8	1	0.05774	0.1155	12.83%	0.0%
177.5		4	0.65	0.4909	0.8091	0.6	0.8	0.05	0.1	15.38%	27.78%
355.1		4	0.2	0	0.4598	0	0.4	0.08165	0.1633	81.65%	77.78%
693		4	0.2	0	0.4598	0	0.4	0.08165	0.1633	81.65%	77.78%
1390		4	0	0	0	0	0	0	0		100.0%
2970		4	0.05	0	0.2091	0	0.2	0.05	0.1	200.0%	94.44%
96h Survival Rate Detail											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
0	Lab Control	0.8	1	1	0.8						
177.5		0.8	0.6	0.6	0.6						
355.1		0.4	0	0.2	0.2						
693		0	0.2	0.4	0.2						
1390		0	0	0	0						
2970		0	0	0.2	0						
96h Survival Rate Binomials											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
0	Lab Control	4/5	5/5	5/5	4/5						
177.5		4/5	3/5	3/5	3/5						
355.1		2/5	0/5	1/5	1/5						
693		0/5	1/5	2/5	1/5						
1390		0/5	0/5	0/5	0/5						
2970		0/5	0/5	1/5	0/5						

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CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Analytical Report

Report Date: 02 Jun-16 16:03 (p 1 of 2)
Test Code: 7454A57A | 19-5170-4442

Americamysis 96-h Acute Survival Test										SPAWAR Systems Center	
Analysis ID:	11-7286-9114		Endpoint:	96h Survival Rate				CETIS Version:	CETISv1.8.7		
Analyzed:	05 May-16 11:49		Analysis:	Parametric-Control vs Treatments				Official Results:	Yes		
Batch ID:	00-4319-0877		Test Type:	Survival (96h)				Analyst:	Jacob Munson-Decker		
Start Date:	28 Oct-15 09:45		Protocol:	EPA/821/R-02-012 (2002)				Diluent:	Laboratory Seawater		
Ending Date:	01 Nov-15 08:30		Species:	Americamysis bahia				Brine:	Not Applicable		
Duration:	95h		Source:	Aquatic Research Organisms, NH				Age:	5		
Sample ID:	20-6715-8179		Code:	7B3654A3				Client:	SPAWAR		
Sample Date:	28 Oct-15 09:35		Material:	Copper sulfate				Project:	Pulsed Exposure		
Receive Date:			Source:	Pulsed Exposure							
Sample Age:	10m		Station:	12 Hour							
Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	NOEL	LOEL	TOEL	TU		
Angular (Corrected)	NA	C > T	NA	NA	24.5%	<177.5	177.5	NA			
Dunnett Multiple Comparison Test											
Control	vs	C-µg/L	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)		
Lab Control		177.5*	2.53	2.287	0.258	6	0.0328	CDF	Significant Effect		
		355.1*	6.809	2.287	0.258	6	<0.0001	CDF	Significant Effect		
		693*	6.809	2.287	0.258	6	<0.0001	CDF	Significant Effect		
ANOVA Table											
Source	Sum Squares		Mean Square		DF	F Stat	P-Value	Decision(α:5%)			
Between	1.721797		0.5739322		3	22.63	<0.0001	Significant Effect			
Error	0.3043779		0.02536483		12						
Total	2.026175				15						
Distributional Tests											
Attribute	Test		Test Stat	Critical	P-Value	Decision(α:1%)					
Variances	Bartlett Equality of Variance		0.977	11.34	0.8068	Equal Variances					
Distribution	Shapiro-Wilk W Normality		0.944	0.8408	0.4009	Normal Distribution					
96h Survival Rate Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Lab Control	4	0.9	0.7163	1	0.9	0.8	1	0.05774	12.83%	0.0%
177.5		4	0.65	0.4909	0.8091	0.6	0.6	0.8	0.05	15.38%	27.78%
355.1		4	0.2	0	0.4598	0.2	0	0.4	0.08165	81.65%	77.78%
693		4	0.2	0	0.4598	0.2	0	0.4	0.08165	81.65%	77.78%
1390		4	0	0	0	0	0	0	0		100.0%
2970		4	0.05	0	0.2091	0	0	0.2	0.05	200.0%	94.44%
Angular (Corrected) Transformed Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Lab Control	4	1.226	1.007	1.445	1.226	1.107	1.345	0.06874	11.21%	0.0%
177.5		4	0.9413	0.7655	1.117	0.8861	0.8861	1.107	0.05527	11.74%	23.23%
355.1		4	0.4594	0.161	0.7578	0.4636	0.2255	0.6847	0.09377	40.82%	62.54%
693		4	0.4594	0.161	0.7578	0.4636	0.2255	0.6847	0.09377	40.82%	62.54%
1390		4	0.2255	0.2255	0.2256	0.2255	0.2255	0.2255	0	0.0%	81.61%
2970		4	0.285	0.09558	0.4745	0.2255	0.2255	0.4636	0.05953	41.77%	76.75%
96h Survival Rate Detail											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
0	Lab Control	0.8	1	1	0.8						
177.5		0.8	0.6	0.6	0.6						
355.1		0.4	0	0.2	0.2						
693		0	0.2	0.4	0.2						
1390		0	0	0	0						
2970		0	0	0.2	0						

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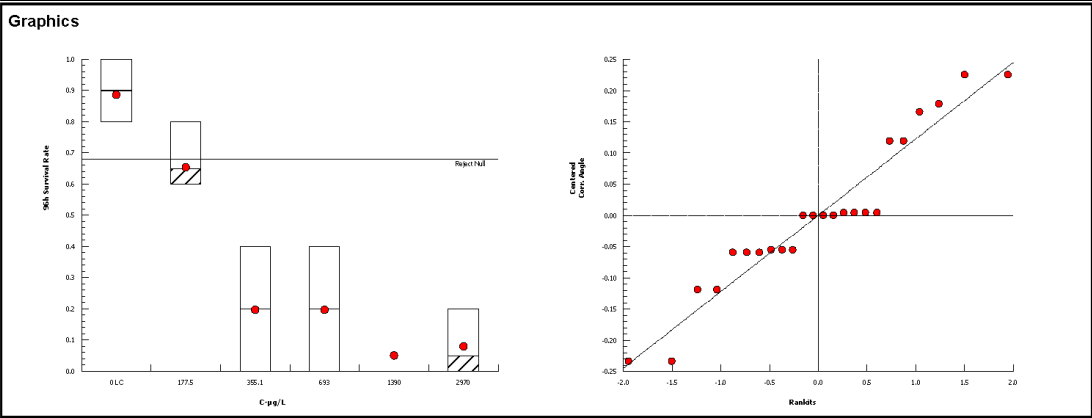
Analyst:_____ QA:_____

CETIS Analytical Report

Report Date: 02 Jun-16 16:03 (p 2 of 2)
Test Code: 7454A57A | 19-5170-4442

Americamysis 96-h Acute Survival Test					SPAWAR Systems Center
Analysis ID:	11-7286-9114	Endpoint:	96h Survival Rate	CETIS Version:	CETISv1.8.7
Analyzed:	05 May-16 11:49	Analysis:	Parametric-Control vs Treatments	Official Results:	Yes
Angular (Corrected) Transformed Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Control	1.107	1.345	1.345	1.107
177.5		1.107	0.8861	0.8861	0.8861
355.1		0.6847	0.2255	0.4636	0.4636
693		0.2255	0.4636	0.6847	0.4636
1390		0.2255	0.2255	0.2255	0.2255
2970		0.2255	0.2255	0.4636	0.2255

96h Survival Rate Binomials					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Control	4/5	5/5	5/5	4/5
177.5		4/5	3/5	3/5	3/5
355.1		2/5	0/5	1/5	1/5
693		0/5	1/5	2/5	1/5
1390		0/5	0/5	0/5	0/5
2970		0/5	0/5	1/5	0/5



CETIS Analytical Report

Report Date: 02 Jun-16 16:03 (p 1 of 2)
Test Code: 7454A57A | 19-5170-4442

Americamysis 96-h Acute Survival Test						SPAWAR Systems Center					
Analysis ID: 13-0468-2566		Endpoint: 96h Survival Rate				CETIS Version: CETISv1.8.7					
Analyzed: 05 May-16 11:50		Analysis: Linear Regression (MLE)				Official Results: Yes					
Batch ID: 00-4319-0877		Test Type: Survival (96h)				Analyst: Jacob Munson-Decker					
Start Date: 28 Oct-15 09:45		Protocol: EPA/821/R-02-012 (2002)				Diluent: Laboratory Seawater					
Ending Date: 01 Nov-15 08:30		Species: Americamysis bahia				Brine: Not Applicable					
Duration: 95h		Source: Aquatic Research Organisms, NH				Age: 5					
Sample ID: 20-6715-8179		Code: 7B3654A3				Client: SPAWAR					
Sample Date: 28 Oct-15 09:35		Material: Copper sulfate				Project: Pulsed Exposure					
Receive Date:		Source: Pulsed Exposure									
Sample Age: 10m		Station: 12 Hour									
Linear Regression Options											
Model Function			Threshold Option		Threshold	Optimized	Pooled	Het Corr	Weighted		
Log-Normal [NED=A+B*log(X)]			Control Threshold		0.1	Yes	No	No	Yes		
Regression Summary											
Iters	LL	AICc	BIC	Mu	Sigma	Adj R2	F Stat	Critical	P-Value	Decision(α:5%)	
8	-46.64	100.5	102.8	2.38	0.4933	0.547	8.432	3.16	0.0010	Significant Lack of Fit	
Point Estimates											
Level	μg/L	95% LCL	95% UCL								
LC50	239.6	103.9	367.4								
Regression Parameters											
Parameter	Estimate	Std Error	95% LCL	95% UCL	t Stat	P-Value	Decision(α:5%)				
Threshold	0.09418	0.06521	-0.03363	0.222	1.444	0.1634	Non-Significant Parameter				
Slope	2.027	0.4955	1.056	2.999	4.091	0.0005	Significant Parameter				
Intercept	-4.824	1.328	-7.427	-2.221	-3.632	0.0016	Significant Parameter				
ANOVA Table											
Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)					
Model	37.64648	37.64648	1	29.77	<0.0001	Significant					
Lack of Fit	15.51407	5.171355	3	8.432	0.0010	Significant					
Pure Error	11.03946	0.613303	18								
Residual	26.55352	1.264454	21								
Residual Analysis											
Attribute	Method	Test Stat	Critical	P-Value	Decision(α:5%)						
Goodness-of-Fit	Pearson Chi-Sq GOF	26.55	32.67	0.1861	Non-Significant Heterogeneity						
	Likelihood Ratio GOF	19.61	32.67	0.5463	Non-Significant Heterogeneity						
Variances	Mod Levene Equality of Variance	0.6303	2.773	0.6791	Equal Variances						
Distribution	Shapiro-Wilk W Normality	0.832	0.9169	0.0010	Non-normal Distribution						
	Anderson-Darling A2 Normality	1.269	2.492	0.0023	Non-normal Distribution						
96h Survival Rate Summary											
			Calculated Variate(A/B)								
C-μg/L	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
0	Lab Control	4	0.9	0.8	1	0.05774	0.1155	12.83%	0.0%	18	20
177.5		4	0.65	0.6	0.8	0.05	0.1	15.38%	27.78%	13	20
355.1		4	0.2	0	0.4	0.08165	0.1633	81.65%	77.78%	4	20
693		4	0.2	0	0.4	0.08165	0.1633	81.65%	77.78%	4	20
1390		4	0	0	0	0	0		100.0%	0	20
2970		4	0.05	0	0.2	0.05	0.1	200.0%	94.44%	1	20

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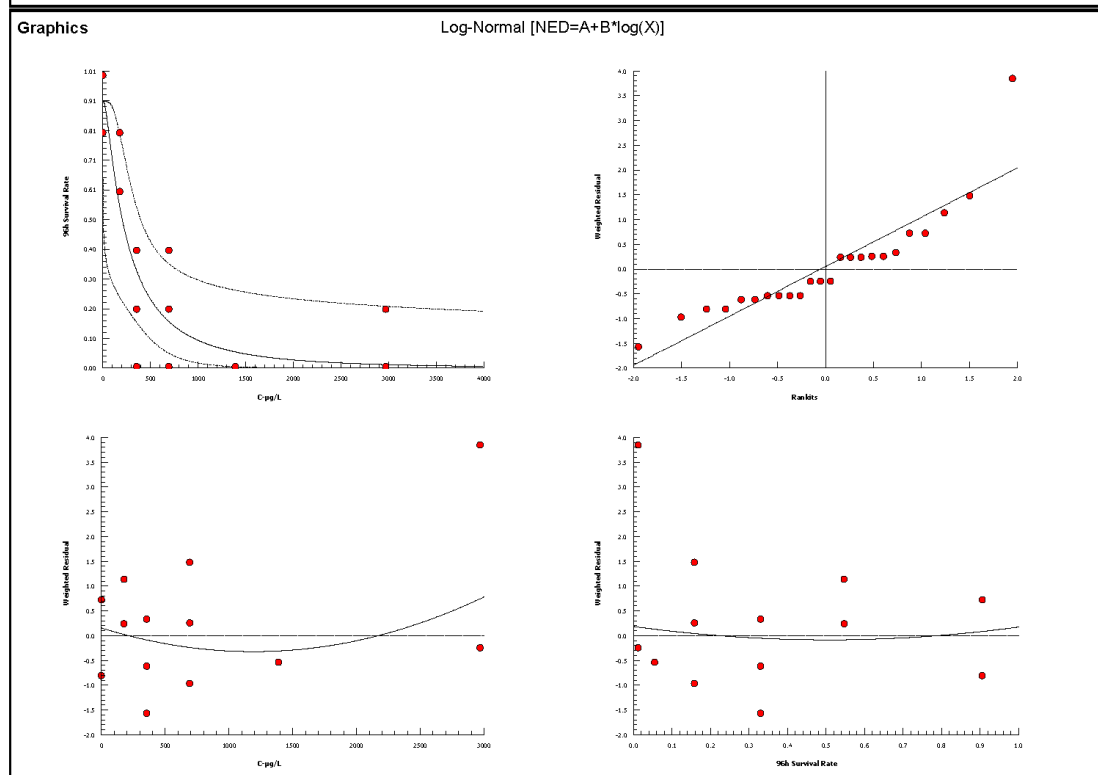
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Analyst:_____ QA:_____

CETIS Analytical Report

Report Date: 02 Jun-16 16:03 (p 2 of 2)
Test Code: 7454A57A | 19-5170-4442

Americamysis 96-h Acute Survival Test					SPAWAR Systems Center
Analysis ID: 13-0468-2566		Endpoint: 96h Survival Rate		CETIS Version: CETISv1.8.7	
Analyzed: 05 May-16 11:50		Analysis: Linear Regression (MLE)		Official Results: Yes	
96h Survival Rate Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Control	0.8	1	1	0.8
177.5		0.8	0.6	0.6	0.6
355.1		0.4	0	0.2	0.2
693		0	0.2	0.4	0.2
1390		0	0	0	0
2970		0	0	0.2	0
96h Survival Rate Binomials					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Control	4/5	5/5	5/5	4/5
177.5		4/5	3/5	3/5	3/5
355.1		2/5	0/5	1/5	1/5
693		0/5	1/5	2/5	1/5
1390		0/5	0/5	0/5	0/5
2970		0/5	0/5	1/5	0/5



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Analyst:_____ QA:_____

CETIS Summary Report

Report Date: 02 Jun-16 16:02 (p 1 of 1)
 Test Code: 2A8835AB | 07-1356-9707

Americamysis 96-h Acute Survival Test								SPAWAR Systems Center			
Batch ID:	00-4319-0877	Test Type:	Survival (96h)					Analyst:	Jacob Munson-Decker		
Start Date:	28 Oct-15 09:45	Protocol:	EPA/821/R-02-012 (2002)					Diluent:	Laboratory Seawater		
Ending Date:	01 Nov-15 08:30	Species:	Americamysis bahia					Brine:	Not Applicable		
Duration:	95h	Source:	Aquatic Research Organisms, NH					Age:	5		
Sample ID:	03-4497-5179	Code:	148FE74B					Client:	SPAWAR		
Sample Date:	07 Jan-16	Material:	Copper sulfate					Project:	Pulsed Exposure		
Receive Date:		Source:	Reference Toxicant								
Sample Age:	NA	Station:	Reference Toxicant								
Comparison Summary											
Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method				
08-8701-5964	96h Survival Rate	88.8	177.5	125.5	31.4%		Dunnett Multiple Comparison Test				
Point Estimate Summary											
Analysis ID	Endpoint	Level	µg/L	95% LCL	95% UCL	TU	Method				
04-8850-7955	96h Survival Rate	LC50	135.2	91.32	172.3		Linear Regression (MLE)				
96h Survival Rate Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Lab Control	4	0.95	0.7909	1	0.8	1	0.05	0.1	10.53%	0.0%
44.4		4	0.8	0.5402	1	0.6	1	0.08165	0.1633	20.41%	15.79%
88.8		4	0.7	0.2891	1	0.4	1	0.1291	0.2582	36.89%	26.32%
177.5		4	0.3	0	0.6182	0	0.4	0.1	0.2	66.67%	68.42%
355.1		4	0	0	0	0	0	0	0		100.0%
693		4	0	0	0	0	0	0	0		100.0%
96h Survival Rate Detail											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
0	Lab Control	1	1	0.8	1						
44.4		0.8	1	0.6	0.8						
88.8		1	0.4	0.6	0.8						
177.5		0.4	0	0.4	0.4						
355.1		0	0	0	0						
693		0	0	0	0						
96h Survival Rate Binomials											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
0	Lab Control	5/5	5/5	4/5	5/5						
44.4		4/5	5/5	3/5	4/5						
88.8		5/5	2/5	3/5	4/5						
177.5		2/5	0/5	2/5	2/5						
355.1		0/5	0/5	0/5	0/5						
693		0/5	0/5	0/5	0/5						

CETIS Analytical Report

Report Date: 02 Jun-16 16:02 (p 1 of 2)
Test Code: 2A8835AB | 07-1356-9707

Americamysis 96-h Acute Survival Test										SPAWAR Systems Center	
Analysis ID:	08-8701-5964		Endpoint:	96h Survival Rate				CETIS Version:	CETISv1.8.7		
Analyzed:	05 May-16 11:50		Analysis:	Parametric-Control vs Treatments				Official Results:	Yes		
Batch ID:	00-4319-0877		Test Type:	Survival (96h)				Analyst:	Jacob Munson-Decker		
Start Date:	28 Oct-15 09:45		Protocol:	EPA/821/R-02-012 (2002)				Diluent:	Laboratory Seawater		
Ending Date:	01 Nov-15 08:30		Species:	Americamysis bahia				Brine:	Not Applicable		
Duration:	95h		Source:	Aquatic Research Organisms, NH				Age:	5		
Sample ID:	03-4497-5179		Code:	148FE74B				Client:	SPAWAR		
Sample Date:	07 Jan-16		Material:	Copper sulfate				Project:	Pulsed Exposure		
Receive Date:			Source:	Reference Toxicant							
Sample Age:	NA		Station:	Reference Toxicant							
Data Transform	Zeta	Alt Hyp	Trials	Seed			PMSD	NOEL	LOEL	TOEL	TU
Angular (Corrected)	NA	C > T	NA	NA			31.4%	88.8	177.5	125.5	
Dunnett Multiple Comparison Test											
Control	vs	C-µg/L	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)		
Lab Control		44.4	1.153	2.287	0.346	6	0.2790	CDF	Non-Significant Effect		
		88.8	1.851	2.287	0.346	6	0.1030	CDF	Non-Significant Effect		
		177.5*	4.732	2.287	0.346	6	0.0007	CDF	Significant Effect		
ANOVA Table											
Source	Sum Squares		Mean Square		DF		F Stat	P-Value	Decision(α:5%)		
Between	1.115546		0.3718488		3		8.126	0.0032	Significant Effect		
Error	0.5491378		0.04576148		12						
Total	1.664684				15						
Distributional Tests											
Attribute	Test		Test Stat	Critical	P-Value		Decision(α:1%)				
Variances	Bartlett Equality of Variance		1.904	11.34	0.5926		Equal Variances				
Distribution	Shapiro-Wilk W Normality		0.9424	0.8408	0.3800		Normal Distribution				
96h Survival Rate Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Lab Control	4	0.95	0.7909	1	1	0.8	1	0.05	10.53%	0.0%
44.4		4	0.8	0.5402	1	0.8	0.6	1	0.08165	20.41%	15.79%
88.8		4	0.7	0.2891	1	0.7	0.4	1	0.1291	36.89%	26.32%
177.5		4	0.3	0	0.6182	0.4	0	0.4	0.1	66.67%	68.42%
355.1		4	0	0	0	0	0	0	0		100.0%
693		4	0	0	0	0	0	0	0		100.0%
Angular (Corrected) Transformed Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Lab Control	4	1.286	1.096	1.475	1.345	1.107	1.345	0.05953	9.26%	0.0%
44.4		4	1.111	0.813	1.41	1.107	0.8861	1.345	0.09377	16.87%	13.56%
88.8		4	1.006	0.553	1.459	0.9966	0.6847	1.345	0.1423	28.29%	21.77%
177.5		4	0.5699	0.2046	0.9353	0.6847	0.2255	0.6847	0.1148	40.29%	55.67%
355.1		4	0.2255	0.2255	0.2256	0.2255	0.2255	0.2255	0	0.0%	82.46%
693		4	0.2255	0.2255	0.2256	0.2255	0.2255	0.2255	0	0.0%	82.46%
96h Survival Rate Detail											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
0	Lab Control	1	1	0.8	1						
44.4		0.8	1	0.6	0.8						
88.8		1	0.4	0.6	0.8						
177.5		0.4	0	0.4	0.4						
355.1		0	0	0	0						
693		0	0	0	0						

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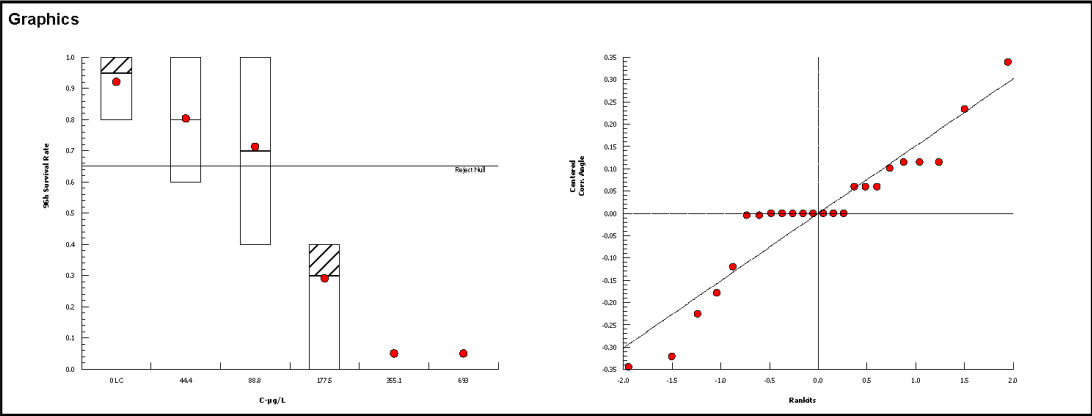
Analyst:_____ QA:_____

CETIS Analytical Report

Report Date: 02 Jun-16 16:02 (p 2 of 2)
Test Code: 2A8835AB | 07-1356-9707

Americamysis 96-h Acute Survival Test					SPAWAR Systems Center
Analysis ID:	08-8701-5964	Endpoint:	96h Survival Rate	CETIS Version:	CETISv1.8.7
Analyzed:	05 May-16 11:50	Analysis:	Parametric-Control vs Treatments	Official Results:	Yes
Angular (Corrected) Transformed Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Control	1.345	1.345	1.107	1.345
44.4		1.107	1.345	0.8861	1.107
88.8		1.345	0.6847	0.8861	1.107
177.5		0.6847	0.2255	0.6847	0.6847
355.1		0.2255	0.2255	0.2255	0.2255
693		0.2255	0.2255	0.2255	0.2255

96h Survival Rate Binomials					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Control	5/5	5/5	4/5	5/5
44.4		4/5	5/5	3/5	4/5
88.8		5/5	2/5	3/5	4/5
177.5		2/5	0/5	2/5	2/5
355.1		0/5	0/5	0/5	0/5
693		0/5	0/5	0/5	0/5



CETIS Analytical Report

Report Date: 02 Jun-16 16:02 (p 1 of 2)
Test Code: 2A8835AB | 07-1356-9707

Americamysis 96-h Acute Survival Test						SPAWAR Systems Center					
Analysis ID: 04-8850-7955		Endpoint: 96h Survival Rate				CETIS Version: CETISv1.8.7					
Analyzed: 05 May-16 11:50		Analysis: Linear Regression (MLE)				Official Results: Yes					
Batch ID: 00-4319-0877		Test Type: Survival (96h)				Analyst: Jacob Munson-Decker					
Start Date: 28 Oct-15 09:45		Protocol: EPA/821/R-02-012 (2002)				Diluent: Laboratory Seawater					
Ending Date: 01 Nov-15 08:30		Species: Americamysis bahia				Brine: Not Applicable					
Duration: 95h		Source: Aquatic Research Organisms, NH				Age: 5					
Sample ID: 03-4497-5179		Code: 148FE74B				Client: SPAWAR					
Sample Date: 07 Jan-16		Material: Copper sulfate				Project: Pulsed Exposure					
Receive Date:		Source: Reference Toxicant									
Sample Age: NA		Station: Reference Toxicant									
Linear Regression Options											
Model Function			Threshold Option		Threshold	Optimized	Pooled	Het Corr	Weighted		
Log-Normal [NED=A+B*log(X)]			Control Threshold		0.05	Yes	No	No	Yes		
Regression Summary											
Iters	LL	AICc	BIC	Mu	Sigma	Adj R2	F Stat	Critical	P-Value	Decision(α:5%)	
29	-39.91	87.03	89.36	2.131	0.2066	0.7801	1.086	3.16	0.3804	Non-Significant Lack of Fit	
Point Estimates											
Level	µg/L	95% LCL	95% UCL								
LC50	135.2	91.32	172.3								
Regression Parameters											
Parameter	Estimate	Std Error	95% LCL	95% UCL	t Stat	P-Value	Decision(α:5%)				
Threshold	0.1187	0.05509	0.01076	0.2267	2.155	0.0429	Significant Parameter				
Slope	4.84	1.282	2.328	7.352	3.777	0.0011	Significant Parameter				
Intercept	-10.31	2.819	-15.84	-4.789	-3.659	0.0015	Significant Parameter				
ANOVA Table											
Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)					
Model	62.43002	62.43002	1	83.62	<0.0001	Significant					
Lack of Fit	2.402125	0.800708	3	1.086	0.3804	Non-Significant					
Pure Error	13.27694	0.737608	18								
Residual	15.67907	0.746622	21								
Residual Analysis											
Attribute	Method			Test Stat	Critical	P-Value	Decision(α:5%)				
Goodness-of-Fit	Pearson Chi-Sq GOF			15.68	32.67	0.7874	Non-Significant Heterogeneity				
	Likelihood Ratio GOF			19.43	32.67	0.5576	Non-Significant Heterogeneity				
Variances	Mod Levene Equality of Variance			1.469	2.773	0.2485	Equal Variances				
Distribution	Shapiro-Wilk W Normality			0.9361	0.9169	0.1334	Normal Distribution				
	Anderson-Darling A2 Normality			0.7484	2.492	0.0511	Normal Distribution				
96h Survival Rate Summary											
			Calculated Variate(A/B)								
C-µg/L	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
0	Lab Control	4	0.95	0.8	1	0.05	0.1	10.53%	0.0%	19	20
44.4		4	0.8	0.6	1	0.08165	0.1633	20.41%	15.79%	16	20
88.8		4	0.7	0.4	1	0.1291	0.2582	36.89%	26.32%	14	20
177.5		4	0.3	0	0.4	0.1	0.2	66.67%	68.42%	6	20
355.1		4	0	0	0	0	0		100.0%	0	20
693		4	0	0	0	0	0		100.0%	0	20

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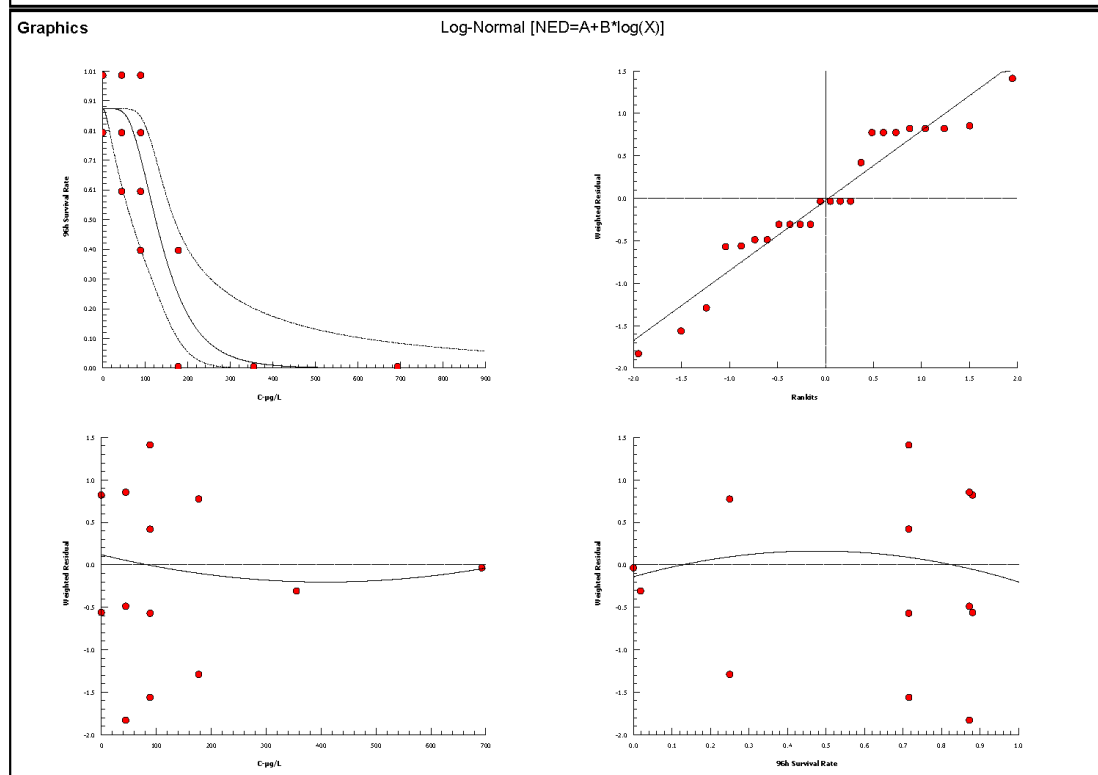
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Analyst:_____ QA:_____

CETIS Analytical Report

Report Date: 02 Jun-16 16:02 (p 2 of 2)
Test Code: 2A8835AB | 07-1356-9707

Americamysis 96-h Acute Survival Test					SPAWAR Systems Center
Analysis ID: 04-8850-7955		Endpoint: 96h Survival Rate		CETIS Version: CETISv1.8.7	
Analyzed: 05 May-16 11:50		Analysis: Linear Regression (MLE)		Official Results: Yes	
96h Survival Rate Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Control	1	1	0.8	1
44.4		0.8	1	0.6	0.8
88.8		1	0.4	0.6	0.8
177.5		0.4	0	0.4	0.4
355.1		0	0	0	0
693		0	0	0	0
96h Survival Rate Binomials					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Control	5/5	5/5	4/5	5/5
44.4		4/5	5/5	3/5	4/5
88.8		5/5	2/5	3/5	4/5
177.5		2/5	0/5	2/5	2/5
355.1		0/5	0/5	0/5	0/5
693		0/5	0/5	0/5	0/5



000-010-187-1

CETIS™ v1.8.7.16

Analyst: _____ QA: _____

Marine Acute Bioassay
Static-Renewal Conditions

Water Quality Measurements
& Test Organism Survival

Project: Definitive Pulsed Copper Exposure Test Species: A. bahia
Sample ID: 3-hour pulse Start Date/Time: 10/28/15 0935
Test No.: End Date/Time: 11/1/15 0830

Tech Initials				
0	24	48	72	96
Counts: NH	NH	NH	NH	JM
Readings: NH	NH	NH	NH	JM
Dilutions made by: MC				

Cu Concentration mg/L	Rep	Number of Live Organisms					Salinity (ppt)					Temperature (°C)					Dissolved Oxygen (mg/L)					pH (units)				
		0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96
Lab Control	A	5	5	4	4	4	32.8	34.1	34.2	33.8	33.5	20.3	19.7	19.7	19.7	19.6	8.7	8.2	8.4	7.8	8.1	7.82	7.81	7.80	7.72	7.63
	B	5	5	5	5	5																				
	C	5	5	5	5	5																				
	D	5	5	5	4	4																				
	E																									
200	A	5	5	3	3	2	33.9	34.2	34.0	34.2	34.1	20.1	19.8	19.9	19.8	19.8	8.9	8.7	8.6	8.1	8.1	7.93	7.95	7.93	7.81	7.70
	B	5	5	4	4	4																				
	C	5	4	4	3	3																				
	D	5	5	5	4	4																				
	E																									
400	A	5	5	3	3	3	34.0	34.1	34.1	34.0	34.1	19.9	19.8	19.9	19.9	19.7	9.0	8.7	8.3	8.7	8.3	8.00	7.97	7.93	7.86	7.82
	B	5	5	5	5	5																				
	C	5	5	4	4	3																				
	D	5	5	4	4	4																				
	E																									
800	A	5	4	4	4	4	34.0	34.1	34.1	34.0	34.2	20.0	19.8	19.9	19.8	19.8	9.1	8.7	8.3	8.9	8.3	7.96	7.97	7.93	7.96	7.77
	B	5	5	2	2	2																				
	C	5	5	5	5	5																				
	D	5	4	4	4	4																				
	E																									
1600	A	5	5	4	4	4	34.0	34.4	34.4	34.5	34.3	20.3	19.7	19.9	19.8	19.9	8.7	8.8	8.7	8.7	8.6	7.84	7.91	7.93	7.73	7.83
	B	5	4	2	0	-																				
	C	5	4	2	2	1																				
	D	5	4	4	4	4																				
	E																									
3200	A	5	2	0	-	-	33.9	34.1	33.8	34.2	34.1	20.1	19.9	19.9	20.1	19.9	8.9	9.0	7.8	8.5	8.4	7.81	8.00	7.89	7.82	7.78
	B	5	3	1	0	-																				
	C	5	5	4	2	2																				
	D	5	4	3	3	3																				
	E																									

Initial Counts
QC'd by: MC

Animal Source/Date Received: ARO 10/27/2015 Age at Initiation: 5 days

Comments: i = initial reading in fresh test solution, f = final reading in test chamber prior to renewal
Organisms fed prior to initiation, circle one (y / n)
Tests aerated? Circle one (y / n) if yes, sample ID(s): ② = Q22 Duration:

QC Check: NH 11/2/15

Feeding Times				
0	24	48	72	96
AM: 0800 0930 1000 0830 0800				
PM: 1400 1630 1400 1000				

Final Review: all 11/5/15

① Counts after pulse exposure recorded on back
12 hour pulse

Marine Acute Bioassay
Static-Renewal Conditions

Water Quality Measurements
& Test Organism Survival

Project: Pulsed exposure definitive Test Species: A. balearica
Sample ID: 6 hour pulse Start Date/Time: 10/28/15 0935
Test No.: End Date/Time: 11/1/15 0830

Tech Initials				
0	24	48	72	96
Counts: <u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>
Readings: <u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>
Dilutions made by: <u>MC</u>				

Sample ID	Rep	Number of Live Organisms					Salinity (ppt)					Temperature (°C)					Dissolved Oxygen (mg/L)					pH (units)				
		0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96
LC	A	5	5	4	4	4	33.9	34.1	34.2	33.8	33.5	20.3	19.7	19.7	19.7	19.6	8.7	8.2	8.4	7.8	8.1	7.62	7.41	7.8	7.72	7.60
	B	5	5	5	5	5																				
	C	5	5	5	5	5																				
	D	5	5	5	4	4																				
200	A	5	5	5	4	4	34.0	34.2	34.0	34.2	34.3	19.8	19.8	19.9	19.9	19.5	9.0	8.7	8.6	8.1	8.6	8.6	7.85	7.8	7.81	7.77
	B	5	5	5	5	5																				
	C	5	5	4	4	4																				
	D	5	5	4	4	4																				
400	A	5	5	3	3	3	34.0	34.3	34.5	34.5	34.6	19.9	19.8	19.9	19.9	19.5	9.1	8.7	8.6	8.1	8.6	8.6	7.84	7.79	7.81	7.79
	B	5	4	4	2	2																				
	C	5	5	3	3	3																				
	D	5	5	5	5	5																				
800	A	5	5	3	3	3	34.0	34.1	34.1	34.0	34.1	19.9	19.8	19.9	19.9	19.7	9.1	8.7	8.3	8.4	8.3	8.02	7.97	7.93	7.96	7.85
	B	5	5	4	4	4																				
	C	5	5	4	3	3																				
	D	5	5	1	1	1																				
1600	A	5	5	1	1	1	34.1	34.4	34.4	34.5	34.3	19.8	19.7	19.9	19.8	19.9	8.7	8.8	8.9	8.6	8.6	8.01	7.91	7.93	7.93	7.83
	B	5	4	1	1	1																				
	C	5	4	3	2	2																				
	D	5	5	1	1	1																				
3200	A	5	4	0	-	-	33.4	34.1	33.8	34.2	34.2	20.4	19.9	19.9	20.1	19.9	8.9	10	7.9	8.5	8.2	7.91	7.60	7.81	7.82	7.76
	B	5	2	0	-	-																				
	C	5	4	1	1	1																				
	D	5	2	1	1	1																				
A																										
B																										
C																										
D																										

Initial Counts
QC'd by: MC

Animal Source/Date Received: Aro 10/29/15 Age at Initiation: 5 days

Comments: i = initial reading in fresh test solution, f = final reading in test chamber prior to renewal
Organisms fed prior to initiation, circle one (y) / n)
Tests aerated? Circle one (y) if yes, sample ID(s): (y) = Q22 Duration:
Aeration source: (y) = Q22

Feeding Times				
0	24	48	72	96
AM: <u>0800</u>	<u>0900</u>	<u>1000</u>	<u>0830</u>	<u>0900</u>
PM: <u>1400</u>	<u>1600</u>	<u>1400</u>	<u>1100</u>	<u>—</u>

QC Check: NA 11/2/15

Final Review: NA 11/5/15

(A) counts after pulse exposure on back 2 3 hours pulse

Marine Acute Bioassay
Static-Renewal Conditions

Water Quality Measurements
& Test Organism Survival

Project: Pulsed exposure definitive Test Species: A. bahia
Sample ID: 12 hour pulse Start Date/Time: 10/28/15 0935
Test No.: _____ End Date/Time: 11/11/2015 0830

Tech Initials				
0	24	48	72	96
Counts: <u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>
Readings: <u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>
Dilutions made by: <u>AC</u>				

Sample ID	Rep	Number of Live Organisms					Salinity (ppt)					Temperature (°C)					Dissolved Oxygen (mg/L)					pH (units)				
		0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96
LC (49/L)	A	5	5	4	4	4	33.8	34.1	34.2	33.8	33.5	20.3	19.7	19.7	19.7	19.6	8.7	8.7	8.4	7.8	8.1	7.8	7.8	7.8	7.6	
	B	5	5	5	5	5																				
	C	5	5	5	5	5																				
	D	5	5	5	4	4																				
200	A	5	4	4	4	4	33.9	34.2	34.2	34.2	34.0	19.8	19.8	19.9	19.9	19.7	9.1	8.7	8.6	8.1	8.6	8.0	7.8	7.8	7.7	
	B	5	4	4	3	3																				
	C	5	4	2	3	3																				
	D	5	5	3	3	3																				
400	A	5	4	3	2	2	34.1	34.1	34.5	34.5	34.6	19.8	19.8	19.8	19.8	19.5	9.1	8.7	8.6	8.1	8.6	8.0	7.8	7.8	7.7	
	B	5	3	2	2	0																				
	C	5	3	1	1	1																				
	D	5	3	1	1	1											9.1									
800	A	5	2	0	-	-	34.0	34.1	34.1	34.0	33.9	19.8	19.8	19.9	19.9	19.7	8.8	8.7	8.3	8.9	8.8	8.0	7.9	7.8	7.8	
	B	5	4	1	1	1																				
	C	5	8	2	2	2																				
	D	5	1	1	1	1																				
1600	A	5	1	0	-	-	34.1	34.1	34.5	34.3	34.3	20.3	19.9	19.8	19.9	19.9	8.7	9.0	8.9	8.7	8.6	8.0	8.0	7.8	7.8	
	B	5	0	-	-	-																				
	C	5	2	0	-	-																				
	D	5	4	0	-	-																				
3200	A	5	2	0	-	-	33.9	34.1	33.8	34.2	33.3	20.4	19.9	19.9	20.1	19.9	8.9	9.0	8.8	8.5	8.7	8.1	8.0	7.8	7.8	
	B	5	1	1	0	-																				
	C	5	1	1	1	1																				
	D	5	2	0	-	-																				
	A	5	1	1	1	1	33.9																			
	B	5																								
	C																									
	D																									

Initial Counts
QC'd by: AC

Animal Source/Date Received: ARO, 10/27/2015 Age at Initiation: 5 days

Comments: i = initial reading in fresh test solution, f = final reading in test chamber prior to renewal
Organisms fed prior to initiation, circle one (y / n) (y)
Tests aerated? Circle one (y / n) if yes, sample ID(s): _____ Duration: _____
Aeration source: (B) = Q22

Feeding Times				
0	24	48	72	96
AM: <u>0800</u>	<u>0830</u>	<u>1000</u>	<u>0830</u>	<u>0800</u>
PM: <u>1400</u>	<u>1630</u>	<u>1400</u>	<u>1400</u>	<u>1400</u>

C Check: 11/2/15 AAT

Final Review: all 11/5/15

(A) Pulse counts after pulse exposure on back 2

Marine Acute Bioassay
Static-Renewal Conditions

Water Quality Measurements
& Test Organism Survival

Project: Pulse Cu Exposure definitive Test Species: A. balearica
Sample ID: Cu Reference Test (CUSA) Start Date/Time: 10/28/15 0945
Test No.: 96hr Static End Date/Time: 11/1/15 0830

Tech Initials					
0	24	48	72	96	
Counts: <u>NH</u>	<u>NH</u>	<u>NH</u>	<u>NH</u>	<u>NH</u>	<u>JH</u>
Readings: <u>NH</u>	<u>NH</u>	<u>NH</u>	<u>NH</u>	<u>NH</u>	<u>JH</u>
Dilutions made by: <u>MC</u>	<u>/</u>	<u>/</u>	<u>/</u>	<u>/</u>	<u>/</u>

Cu Concentration μg/L	Rep	Number of Live Organisms					Salinity (ppt)					Temperature (°C)					Dissolved Oxygen (mg/L)					pH (units)				
		0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	(A)	0	24	48	72	96	0	24	48	72
Lab Control	A	5	5	5	5	5	33.9	34.1	33.9	34.0	34.1	19.7	19.8	19.8	20.2	19.7	9.1	8.8	8.7	8.7	8.4	7.99	7.90	7.87	7.91	7.88
	B	5	5	5	5	5																				
	C	5	5	5	5	4																				
	D	5	5	5	5	5																				
	E	-	-	-	-	-																				
50	A	5	5	4	4	4	34.0	34.1	34.1	34.2	34.2	19.6	19.8	19.8	20.2	19.7	9.1	8.7	8.4	8.7	8.9	8.05	7.97	7.95	7.89	7.92
	B	5	5	5	5	5																				
	C	5	5	4	3	3																				
	D	5	5	5	5	4																				
	E	-	-	-	-	-																				
100	A	5	5	5	5	5	34.0	34.1	34.1	34.2	34.3	19.6	19.8	19.8	20.3	19.7	9.1	8.8	8.6	8.6	8.7	8.07	7.99	7.97	7.93	7.94
	B	5	4	2	2	2																				
	C	5	5	3	3	3																				
	D	5	5	4	4	4																				
	E	-	-	-	-	-																				
200	A	5	5	3	2	2	34.0	34.1	34.0	34.1	34.1	19.6	19.8	19.8	20.2	19.7	9.2	8.8	8.6	8.6	8.5	8.07	8.01	7.99	7.95	7.96
	B	5	3	0	-	-																				
	C	5	4	2	2	2																				
	D	5	5	3	2	2																				
	E	-	-	-	-	-																				
400	A	5	3	1	0	-	34.1	34.2	34.2	34.1	-	19.7	19.7	19.7	20.0	19.7	9.2	8.9	8.7	8.7	-	8.07	8.01	7.99	7.95	-
	B	5	4	0	-	-																				
	C	5	4	0	-	-																				
	D	5	4	0	-	-																				
	E	-	-	-	-	-																				
800	A	5	5	2	1	0	34.1	34.2	34.1	34.2	34.3	19.7	19.7	19.7	20.1	19.7	9.2	9.0	8.6	8.6	8.8	8.07	8.03	7.99	7.95	7.96
	B	5	4	0	-	-																				
	C	5	3	1	0	-																				
	D	5	3	1	0	-																				
	E	-	-	-	-	-																				

Initial Counts
QC'd by: MC

Animal Source/Date Received: ABO, 10/27/15 Age at Initiation: 50 days

Comments: i = initial reading in fresh test solution, f = final reading in test chamber prior to renewal
Organisms fed prior to initiation, circle one (y/n) (y)
Tests aerated? Circle one (y/n) (y) if yes, sample ID(s): _____ Duration: _____

QC Check: NH 11/2/15 Aeration Source: None (A) = Q22 Final Review: lll 11/15/15

Feeding Times					
0	24	48	72	96	
AM: <u>0800</u>	<u>0930</u>	<u>1000</u>	<u>0830</u>	<u>0800</u>	
PM: <u>1400</u>	<u>1630</u>	<u>1400</u>	<u>1100</u>	<u>-</u>	

A.3. COPPER EXPOSURES – ANALYTICAL CHEMISTRY REPORTS:



29 December 2015

Nautilus Environmental, LLC
Attn: Kellyn Lupfer
4340 Vandever Avenue
San Diego, CA 92120

EMA Log #: 15L0514

Project Name: SPAWAR-Pulsed

Enclosed are the results of analyses for samples received by the laboratory on 12/15/15 10:30. Samples were analyzed pursuant to client request utilizing EPA or other ELAP approved methodologies. I certify that this data is in compliance both technically and for completeness.

A handwritten signature in black ink, appearing to read 'Dan Verdon'.

Dan Verdon
Laboratory Director

CA ELAP Certification #: 2564

4340 Viewridge Avenue, Suite A - San Diego, California 92123 - (858) 560-7717 - Fax (858) 560-7763
Analytical Chemistry Laboratory

Client Name: Nautilus Environmental, LLC
Project Name: SPAWAR-Pulsed

EMA Log #: 15L0514

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
1 Cu(TO-EP-0) B	15L0514-01	Seawater	11/05/15 00:00	12/15/15 10:30
2 Cu(TO-EP-31.3) B	15L0514-02	Seawater	11/05/15 00:00	12/15/15 10:30
3 Cu(TO-EP-62.5) B	15L0514-03	Seawater	11/05/15 00:00	12/15/15 10:30
4 Cu(TO-EP-125) B	15L0514-04	Seawater	11/05/15 00:00	12/15/15 10:30
5 Cu(TO-EP-250) B	15L0514-05	Seawater	11/05/15 00:00	12/15/15 10:30
6 Cu(TO-EP-500) B	15L0514-06	Seawater	11/05/15 00:00	12/15/15 10:30
7 Cu(TO-EC-0) B	15L0514-07	Seawater	11/05/15 00:00	12/15/15 10:30
8 Cu(TO-EC-5.8) B	15L0514-08	Seawater	11/05/15 00:00	12/15/15 10:30
9 Cu(TO-EC-8.4) B	15L0514-09	Seawater	11/05/15 00:00	12/15/15 10:30
11 Cu(TO-EC-17.2) B	15L0514-10	Seawater	11/05/15 00:00	12/15/15 10:30
12 Cu(TO-EC-24) B	15L0514-11	Seawater	11/05/15 00:00	12/15/15 10:30
13 Cu(TO-EC-31.3) B	15L0514-12	Seawater	11/05/15 00:00	12/15/15 10:30

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.



Client Name: Nautilus Environmental, LLC
Project Name: SPAWAR-Pulsed

EMA Log #: 15L0514

Total Metals by EPA 6000/7000 Series Methods

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
1 Cu(TO-EP-0) B (15L0514-01) Seawater Sampled: 11/05/15 00:00 Received: 12/15/15 10:30										
Copper	ND	0.002	0.100	mg/l	2	5122344	12/23/15	12/23/15	EPA 6010	
2 Cu(TO-EP-31.3) B (15L0514-02) Seawater Sampled: 11/05/15 00:00 Received: 12/15/15 10:30										
Copper	0.015	0.002	0.100	mg/l	2	5122344	12/23/15	12/23/15	EPA 6010	J
3 Cu(TO-EP-62.5) B (15L0514-03) Seawater Sampled: 11/05/15 00:00 Received: 12/15/15 10:30										
Copper	0.036	0.002	0.100	mg/l	2	5122344	12/23/15	12/23/15	EPA 6010	J
4 Cu(TO-EP-125) B (15L0514-04) Seawater Sampled: 11/05/15 00:00 Received: 12/15/15 10:30										
Copper	0.081	0.002	0.100	mg/l	2	5122344	12/23/15	12/23/15	EPA 6010	J
5 Cu(TO-EP-250) B (15L0514-05) Seawater Sampled: 11/05/15 00:00 Received: 12/15/15 10:30										
Copper	0.179	0.002	0.100	mg/l	2	5122344	12/23/15	12/23/15	EPA 6010	
6 Cu(TO-EP-500) B (15L0514-06) Seawater Sampled: 11/05/15 00:00 Received: 12/15/15 10:30										
Copper	0.367	0.002	0.100	mg/l	2	5122344	12/23/15	12/23/15	EPA 6010	
7 Cu(TO-EC-0) B (15L0514-07) Seawater Sampled: 11/05/15 00:00 Received: 12/15/15 10:30										
Copper	ND	0.002	0.100	mg/l	2	5122344	12/23/15	12/23/15	EPA 6010	
8 Cu(TO-EC-5.8) B (15L0514-08) Seawater Sampled: 11/05/15 00:00 Received: 12/15/15 10:30										
Copper	ND	0.002	0.100	mg/l	2	5122344	12/23/15	12/23/15	EPA 6010	
9 Cu(TO-EC-8.4) B (15L0514-09) Seawater Sampled: 11/05/15 00:00 Received: 12/15/15 10:30										
Copper	ND	0.002	0.100	mg/l	2	5122344	12/23/15	12/23/15	EPA 6010	

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

EnviroMatrix



Analytical, Inc.

Client Name: Nautilus Environmental, LLC
Project Name: SPAWAR-Pulsed

EMA Log #: 15L0514

Total Metals by EPA 6000/7000 Series Methods

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
11 Cu(TO-EC-17.2) B (15L0514-10) Seawater Sampled: 11/05/15 00:00 Received: 12/15/15 10:30										
Copper	0.006	0.002	0.100	mg/l	2	5122344	12/23/15	12/23/15	EPA 6010	J
12 Cu(TO-EC-24) B (15L0514-11) Seawater Sampled: 11/05/15 00:00 Received: 12/15/15 10:30										
Copper	0.010	0.002	0.100	mg/l	2	5122344	12/23/15	12/23/15	EPA 6010	J
13 Cu(TO-EC-31.3) B (15L0514-12) Seawater Sampled: 11/05/15 00:00 Received: 12/15/15 10:30										
Copper	0.017	0.002	0.100	mg/l	2	5122344	12/23/15	12/23/15	EPA 6010	J

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

EnviroMatrix



Analytical, Inc.

Client Name: Nautilus Environmental, LLC
Project Name: SPAWAR-Pulsed

EMA Log #: 15L0514

Total Metals by EPA 6000/7000 Series Methods - Quality Control

Analyte	Result	MDL	Reporting Limit	Units	Spike Level	Source Result	%REC Limits	RPD	RPD Limit	Notes
Batch 5122344										
Blank (5122344-BLK1)					Prepared & Analyzed: 12/23/15					
Copper	ND	0.0009	0.050	mg/l						
LCS (5122344-BS1)					Prepared & Analyzed: 12/23/15					
Copper	1.03	0.0009	0.050	mg/l	1.00	103	75-125			
Duplicate (5122344-DUP1)			Source: 15L0511-01			Prepared & Analyzed: 12/23/15				
Copper	0.730	0.090	5.00	mg/l	0.749			3	20	J

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

EnviroMatrix



Analytical, Inc.

Client Name: Nautilus Environmental, LLC
Project Name: SPAWAR-Pulsed

EMA Log #: 15L0514

Notes and Definitions

J	Detected but below the Reporting Limit; therefore, result is an estimated concentration (CLP J-Flag).
ND	Analyte NOT DETECTED at or above the reporting limit (or method detection limit when specified)
NR	Not Reported
dry	Sample results reported on a dry weight basis (if indicated in units column)
RPD	Relative Percent Difference
MDL	Method detection limit (indicated per client's request)

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

EnviroMatrix  Analytical, Inc.

1560514

CHAIN-OF-CUSTODY RECORD

EMA LOG #:

Client: ANABOLUS Environmental / SPAWAR

Attn: Kellie Lupton

Sampler(s): Kelly Lupton

Address:

Phone: 858-387-7333 x211

Fax:

Email: kelly@anabolusenvironmental.com

Billing Address:

Project ID: SPAWAR-D-10-26

Project #:

PO #:

ID #	Client Sample ID	Sample Date	Sample Time	Sample Matrix	Container # / Type
1	1400-1740-EP-23	11/1/15	-	SW	HDPE
2	1400-1740-EP-24	11/1/15	-	SW	
3	1400-1740-EP-25	11/1/15	-	SW	
4	1400-1740-EP-26	11/1/15	-	SW	
5	1400-1740-EP-27	11/1/15	-	SW	
6	1400-1740-EP-28	11/1/15	-	SW	
7	1400-1740-EP-29	11/1/15	-	SW	
8	1400-1740-EP-30	11/1/15	-	SW	
9	1400-1740-EP-31	11/1/15	-	SW	
10	1400-1740-EP-32	11/1/15	-	SW	

Matrix Codes: A = Air, DW = Drinking Water, GW = Groundwater, SW = Storm Water

WW = Wastewater, S = Soil, SED = Sediment, SD = Solid, T = Tissue, O = Oil, L = Liquid

Shipped By: Courier UPS FedEx USPS

Turn-Around-Time: Same Day 1 day 2 day 3 day 4 day 5 day 7 day

Shipping Requirements: Fax PDF Excel GeotrackerPDF Hard Copy EDT

Sample Delivery: Laboratory Return to Client PU or Delivery Archive

Container: Containers No N/A

Custody Seals Intact: Yes No

Custody Labels Agree: No N/A

Sampled By: EMA Autosampler

Project/Sample Comments: SW = Wastewater

Requested Analysis

Oil & Grease 0.13.1 0.41.2 0.164	8015 (TPH) 0 Gas 0 Diesel 0 Ext	624&8260 (VOC) Full BTX MTBE Oxy Nap	625 / 8270 (SVOC) 0 PAH only	608 / 8081 (Organochlorine Pesticides)	608 / 8082 (Polychlorinated Biphenyls)	8141 (Organophosphorus Pesticides)	TBT (Organotin Compounds)	0 PH 0 EC 0 TSS 0 TDS	0 Nitrate 0 Nitrite 0 TKN 0 NH3	CAC Title 22/CAM17 Metals 0 TTLC 0 STLC	TCAP (RCRA) 0 Metals 0 Organics	Coliform, Total (MTF) 0 Fecal (MTF)	Coliform, T-E, Coli 0 P/A 0 Fumigation	Enterococcus 0 MTF 0 Enteric	Heterotrophic Plate Count (HPC)	0 BOD 0 COD 0 Cyanide	Ammonia Nitrogen (mg/L)	Ammonia Nitrogen (mg/L)
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

RELINQUISHED BY

Signature: Kelly Lupton

Print: Kelly Lupton

Company: SPAWAR

DATE/TIME

12-15-15

1030

SIGNATURE

Signature: [Signature]

Print: [Signature]

Company: [Signature]

Additional costs may apply. Please note there is a \$35 minimum charge for all shows.

^aEMA reserves the right to return any samples that do not match our waste profile.
NOTE: By relinquishing samples to EMA, Inc., client agrees to pay for the services requested on this COC form and any additional analyses performed on this project. Payment for services is due within 30 days from date of invoice. Samples will be disposed of 7 days after report has been finalized unless otherwise noted. All work is subject to EMA's terms and conditions.

CHAIN-OF-CUSTODY RECORD

15L0514

-EnviroMatrix Analytical, Inc.

4340 Viewridge Ave., Ste. A - San Diego, CA 92123 - Phone (858) 560-7717 - Fax (858) 560-7763

EMA LOG #:

Client: NACHOS ENVIRONMENTAL / SPACAR

Attn: Kellie Cooper

Sampler(s): Molly Cohn

Address:

Phone: 658-587-7333 Fax:

Email: kcooper@nachoenv.com

Billing Address:

Project ID: SPACAR PIER

Project #:

PO #:

ID #	Client Sample ID	Sample Date	Sample Time	Sample Matrix	Container # / Type
1	800 (T ₀ - EC - 58)	11/5/15		30	HDPE
2	900 (T ₀ - EC - 54)	11/5/15			
3	100 (T ₀ - EC - 172)	11/5/15			
4	120 (T ₀ - EC - 24)	11/5/15			
5	130 (T ₀ - EC - 33)	11/5/15			
6	140 (T ₀ - EC - 31)	11/5/15			
7	150 (T ₀ - EC - 213)	11/5/15			
8	160 (T ₀ - EC - 23)	11/5/15			
9	170 (T ₀ - EC - 2)	11/5/15			
10	180 (T ₀ - EC - 23)	11/5/15			

Matrix Codes: A = Air, DW = Drinking Water, GW = Groundwater, SW = Storm Water
WW = Wastewater, S = Soil, SED = Sediment, SD = Solid, T = Tissue, O = Oil, L = Liquid

Shipped By: ☐ Courier ☐ UPS ☐ FedEx ☐ USPS ☐ Client Drop Off ☐ Other

Turn-Around-Time: ☐ Same Day ☐ 1 day ☐ 2 day ☐ 3 day ☐ 4 day ☐ 5 day ☐ 7 day ☐ 10 day

Reporting Requirements: ☐ Fax ☐ Email ☐ Geospatial/EDF ☐ Hard Copy ☐ EDT

Sample Disposal: ☐ By Laboratory ☐ Return to Client: ☐ PU or Delivery ☐ Archive

Correct Container: ☒ No ☐ N/A

Custody Seals Intact: Yes ☒ No ☐ N/A

COCL Label Agree: ☒ No ☐ N/A

Project/Sample Comments:

DW = Salt water

Requested Analysis	RELINQUISHED BY	DATE/TIME	RECEIVED BY
Oil & Grease ☐ 413.1 ☐ 413.2 ☐ 1664	Signature: <i>Molly Cohn</i> Print: Molly Cohn Company: SPACAR	12-15-15 1030	Signature: <i>[Signature]</i> Print: <i>[Signature]</i> Company: <i>[Signature]</i>
8015 (TPH) ☐ Gas ☐ Diesel ☐ Fuel			
624/8260 (VOC) Full BTX MTBE Oxy Nap			
625 / 8270 (SVOC) ☐ PAH only			
608 / 8081 (Organochlorine Pesticides)			
608 / 8082 (Polychlorinated Biphenyls)			
8141 (Organophosphorus Pesticides)			
TBT (Organotin Compounds)			
pH ☐ EC ☐ TSS ☐ TDS			
0 Nitrate ☐ Nitrite ☐ TKN ☐ NH3			
CAC Title 22/CAM17 Metals ☐ TLIC ☐ STLC			
TCLP (RCRA) ☐ Metals ☐ Organics			
Cd ☐ Cr ☐ Pb ☐ Ni ☐ Ag ☐ Zn ☐ Dissolved			
Coliform, ☐ Total (MTF) ☐ Fecal (MTF)			
Coliform, T+E, Coli ☐ P/A ☐ Enumeration			
Enterococcus, ☐ MTF ☐ Enterolert			
Heterotrophic Plate Count (HPC)			
BOD ☐ COD ☐ Cyanide			
APPROX Volume (ml)			
APPROX Concentration (mg/l)			

*Additional costs may apply. Please note there is a \$15 minimum charge for all clients.

EMA reserves the right to return any samples that do not meet our waste profile.

NOTE: By relinquishing samples to EMA, Inc., client agrees to pay for the services requested on this COC form and any additional analyses performed on this project. Payment for services is due within 30 days from date of invoice. Samples will be disposed of 7 days after report has been finalized unless otherwise noted. All work is subject to EMA's terms and conditions.

EnviroMatrix



Analytical, Inc.

29 December 2015

Nautilus Environmental, LLC
Attn: Kellyn Lupfer
4340 Vandever Avenue
San Diego, CA 92120

EMA Log #: 15L0513

Project Name: SPAWAR-Pulsed

Enclosed are the results of analyses for samples received by the laboratory on 12/15/15 10:30. Samples were analyzed pursuant to client request utilizing EPA or other ELAP approved methodologies. I certify that this data is in compliance both technically and for completeness.

A handwritten signature in black ink, appearing to read 'Dan Verdon'.

Dan Verdon
Laboratory Director

CA ELAP Certification #: 2564

4340 Viewridge Avenue, Suite A - San Diego, California 92123 - (858) 560-7717 - Fax (858) 560-7763
Analytical Chemistry Laboratory

Client Name: Nautilus Environmental, LLC
Project Name: SPAWAR-Pulsed

EMA Log #: 15L0513

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
1 Cu(TO-MC-0)	15L0513-01	Seawater	10/28/15 00:00	12/15/15 10:30
2 Cu(TO-MC-50)	15L0513-02	Seawater	10/28/15 00:00	12/15/15 10:30
3 Cu(TO-MC-100)	15L0513-03	Seawater	10/28/15 00:00	12/15/15 10:30
4 Cu(TO-MC-200)	15L0513-04	Seawater	10/28/15 00:00	12/15/15 10:30
5 Cu(TO-MC-400)	15L0513-05	Seawater	10/28/15 00:00	12/15/15 10:30
6 Cu(TO-MC-800)	15L0513-06	Seawater	10/28/15 00:00	12/15/15 10:30
7 Cu(TO-MP-1600)	15L0513-07	Seawater	10/28/15 00:00	12/15/15 10:30
8 Cu(TO-MP-3200)	15L0513-08	Seawater	10/28/15 00:00	12/15/15 10:30
9 Cu(TO-EP-0)	15L0513-09	Seawater	10/28/15 00:00	12/15/15 10:30
10 Cu(TO-EP-15.6)	15L0513-10	Seawater	10/28/15 00:00	12/15/15 10:30
Cu 11(TO-EP-31.3)	15L0513-11	Seawater	10/28/15 00:00	12/15/15 10:30
Cu 12(TO-EP-62.5)	15L0513-12	Seawater	10/28/15 00:00	12/15/15 10:30
Cu 13(TO-EP-125)	15L0513-13	Seawater	10/28/15 00:00	12/15/15 10:30
Cu 14(TO-EP-250)	15L0513-14	Seawater	10/28/15 00:00	12/15/15 10:30
Cu 15(TO-EC-0)	15L0513-15	Seawater	10/28/15 00:00	12/15/15 10:30
Cu 16(TO-EC-5.8)	15L0513-16	Seawater	10/28/15 00:00	12/15/15 10:30
Cu 17(TO-EC-8.4)	15L0513-17	Seawater	10/28/15 00:00	12/15/15 10:30
Cu 18(TO-EC-12)	15L0513-18	Seawater	10/28/15 00:00	12/15/15 10:30
Cu 19(TO-EC-17.2)	15L0513-19	Seawater	10/28/15 00:00	12/15/15 10:30
Cu 20(TO-EC-24)	15L0513-20	Seawater	10/28/15 00:00	12/15/15 10:30
21 Cu (TO-EC-35)	15L0513-21	Seawater	10/28/15 00:00	12/15/15 10:30

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

EnviroMatrix  Analytical, Inc.

Client Name: Nautilus Environmental, LLC
Project Name: SPAWAR-Pulsed

EMA Log #: 15L0513

Total Metals by EPA 6000/7000 Series Methods

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
1 Cu(TO-MC-0) (15L0513-01) Seawater Sampled: 10/28/15 00:00 Received: 12/15/15 10:30										
Copper	ND	0.002	0.100	mg/l	2	5122347	12/23/15	12/28/15	EPA 6010	
2 Cu(TO-MC-50) (15L0513-02) Seawater Sampled: 10/28/15 00:00 Received: 12/15/15 10:30										
Copper	0.039	0.002	0.100	mg/l	2	5122347	12/23/15	12/28/15	EPA 6010	J
3 Cu(TO-MC-100) (15L0513-03) Seawater Sampled: 10/28/15 00:00 Received: 12/15/15 10:30										
Copper	0.072	0.002	0.100	mg/l	2	5122347	12/23/15	12/28/15	EPA 6010	J
4 Cu(TO-MC-200) (15L0513-04) Seawater Sampled: 10/28/15 00:00 Received: 12/15/15 10:30										
Copper	0.138	0.002	0.100	mg/l	2	5122347	12/23/15	12/28/15	EPA 6010	
5 Cu(TO-MC-400) (15L0513-05) Seawater Sampled: 10/28/15 00:00 Received: 12/15/15 10:30										
Copper	0.323	0.002	0.100	mg/l	2	5122347	12/23/15	12/28/15	EPA 6010	
6 Cu(TO-MC-800) (15L0513-06) Seawater Sampled: 10/28/15 00:00 Received: 12/15/15 10:30										
Copper	0.693	0.002	0.100	mg/l	2	5122347	12/23/15	12/28/15	EPA 6010	
7 Cu(TO-MP-1600) (15L0513-07) Seawater Sampled: 10/28/15 00:00 Received: 12/15/15 10:30										
Copper	1.39	0.002	0.100	mg/l	2	5122347	12/23/15	12/28/15	EPA 6010	
8 Cu(TO-MP-3200) (15L0513-08) Seawater Sampled: 10/28/15 00:00 Received: 12/15/15 10:30										
Copper	2.97	0.002	0.100	mg/l	2	5122347	12/23/15	12/28/15	EPA 6010	
9 Cu(TO-EP-0) (15L0513-09) Seawater Sampled: 10/28/15 00:00 Received: 12/15/15 10:30										
Copper	ND	0.002	0.100	mg/l	2	5122347	12/23/15	12/28/15	EPA 6010	

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

EnviroMatrix Analytical, Inc.



Client Name: Nautilus Environmental, LLC
Project Name: SPAWAR-Pulsed

EMA Log #: 15L0513

Total Metals by EPA 6000/7000 Series Methods

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
10 Cu(TO-EP-15.6) (15L0513-10) Seawater Sampled: 10/28/15 00:00 Received: 12/15/15 10:30										
Copper	0.004	0.002	0.100	mg/l	2	5122347	12/23/15	12/28/15	EPA 6010	J
Cu 11(TO-EP-31.3) (15L0513-11) Seawater Sampled: 10/28/15 00:00 Received: 12/15/15 10:30										
Copper	0.012	0.002	0.100	mg/l	2	5122347	12/23/15	12/28/15	EPA 6010	J
Cu 12(TO-EP-62.5) (15L0513-12) Seawater Sampled: 10/28/15 00:00 Received: 12/15/15 10:30										
Copper	0.039	0.002	0.100	mg/l	2	5122347	12/23/15	12/28/15	EPA 6010	J
Cu 13(TO-EP-125) (15L0513-13) Seawater Sampled: 10/28/15 00:00 Received: 12/15/15 10:30										
Copper	0.089	0.002	0.100	mg/l	2	5122347	12/23/15	12/28/15	EPA 6010	J
Cu 14(TO-EP-250) (15L0513-14) Seawater Sampled: 10/28/15 00:00 Received: 12/15/15 10:30										
Copper	0.225	0.002	0.100	mg/l	2	5122347	12/23/15	12/28/15	EPA 6010	
Cu 15(TO-EC-0) (15L0513-15) Seawater Sampled: 10/28/15 00:00 Received: 12/15/15 10:30										
Copper	ND	0.002	0.100	mg/l	2	5122347	12/23/15	12/29/15	EPA 6010	
Cu 16(TO-EC-5.8) (15L0513-16) Seawater Sampled: 10/28/15 00:00 Received: 12/15/15 10:30										
Copper	ND	0.002	0.100	mg/l	2	5122347	12/23/15	12/29/15	EPA 6010	
Cu 17(TO-EC-8.4) (15L0513-17) Seawater Sampled: 10/28/15 00:00 Received: 12/15/15 10:30										
Copper	ND	0.002	0.100	mg/l	2	5122347	12/23/15	12/29/15	EPA 6010	
Cu 18(TO-EC-12) (15L0513-18) Seawater Sampled: 10/28/15 00:00 Received: 12/15/15 10:30										
Copper	0.003	0.002	0.100	mg/l	2	5122347	12/23/15	12/29/15	EPA 6010	J

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

EnviroMatrix



Analytical, Inc.

Client Name: Nautilus Environmental, LLC
Project Name: SPAWAR-Pulsed

EMA Log #: 15L0513

Total Metals by EPA 6000/7000 Series Methods

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Cu 19(TO-EC-17.2) (15L0513-19) Seawater Sampled: 10/28/15 00:00 Received: 12/15/15 10:30										
Copper	0.008	0.002	0.100	mg/l	2	5122347	12/23/15	12/29/15	EPA 6010	J
Cu 20(TO-EC-24) (15L0513-20) Seawater Sampled: 10/28/15 00:00 Received: 12/15/15 10:30										
Copper	0.011	0.002	0.100	mg/l	2	5122347	12/23/15	12/29/15	EPA 6010	J
21 Cu (TO-EC-35) (15L0513-21) Seawater Sampled: 10/28/15 00:00 Received: 12/15/15 10:30										
Copper	0.017	0.002	0.100	mg/l	2	5122344	12/23/15	12/23/15	EPA 6010	J

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

EnviroMatrix



Analytical, Inc.

Client Name: Nautilus Environmental, LLC
Project Name: SPAWAR-Pulsed

EMA Log #: 15L0513

Total Metals by EPA 6000/7000 Series Methods - Quality Control

Analyte	Result	MDL	Reporting Limit	Units	Spike Level	Source Result	%REC Limits	RPD	RPD Limit	Notes
Batch 5122344										
Blank (5122344-BLK1)					Prepared & Analyzed: 12/23/15					
Copper	ND	0.0009	0.050	mg/l						
LCS (5122344-BS1)					Prepared & Analyzed: 12/23/15					
Copper	1.03	0.0009	0.050	mg/l	1.00	103	75-125			
Duplicate (5122344-DUP1)					Source: 15L0511-01		Prepared & Analyzed: 12/23/15			
Copper	0.730	0.090	5.00	mg/l	0.749			3	20	J
Batch 5122347										
Blank (5122347-BLK1)					Prepared: 12/23/15 Analyzed: 12/28/15					
Copper	ND	0.0009	0.050	mg/l						
LCS (5122347-BS1)					Prepared: 12/23/15 Analyzed: 12/28/15					
Copper	1.06	0.0009	0.050	mg/l	1.00	106	75-125			
Duplicate (5122347-DUP1)					Source: 15L0513-06		Prepared: 12/23/15 Analyzed: 12/28/15			
Copper	0.671	0.002	0.100	mg/l	0.693			3	20	

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

EnviroMatrix



Analytical, Inc.

Client Name: Nautilus Environmental, LLC
Project Name: SPAWAR-Pulsed

EMA Log #: 15L0513

Notes and Definitions

J	Detected but below the Reporting Limit; therefore, result is an estimated concentration (CLP J-Flag).
ND	Analyte NOT DETECTED at or above the reporting limit (or method detection limit when specified)
NR	Not Reported
dry	Sample results reported on a dry weight basis (if indicated in units column)
RPD	Relative Percent Difference
MDL	Method detection limit (indicated per client's request)

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

EnviroMatrix



Analytical, Inc.

CHAIN-OF-CUSTODY RECORD

15L0513

EMALOG #:
Client: NAVAHLUS ENVIRONMENTAL SPANAR

Attn: Kellyn Cooper
Sample(s): Kellyn Cooper

Address:
Phone: 858-587-7333 x20 Fax:
Email: Kellyn.Cooper@navahlus.com

Billing Address:
Project ID: SPANAR - Poles

Project #:
PO #:

ID #	Client Sample ID	Sample Date	Sample Time	Sample Matrix	Container # / Type
1	100 (To - MC - 100)	10/28/15	15:00	SEA	HBBE
2	200 (To - MC - 200)	10/28/15	15:00	SEA	HBBE
3	300 (To - MC - 300)	10/28/15	15:00	SEA	HBBE
4	400 (To - MC - 400)	10/28/15	15:00	SEA	HBBE
5	500 (To - MC - 500)	10/28/15	15:00	SEA	HBBE
6	600 (To - MC - 600)	10/28/15	15:00	SEA	HBBE
7	700 (To - MC - 700)	10/28/15	15:00	SEA	HBBE
8	800 (To - MC - 800)	10/28/15	15:00	SEA	HBBE
9	900 (To - MC - 900)	10/28/15	15:00	SEA	HBBE
10	1000 (To - MC - 1000)	10/28/15	15:00	SEA	HBBE

Matrix Codes: A = Air, DW = Drinking Water, GW = Groundwater, SW = Storm Water
WW = Wastewater, S = Soil, SED = Sediment, SD = Solid, T = Tissue, O = Oil, L = Liquid

Shipped By: ☐ Courier ☐ UPS ☐ FedEx ☐ USPS ☐ Client Drop Off ☐ Other

Turn-Around-Time: ☐ Same Day ☐ 1 day ☐ 2 day ☐ 3 day ☐ 5 day ☐ STD (7 day)

Reporting Requirements: ☐ Fax ☐ PDF ☐ Excel ☐ Geomark/EDF ☐ Hard Copy ☐ EDT

Sample Disposal: ☒ By Laboratory ☐ Return to Client ☐ PU or Delivery ☐ Archive

Correct Containers: ☒ No ☐ N/A

Custody Seal Intact: ☒ Yes ☐ No

COC/Lab/Agree: ☒ No ☐ N/A

Project/Sample Comments:
x0 = salt water

Requested Analysis		RELINQUISHED BY	DATE/TIME	RECEIVED BY
Oil & Grease ☐ 413.1 ☐ 413.2 ☐ 1664	8015 (TPH) ☐ Gas ☐ Diesel ☐ Ex	Signature: <i>[Signature]</i> Print: Kellyn Cooper Company: SPANAR	12-15-15 10:30	Signature: <i>[Signature]</i> Print: Kellyn Cooper Company: SPANAR
624/8260 (VOC) Full BTX MTBE Oxy Nap	625 / 8270 (SVOC) ☐ PAH only	Signature: <i>[Signature]</i> Print: Kellyn Cooper Company: SPANAR		Signature: <i>[Signature]</i> Print: Kellyn Cooper Company: SPANAR
608 / 8081 (Organochlorine Pesticides)	608 / 8082 (Polychlorinated Biphenyls)	Signature: <i>[Signature]</i> Print: Kellyn Cooper Company: SPANAR		Signature: <i>[Signature]</i> Print: Kellyn Cooper Company: SPANAR
8141 (Organophosphorus Pesticides)	TBT (Organotin Compounds)	Signature: <i>[Signature]</i> Print: Kellyn Cooper Company: SPANAR		Signature: <i>[Signature]</i> Print: Kellyn Cooper Company: SPANAR
pH ☐ EC ☐ TSS ☐ TDS	Nitrate ☐ Nitrite ☐ TKN ☐ NH3	Signature: <i>[Signature]</i> Print: Kellyn Cooper Company: SPANAR		Signature: <i>[Signature]</i> Print: Kellyn Cooper Company: SPANAR
CAC Title 22/CAM17 Metals ☐ TLIC ☐ STLC	TCAP (RCRA) ☐ Metals ☐ Organics	Signature: <i>[Signature]</i> Print: Kellyn Cooper Company: SPANAR		Signature: <i>[Signature]</i> Print: Kellyn Cooper Company: SPANAR
Coliform, ☐ Total (MTF) ☐ Fecal (MTF)	Coliform, ☐ F+E Coli ☐ P/A ☐ Enumeration	Signature: <i>[Signature]</i> Print: Kellyn Cooper Company: SPANAR		Signature: <i>[Signature]</i> Print: Kellyn Cooper Company: SPANAR
Enterococcus, ☐ MTF ☐ Enterolent	Heterotrophic Plate Count (HPC)	Signature: <i>[Signature]</i> Print: Kellyn Cooper Company: SPANAR		Signature: <i>[Signature]</i> Print: Kellyn Cooper Company: SPANAR
BOD ☐ COD ☐ Cyanide		Signature: <i>[Signature]</i> Print: Kellyn Cooper Company: SPANAR		Signature: <i>[Signature]</i> Print: Kellyn Cooper Company: SPANAR
Normal Concentration (ppb)	APPROX Volume	Signature: <i>[Signature]</i> Print: Kellyn Cooper Company: SPANAR		Signature: <i>[Signature]</i> Print: Kellyn Cooper Company: SPANAR

Additional costs may apply. Please note there is a \$35 minimum charge for all clients.

EMA reserves the right to return any samples that do not match our waste profile.

NOTE: By relinquishing samples to EMA, Inc., client agrees to pay for the services requested on this COC form and any additional analyses performed on this project. Payment for services is due within 30 days from date of invoice. Samples will be disposed of 7 days after report has been finalized unless otherwise noted. All work is subject to EMA's terms and conditions.

CHAIN-OF-CUSTODY RECORD

1520513

¹Additional costs may apply. Please note there is a \$35 minimum charge for all clients.

EMA reserves the right to return any samples that do not match our waste profile.

NOTE: By relinquishing samples to EMA, Inc., client agrees to pay for the services of EMA, Inc. to examine any samples and do not match out-waste profile.

disposed of 7 days after report has been finalized unless otherwise noted. All work is subject to EMA's terms and conditions. Payment for services is due within 30 days from date of invoice. Samples will be

CHAIN-OF-CUSTODY RECORD

1560513

EnviroMatrix Analytical, Inc.

4340 Viewridge Ave., Ste. A - San Diego, CA 92123 - Phone (858) 560-7717 - Fax (858) 560-7763

EMALOG #: Client: <u>Nauticus Environmental / SFA/AR</u> Attn: <u>Kellyn Lepore</u> Samplers: <u>Molly Colucci</u> Address: Phone: <u>958-587-7333</u> X24 Fax: Email: <u>kellyn@nauticusenvironmental.com</u> Billing Address: Project ID: <u>SFA/AR - Diesel</u> Project #:		Requested Analysis CAC Title 22/CAM17 Metals ☐ TLIC ☐ STLC TCAP (RCRA) ☐ Metals ☐ Organics Cd ☐ Cr ☐ Pb ☐ Ni ☐ Ag ☐ Zn ☐ Dissolved Coliform, ☐ Total (MTF) ☐ Fecal (MTF) Coliform, T-E, Coli ☐ P/A ☐ Enumeration Enterococcus, ☐ MTF ☐ Enterolert Heterotrophic Plate Count (HPC) BOD ☐ COD ☐ Cyanide Approx volume (ML) Normal concentration (ppb)	
RELINQUISHED BY: Signature: <u>[Signature]</u> Print: <u>Molly Colucci</u> Company: <u>SFA/AR</u>		DATE/TIME: 12-15-15 1030	
Oil & Grease ☐ 413.1 ☐ 413.2 ☐ 1664 8015 (TPH) ☐ Gas ☐ Diesel ☐ Ext 624/8260 (VOC) Full BXE MBE Oxy Nap 625 / 8270 (SVOC) ☐ PAH only 608 / 8081 (Organochlorine Pesticides) 608 / 8082 (Polychlorinated Biphenyls) 8141 (Organophosphorus Pesticides) TBT (Organotin Compounds) pH ☐ EC ☐ TSS ☐ TDS Nitrate ☐ Nitrite ☐ TKN ☐ NH3 CAC Title 22/CAM17 Metals ☐ TLIC ☐ STLC		Signature: <u>[Signature]</u> Print: <u>[Signature]</u> Company: <u>[Signature]</u> Signature: <u>[Signature]</u> Print: <u>[Signature]</u> Company: <u>[Signature]</u> Signature: <u>[Signature]</u> Print: <u>[Signature]</u> Company: <u>[Signature]</u>	
ID# Client Sample ID 1 2100 (F - F - 35) 2 2200 (F - F - 35) 3 2300 (F - F - 35) 4 2400 (F - F - 35) 5 2500 (F - F - 35) 6 2600 (F - F - 35) 7 2700 (F - F - 35) 8 2800 (F - F - 35) 9 2900 (F - F - 35) 10 3000 (F - F - 35)		Sample Date 12/15/15 12/15/15 12/15/15 12/15/15 12/15/15 12/15/15 12/15/15 12/15/15 12/15/15 12/15/15	
Sample Time 1030 1030 1030 1030 1030 1030 1030 1030 1030 1030		Sample Matrix SW SW SW SW SW SW SW SW SW SW	
Container # / Type HPC HPC HPC HPC HPC HPC HPC HPC HPC HPC		SEA SEA SEA SEA SEA SEA SEA SEA SEA SEA	
Matrix Codes: A = Air, DW = Drinking Water, GW = Groundwater, SW = Storm Water WW = Wastewater, S = Soil, SED = Sediment, SD = Solid, T = Tissue, O = Oil, L = Liquid Shipped By: ☐ Carrier ☐ UPS ☐ FedEx ☐ USPS ☐ Client Drop Off ☐ Other Turn-Around-Time: ☐ Same Day ☐ 1 day ☐ 2 day ☐ 3 day ☐ 4 day ☐ 5 day ☐ 7 day Reporting Requirements: ☐ Fax ☐ Email ☐ Hard Copy ☐ EDT Sample Disposal: ☐ Laboratory ☐ Return to Client ☐ PID or Delivery ☐ Archive			
Sample Integrity Carrier Container: ☐ N/A Custody Seals Intact: ☐ Yes ☐ No COC Labels Agreed: ☐ Yes ☐ No Sampled By: <u>[Signature]</u> Project/Sample Comments: <u>See below</u>			

Additional costs may apply. Please note there is a \$35 minimum charge for all clients.
 EMA reserves the right to return any samples that do not match our waste profile.
 NOTE: By relinquishing samples to EMA, Inc., client agrees to pay for the services requested on this COC form and any additional analyses performed on this project. Payment for services is due within 30 days from date of invoice. Samples will be disposed of 7 days after report has been finalized unless otherwise noted. All work is subject to EMA's terms and conditions.

A.4. ZINC EXPOSURES – PURPLE URCHIN:

CETIS Summary Report

Report Date: 02 Jun-16 16:13 (p 1 of 1)

Test Code: 14F233C8 | 03-5141-7288

Echinoid Embryo-Larval Development Test								SPAWAR Systems Center			
Batch ID:	18-8664-8575	Test Type:	Development				Analyst:	Jacob Munson-Decker			
Start Date:	25 Mar-16 09:30	Protocol:	EPA/600/R-95/136 (1995)				Diluent:	Laboratory Seawater			
Ending Date:		Species:	Strongylocentrotus purpuratus				Brine:	Not Applicable			
Duration:	NA	Source:	Field Collected				Age:				
Sample ID:	10-0881-9327	Code:	3C215C7F				Client:	SPAWAR			
Sample Date:	25 Mar-16 09:30	Material:	Zinc sulfate				Project:	Pulsed Exposure			
Receive Date:		Source:	Pulsed Exposure								
Sample Age:	NA	Station:	3 Hour								
Comparison Summary											
Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method				
11-8378-1410	Proportion Normal	31000	>31000	NA	24.1%		Steel Many-One Rank Sum Test				
Point Estimate Summary											
Analysis ID	Endpoint	Level	µg/L	95% LCL	95% UCL	TU	Method				
20-4223-0387	Proportion Normal	EC50	27120	22060	32540		Linear Regression (MLE)				
Test Acceptability											
Analysis ID	Endpoint	Attribute		Test Stat	TAC Limits		Overlap	Decision			
11-8378-1410	Proportion Normal	Control Resp		0.9525	0.8 - NL		Yes	Passes Acceptability Criteria			
20-4223-0387	Proportion Normal	Control Resp		0.9525	0.8 - NL		Yes	Passes Acceptability Criteria			
11-8378-1410	Proportion Normal	PMSD		0.2408	NL - 0.25		No	Passes Acceptability Criteria			
Proportion Normal Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	% Effect
6.1	Lab Control	4	0.9525	0.8752	1	0.88	0.98	0.02428	0.04856	5.1%	0.0%
1900		4	0.9525	0.9445	0.9605	0.95	0.96	0.0025	0.005	0.52%	0.0%
3900		4	0.9625	0.9473	0.9777	0.95	0.97	0.004787	0.009574	0.99%	-1.05%
7700		4	0.9475	0.9147	0.9803	0.92	0.97	0.01031	0.02062	2.18%	0.52%
15000		4	0.905	0.8671	0.9429	0.88	0.93	0.0119	0.0238	2.63%	4.99%
31000		4	0.34	0	0.9769	0.02	0.91	0.2001	0.4002	117.7%	64.3%
Proportion Normal Detail											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
6.1	Lab Control	0.98	0.97	0.88	0.98						
1900		0.95	0.95	0.95	0.96						
3900		0.97	0.97	0.96	0.95						
7700		0.95	0.95	0.97	0.92						
15000		0.88	0.93	0.92	0.89						
31000		0.02	0.32	0.11	0.91						
Proportion Normal Binomials											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
6.1	Lab Control	98/100	97/100	88/100	98/100						
1900		95/100	95/100	95/100	96/100						
3900		97/100	97/100	96/100	95/100						
7700		95/100	95/100	97/100	92/100						
15000		88/100	93/100	92/100	89/100						
31000		2/100	32/100	11/100	91/100						

CETIS Analytical Report

Report Date: 02 Jun-16 16:13 (p 1 of 2)
Test Code: 14F233C8 | 03-5141-7288

Echinoid Embryo-Larval Development Test					SPAWAR Systems Center						
Analysis ID:	11-8378-1410	Endpoint:	Proportion Normal			CETIS Version:	CETISv1.8.7				
Analyzed:	02 Jun-16 12:21	Analysis:	Nonparametric-Control vs Treatments			Official Results:	Yes				
Batch ID:	18-8664-8575	Test Type:	Development			Analyst:	Jacob Munson-Decker				
Start Date:	25 Mar-16 09:30	Protocol:	EPA/600/R-95/136 (1995)			Diluent:	Laboratory Seawater				
Ending Date:		Species:	Strongylocentrotus purpuratus			Brine:	Not Applicable				
Duration:	NA	Source:	Field Collected			Age:					
Sample ID:	10-0881-9327	Code:	3C215C7F			Client:	SPAWAR				
Sample Date:	25 Mar-16 09:30	Material:	Zinc sulfate			Project:	Pulsed Exposure				
Receive Date:		Source:	Pulsed Exposure								
Sample Age:	NA	Station:	3 Hour								
Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	NOEL	LOEL	TOEL	TU		
Angular (Corrected)	NA	C > T	NA	NA	24.1%	31000	>31000	NA			
Steel Many-One Rank Sum Test											
Control	vs	C-µg/L	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)		
6.1		1900	14	10	0	6	0.3451	Asymp	Non-Significant Effect		
6.1		3900	15	10	1	6	0.4761	Asymp	Non-Significant Effect		
6.1		7700	14.5	10	1	6	0.4092	Asymp	Non-Significant Effect		
6.1		15000	13.5	10	1	6	0.2853	Asymp	Non-Significant Effect		
6.1		31000	11	10	0	6	0.0805	Asymp	Non-Significant Effect		
Test Acceptability Criteria											
Attribute	Test Stat	TAC Limits	Overlap	Decision							
Control Resp	0.9525	0.8 - NL	Yes	Passes Acceptability Criteria							
PMSD	0.2408	NL - 0.25	No	Passes Acceptability Criteria							
ANOVA Table											
Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)					
Between	1.924405	0.384881	5	9.042	0.0002	Significant Effect					
Error	0.7661615	0.04256453	18								
Total	2.690567		23								
Distributional Tests											
Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)						
Variances	Bartlett Equality of Variance	42.05	15.09	<0.0001	Unequal Variances						
Distribution	Shapiro-Wilk W Normality	0.669	0.884	<0.0001	Non-normal Distribution						
Proportion Normal Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
6.1	Lab Control	4	0.9525	0.8752	1	0.975	0.88	0.98	0.02428	5.1%	0.0%
1900		4	0.9525	0.9445	0.9605	0.95	0.95	0.96	0.0025	0.53%	0.0%
3900		4	0.9625	0.9473	0.9777	0.965	0.95	0.97	0.004787	0.99%	-1.05%
7700		4	0.9475	0.9147	0.9803	0.95	0.92	0.97	0.01031	2.18%	0.52%
15000		4	0.905	0.8671	0.9429	0.905	0.88	0.93	0.0119	2.63%	4.99%
31000		4	0.34	0	0.9769	0.215	0.02	0.91	0.2001	117.7%	64.3%
Angular (Corrected) Transformed Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
6.1	Lab Control	4	1.368	1.206	1.53	1.413	1.217	1.429	0.05085	7.44%	0.0%
1900		4	1.351	1.332	1.371	1.345	1.345	1.369	0.006038	0.89%	1.21%
3900		4	1.377	1.338	1.416	1.383	1.345	1.397	0.01238	1.8%	-0.67%
7700		4	1.343	1.269	1.416	1.345	1.284	1.397	0.02304	3.43%	1.83%
15000		4	1.259	1.194	1.324	1.258	1.217	1.303	0.02044	3.25%	7.95%
31000		4	0.5868	-0.1935	1.367	0.4697	0.1419	1.266	0.2452	83.57%	57.1%

CETIS Analytical Report

Report Date: 02 Jun-16 16:13 (p 2 of 2)
Test Code: 14F233C8 | 03-5141-7288

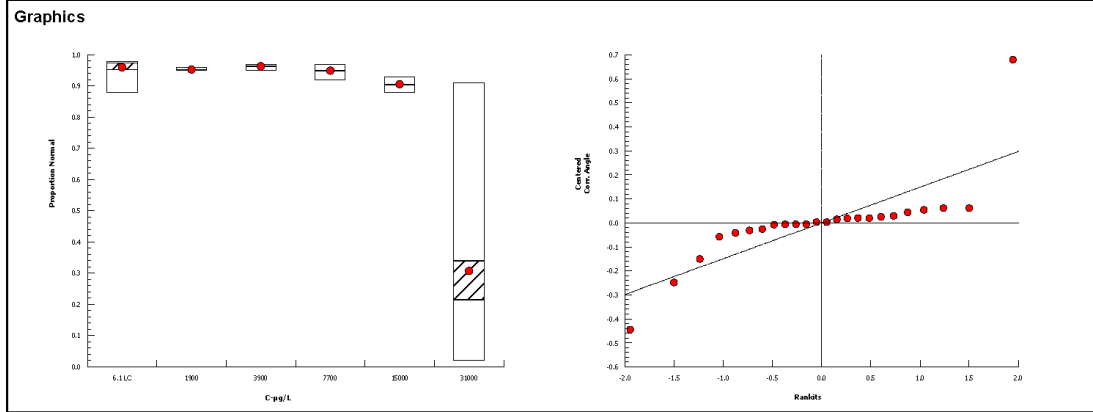
Echinoid Embryo-Larval Development Test SPAWAR Systems Center

Analysis ID: 11-8378-1410 Endpoint: Proportion Normal CETIS Version: CETISv1.8.7
Analyzed: 02 Jun-16 12:21 Analysis: Nonparametric-Control vs Treatments Official Results: Yes

Proportion Normal Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
6.1	Lab Control	0.98	0.97	0.88	0.98
1900		0.95	0.95	0.95	0.96
3900		0.97	0.97	0.96	0.95
7700		0.95	0.95	0.97	0.92
15000		0.88	0.93	0.92	0.89
31000		0.02	0.32	0.11	0.91

Angular (Corrected) Transformed Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
6.1	Lab Control	1.429	1.397	1.217	1.429
1900		1.345	1.345	1.345	1.369
3900		1.397	1.397	1.369	1.345
7700		1.345	1.345	1.397	1.284
15000		1.217	1.303	1.284	1.233
31000		0.1419	0.6013	0.3381	1.266

Proportion Normal Binomials					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
6.1	Lab Control	98/100	97/100	88/100	98/100
1900		95/100	95/100	95/100	96/100
3900		97/100	97/100	96/100	95/100
7700		95/100	95/100	97/100	92/100
15000		88/100	93/100	92/100	89/100
31000		2/100	32/100	11/100	91/100



CETIS Analytical Report

Report Date: 02 Jun-16 16:13 (p 1 of 2)
Test Code: 14F233C8 | 03-5141-7288

Echinoid Embryo-Larval Development Test							SPAWAR Systems Center				
Analysis ID:	20-4223-0387		Endpoint:	Proportion Normal			CETIS Version:	CETISv1.8.7			
Analyzed:	02 Jun-16 12:23		Analysis:	Linear Regression (MLE)			Official Results:	Yes			
Batch ID:	18-8664-8575		Test Type:	Development			Analyst:	Jacob Munson-Decker			
Start Date:	25 Mar-16 09:30		Protocol:	EPA/600/R-95/136 (1995)			Diluent:	Laboratory Seawater			
Ending Date:			Species:	Strongylocentrotus purpuratus			Brine:	Not Applicable			
Duration:	NA		Source:	Field Collected			Age:				
Sample ID:	10-0881-9327		Code:	3C215C7F			Client:	SPAWAR			
Sample Date:	25 Mar-16 09:30		Material:	Zinc sulfate			Project:	Pulsed Exposure			
Receive Date:			Source:	Pulsed Exposure							
Sample Age:	NA		Station:	3 Hour							
Linear Regression Options											
Model Function			Threshold Option	Threshold	Optimized	Pooled	Het Corr	Weighted			
Log-Normal [NED=A+B*log(X)]			Control Threshold	0.0475	Yes	No	Yes	Yes			
Regression Summary											
Iters	LL	AICc	BIC	Mu	Sigma	Adj R2	F Stat	Critical	P-Value	Decision(α:5%)	
6	-681.7	1371	1373	4.433	0.1577	0.8001	0.04186	3.16	0.9882	Non-Significant Lack of Fit	
Point Estimates											
Level	µg/L	95% LCL	95% UCL								
EC50	27120	22060	32540								
Test Acceptability Criteria											
Attribute	Test Stat	TAC Limits		Overlap	Decision						
Control Resp	0.9525	0.8 - NL		Yes	Passes Acceptability Criteria						
Regression Parameters											
Parameter	Estimate	Std Error	95% LCL	95% UCL	t Stat	P-Value	Decision(α:5%)				
Threshold	0.04615	0.0177	0.009339	0.08297	2.607	0.0165	Significant Parameter				
Slope	6.34	1.778	2.643	10.04	3.566	0.0018	Significant Parameter				
Intercept	-28.11	7.891	-44.52	-11.7	-3.562	0.0018	Significant Parameter				
ANOVA Table											
Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)					
Model	1061.223	1061.223	1	94.06	<0.0001	Significant					
Lack of Fit	1.641275	0.547092	3	0.04186	0.9882	Non-Significant					
Pure Error	235.2768	13.07093	18								
Residual	236.918	11.28181	21								
Residual Analysis											
Attribute	Method			Test Stat	Critical	P-Value	Decision(α:5%)				
Goodness-of-Fit	Pearson Chi-Sq GOF			236.9	32.67	<0.0001	Significant Heterogeneity				
	Likelihood Ratio GOF			257.9	32.67	<0.0001	Significant Heterogeneity				
Variances	Mod Levene Equality of Variance			2.724	2.773	0.0529	Equal Variances				
Distribution	Shapiro-Wilk W Normality			0.7006	0.9169	<0.0001	Non-normal Distribution				
	Anderson-Darling A2 Normality			3.056	2.492	<0.0001	Non-normal Distribution				
Proportion Normal Summary											
			Calculated Variate(A/B)								
C-µg/L	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
6.1	Lab Control	4	0.9525	0.88	0.98	0.02428	0.04856	5.1%	0.0%	381	400
1900		4	0.9525	0.95	0.96	0.0025	0.005	0.53%	0.0%	381	400
3900		4	0.9625	0.95	0.97	0.004787	0.009574	0.99%	-1.05%	385	400
7700		4	0.9475	0.92	0.97	0.01031	0.02062	2.18%	0.52%	379	400
15000		4	0.905	0.88	0.93	0.0119	0.0238	2.63%	4.99%	362	400
31000		4	0.34	0.02	0.91	0.2001	0.4002	117.7%	64.3%	136	400

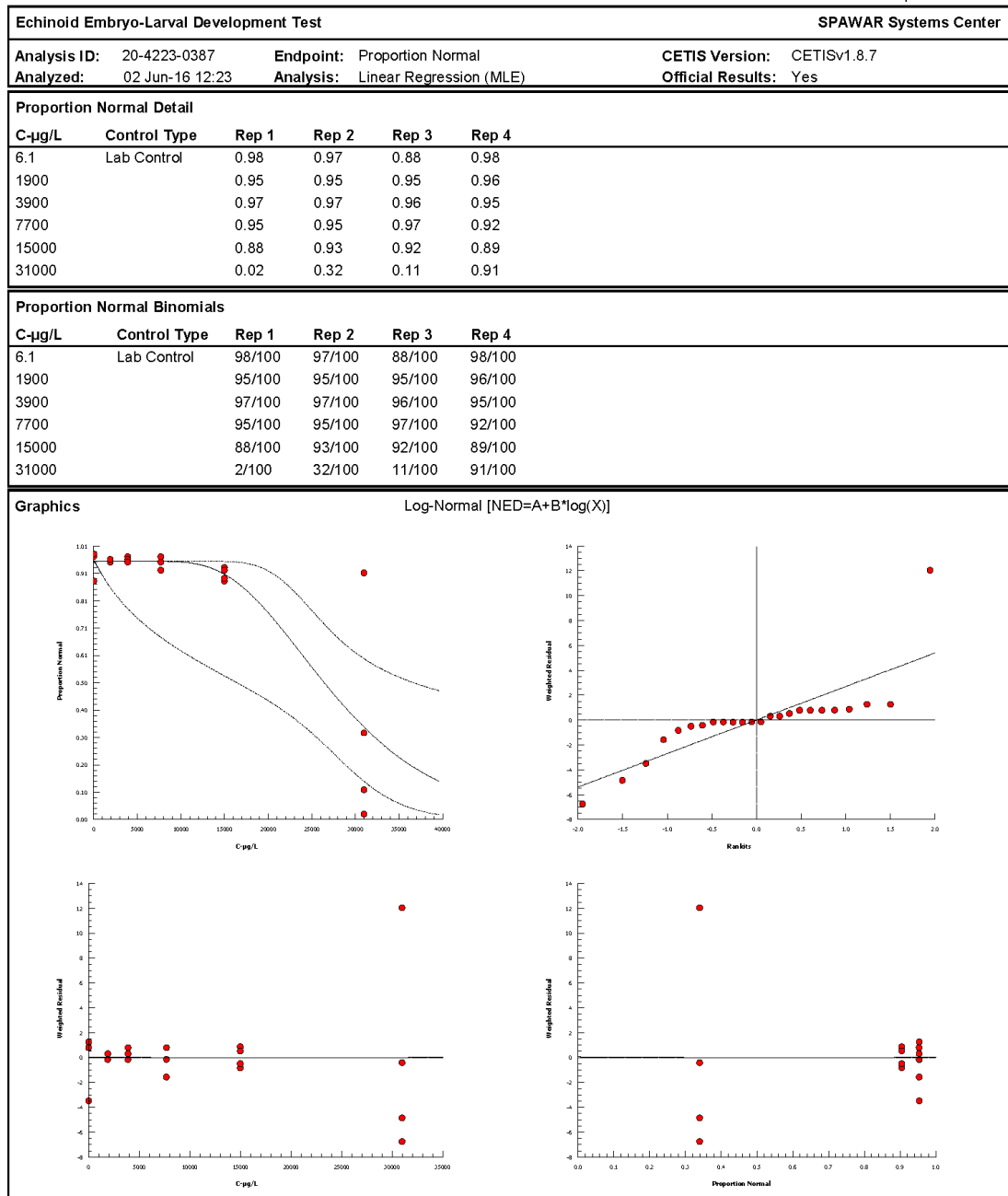
000-010-187-1

CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Analytical Report

Report Date: 02 Jun-16 16:13 (p 2 of 2)
Test Code: 14F233C8 | 03-5141-7288



000-010-187-1

CETIS™ v1.8.7.16

Analyst: _____ QA: _____

CETIS Summary Report

Report Date: 03 Jun-16 08:15 (p 1 of 1)

Test Code: 35DF03E3 | 09-0380-7971

Echinoid Embryo-Larval Development Test								SPAWAR Systems Center			
Batch ID:	18-8664-8575	Test Type: Development				Analyst:		Jacob Munson-Decker			
Start Date:	25 Mar-16 09:30	Protocol: EPA/600/R-95/136 (1995)				Diluent:		Laboratory Seawater			
Ending Date:		Species: Strongylocentrotus purpuratus				Brine:		Not Applicable			
Duration:	NA	Source: Field Collected				Age:					
Sample ID:	10-7952-1621	Code: 40583155				Client:		SPAWAR			
Sample Date:	25 Mar-16 09:30	Material: Zinc sulfate				Project:		Pulsed Exposure			
Receive Date:		Source: Pulsed Exposure									
Sample Age:	NA	Station: 6 Hour									
Comparison Summary											
Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method				
18-8256-3241	Proportion Normal	15000	31000	21560	13.0%		Steel Many-One Rank Sum Test				
Point Estimate Summary											
Analysis ID	Endpoint	Level	µg/L	95% LCL	95% UCL	TU	Method				
17-0420-4437	Proportion Normal	EC50	27140	23300	32980		Linear Regression (MLE)				
Test Acceptability											
Analysis ID	Endpoint	Attribute		Test Stat	TAC Limits		Overlap	Decision			
17-0420-4437	Proportion Normal	Control Resp		0.9525	0.8 - NL		Yes	Passes Acceptability Criteria			
18-8256-3241	Proportion Normal	Control Resp		0.9525	0.8 - NL		Yes	Passes Acceptability Criteria			
18-8256-3241	Proportion Normal	PMSD		0.13	NL - 0.25		No	Passes Acceptability Criteria			
Proportion Normal Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
6.1	Lab Control	4	0.9525	0.8752	1	0.88	0.98	0.02428	0.04856	5.1%	0.0%
1900		4	0.9675	0.9347	1	0.95	0.99	0.01031	0.02062	2.13%	-1.58%
3900		4	0.955	0.9345	0.9755	0.94	0.97	0.006455	0.01291	1.35%	-0.26%
7700		4	0.93	0.9075	0.9525	0.92	0.95	0.007071	0.01414	1.52%	2.36%
15000		4	0.835	0.6469	1	0.66	0.92	0.05909	0.1182	14.15%	12.34%
31000		4	0.38	0.001436	0.7586	0.15	0.6	0.119	0.2379	62.61%	60.1%
Proportion Normal Detail											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
6.1	Lab Control	0.98	0.97	0.88	0.98						
1900		0.99	0.98	0.95	0.95						
3900		0.95	0.94	0.96	0.97						
7700		0.93	0.95	0.92	0.92						
15000		0.66	0.88	0.92	0.88						
31000		0.57	0.6	0.15	0.2						
Proportion Normal Binomials											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
6.1	Lab Control	98/100	97/100	88/100	98/100						
1900		99/100	98/100	95/100	95/100						
3900		95/100	94/100	96/100	97/100						
7700		93/100	95/100	92/100	92/100						
15000		66/100	88/100	92/100	88/100						
31000		57/100	60/100	15/100	20/100						

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Analyst:_____ QA:_____

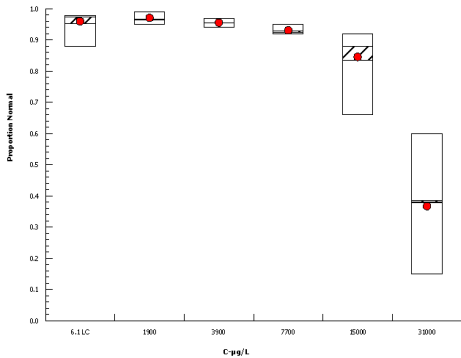
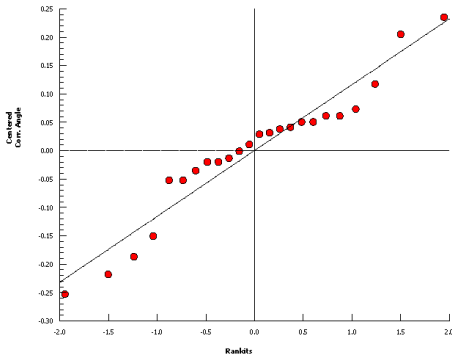
CETIS Analytical Report

Report Date: 03 Jun-16 08:15 (p 1 of 2)
 Test Code: 35DF03E3 | 09-0380-7971

Echinoid Embryo-Larval Development Test					SPAWAR Systems Center													
Analysis ID:	18-8256-3241	Endpoint:	Proportion Normal	CETIS Version:	CETISv1.8.7													
Analyzed:	03 Jun-16 8:09	Analysis:	Nonparametric-Control vs Treatments	Official Results:	Yes													
Batch ID:	18-8664-8575	Test Type:	Development	Analyst:	Jacob Munson-Decker													
Start Date:	25 Mar-16 09:30	Protocol:	EPA/600/R-95/136 (1995)	Diluent:	Laboratory Seawater													
Ending Date:		Species:	Strongylocentrotus purpuratus	Brine:	Not Applicable													
Duration:	NA	Source:	Field Collected	Age:														
Sample ID:	10-7952-1621	Code:	40583155	Client:	SPAWAR													
Sample Date:	25 Mar-16 09:30	Material:	Zinc sulfate	Project:	Pulsed Exposure													
Receive Date:		Source:	Pulsed Exposure															
Sample Age:	NA	Station:	6 Hour															
Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	NOEL	LOEL	TOEL	TU									
Angular (Corrected)	NA	C > T	NA	NA	13.0%	15000	31000	21560										
Steel Many-One Rank Sum Test																		
Control	vs	C-µg/L	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)									
6.1		1900	19	10	2	6	0.9055	Asymp	Non-Significant Effect									
6.1		3900	14.5	10	1	6	0.4092	Asymp	Non-Significant Effect									
6.1		7700	14	10	0	6	0.3451	Asymp	Non-Significant Effect									
6.1		15000	12	10	1	6	0.1424	Asymp	Non-Significant Effect									
6.1		31000*	10	10	0	6	0.0417	Asymp	Significant Effect									
Test Acceptability Criteria																		
Attribute	Test Stat	TAC Limits	Overlap	Decision														
Control Resp	0.9525	0.8 - NL	Yes	Passes Acceptability Criteria														
PMSD	0.13	NL - 0.25	No	Passes Acceptability Criteria														
ANOVA Table																		
Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)												
Between	1.622611	0.3245222	5	18.77	<0.0001	Significant Effect												
Error	0.3112574	0.01729208	18															
Total	1.933868		23															
Distributional Tests																		
Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)													
Variances	Bartlett Equality of Variance	16.73	15.09	0.0050	Unequal Variances													
Distribution	Shapiro-Wilk W Normality	0.9391	0.884	0.1560	Normal Distribution													
Proportion Normal Summary																		
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect							
6.1	Lab Control	4	0.9525	0.8752	1	0.975	0.88	0.98	0.02428	5.1%	0.0%							
1900		4	0.9675	0.9347	1	0.965	0.95	0.99	0.01031	2.13%	-1.58%							
3900		4	0.955	0.9345	0.9755	0.955	0.94	0.97	0.006455	1.35%	-0.26%							
7700		4	0.93	0.9075	0.9525	0.925	0.92	0.95	0.007071	1.52%	2.36%							
15000		4	0.835	0.6469	1	0.88	0.66	0.92	0.05909	14.15%	12.34%							
31000		4	0.38	0.001436	0.7586	0.385	0.15	0.6	0.119	62.61%	60.1%							
Angular (Corrected) Transformed Summary																		
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect							
6.1	Lab Control	4	1.368	1.206	1.53	1.413	1.217	1.429	0.05085	7.44%	0.0%							
1900		4	1.398	1.298	1.497	1.387	1.345	1.471	0.03134	4.49%	-2.17%							
3900		4	1.359	1.308	1.409	1.357	1.323	1.397	0.01579	2.32%	0.67%							
7700		4	1.304	1.258	1.35	1.294	1.284	1.345	0.01444	2.21%	4.66%							
15000		4	1.167	0.9296	1.404	1.217	0.9483	1.284	0.07447	12.77%	14.72%							
31000		4	0.6508	0.2436	1.058	0.6596	0.3977	0.8861	0.1279	39.32%	52.43%							

CETIS Analytical Report

Report Date: 03 Jun-16 08:15 (p 2 of 2)
Test Code: 35DF03E3 | 09-0380-7971

Echinoid Embryo-Larval Development Test					SPAWAR Systems Center
Analysis ID:	18-8256-3241	Endpoint:	Proportion Normal	CETIS Version:	CETISv1.8.7
Analyzed:	03 Jun-16 8:09	Analysis:	Nonparametric-Control vs Treatments	Official Results:	Yes
Proportion Normal Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
6.1	Lab Control	0.98	0.97	0.88	0.98
1900		0.99	0.98	0.95	0.95
3900		0.95	0.94	0.96	0.97
7700		0.93	0.95	0.92	0.92
15000		0.66	0.88	0.92	0.88
31000		0.57	0.6	0.15	0.2
Angular (Corrected) Transformed Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
6.1	Lab Control	1.429	1.397	1.217	1.429
1900		1.471	1.429	1.345	1.345
3900		1.345	1.323	1.369	1.397
7700		1.303	1.345	1.284	1.284
15000		0.9483	1.217	1.284	1.217
31000		0.8556	0.8861	0.3977	0.4636
Proportion Normal Binomials					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
6.1	Lab Control	98/100	97/100	88/100	98/100
1900		99/100	98/100	95/100	95/100
3900		95/100	94/100	96/100	97/100
7700		93/100	95/100	92/100	92/100
15000		66/100	88/100	92/100	88/100
31000		57/100	60/100	15/100	20/100
Graphics					
 					

CETIS Analytical Report

Report Date: 03 Jun-16 08:15 (p 1 of 2)
Test Code: 35DF03E3 | 09-0380-7971

Echinoid Embryo-Larval Development Test								SPAWAR Systems Center			
Analysis ID:	17-0420-4437		Endpoint:	Proportion Normal			CETIS Version:	CETISv1.8.7			
Analyzed:	03 Jun-16 8:10		Analysis:	Linear Regression (MLE)			Official Results:	Yes			
Batch ID:	18-8664-8575		Test Type:	Development			Analyst:	Jacob Munson-Decker			
Start Date:	25 Mar-16 09:30		Protocol:	EPA/600/R-95/136 (1995)			Diluent:	Laboratory Seawater			
Ending Date:			Species:	Strongylocentrotus purpuratus			Brine:	Not Applicable			
Duration:	NA		Source:	Field Collected			Age:				
Sample ID:	10-7952-1621		Code:	40583155			Client:	SPAWAR			
Sample Date:	25 Mar-16 09:30		Material:	Zinc sulfate			Project:	Pulsed Exposure			
Receive Date:			Source:	Pulsed Exposure							
Sample Age:	NA		Station:	6 Hour							
Linear Regression Options											
Model Function			Threshold Option		Threshold	Optimized	Pooled	Het Corr	Weighted		
Log-Normal [NED=A+B*log(X)]			Control Threshold		0.0475	Yes	No	Yes	Yes		
Regression Summary											
Iters	LL	AICc	BIC	Mu	Sigma	Adj R2	F Stat	Critical	P-Value	Decision(α:5%)	
10	-755.3	1518	1520	4.434	0.2344	0.8511	0.09269	3.16	0.9631	Non-Significant Lack of Fit	
Point Estimates											
Level	µg/L	95% LCL	95% UCL								
EC50	27140	23300	32980								
Test Acceptability Criteria											
Attribute	Test Stat	TAC Limits		Overlap	Decision						
Control Resp	0.9525	0.8 - NL		Yes	Passes Acceptability Criteria						
Regression Parameters											
Parameter	Estimate	Std Error	95% LCL	95% UCL	t Stat	P-Value	Decision(α:5%)				
Threshold	0.04515	0.01369	0.01667	0.07362	3.297	0.0034	Significant Parameter				
Slope	4.267	0.8547	2.489	6.044	4.992	<0.0001	Significant Parameter				
Intercept	-18.92	3.743	-26.7	-11.13	-5.054	<0.0001	Significant Parameter				
ANOVA Table											
Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)					
Model	801.944	801.944	1	133.5	<0.0001	Significant					
Lack of Fit	1.919534	0.639845	3	0.09269	0.9631	Non-Significant					
Pure Error	124.2607	6.903373	18								
Residual	126.1803	6.008584	21								
Residual Analysis											
Attribute	Method			Test Stat	Critical	P-Value	Decision(α:5%)				
Goodness-of-Fit	Pearson Chi-Sq GOF			126.2	32.67	<0.0001	Significant Heterogeneity				
	Likelihood Ratio GOF			126.6	32.67	<0.0001	Significant Heterogeneity				
Variances	Bartlett Equality of Variance			16.67	11.07	0.0052	Unequal Variances				
	Mod Levene Equality of Variance			3.727	2.773	0.0172	Unequal Variances				
Distribution	Shapiro-Wilk W Normality			0.9429	0.9169	0.1892	Normal Distribution				
	Anderson-Darling A2 Normality			0.6923	2.492	0.0706	Normal Distribution				
Proportion Normal Summary											
C-µg/L	Control Type	Count	Calculated Variate(A/B)								
			Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
6.1	Lab Control	4	0.9525	0.88	0.98	0.02428	0.04856	5.1%	0.0%	381	400
1900		4	0.9675	0.95	0.99	0.01031	0.02062	2.13%	-1.58%	387	400
3900		4	0.955	0.94	0.97	0.006455	0.01291	1.35%	-0.26%	382	400
7700		4	0.93	0.92	0.95	0.007071	0.01414	1.52%	2.36%	372	400
15000		4	0.835	0.66	0.92	0.05909	0.1182	14.15%	12.34%	334	400
31000		4	0.38	0.15	0.6	0.119	0.2379	62.61%	60.1%	152	400

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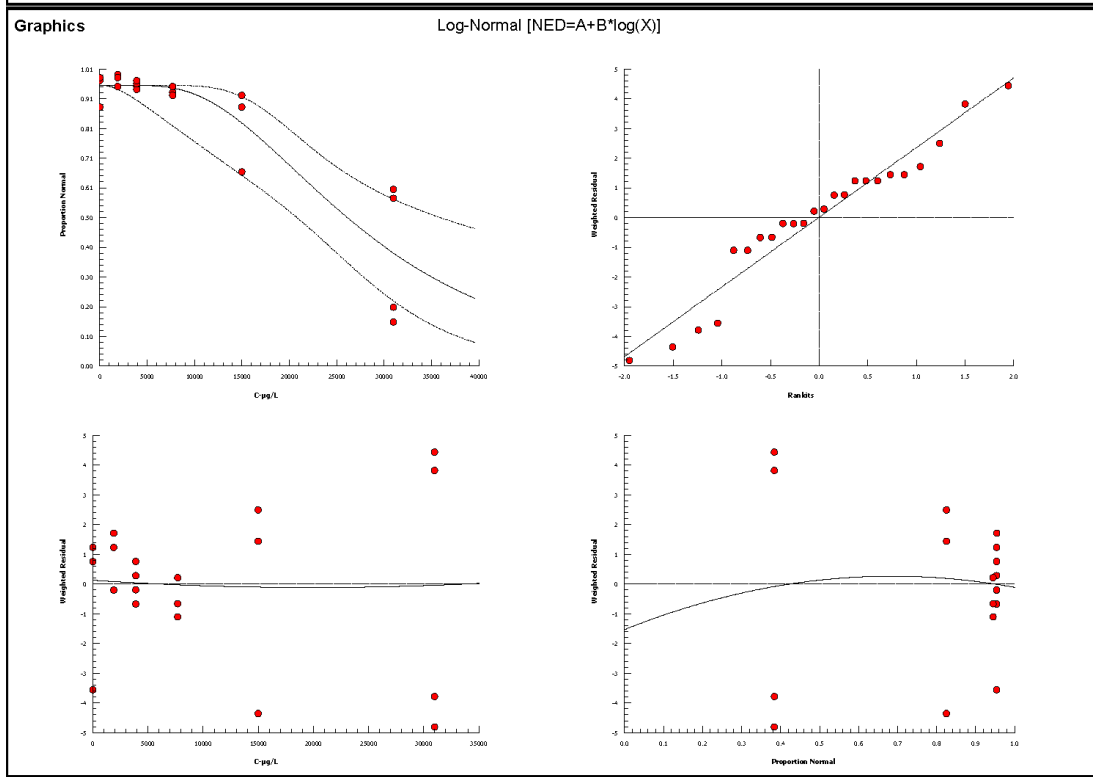
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Analyst:_____ QA:_____

CETIS Analytical Report

Report Date: 03 Jun-16 08:15 (p 2 of 2)
Test Code: 35DF03E3 | 09-0380-7971

Echinoid Embryo-Larval Development Test					SPAWAR Systems Center
Analysis ID:	17-0420-4437	Endpoint:	Proportion Normal	CETIS Version:	CETISv1.8.7
Analyzed:	03 Jun-16 8:10	Analysis:	Linear Regression (MLE)	Official Results:	Yes
Proportion Normal Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
6.1	Lab Control	0.98	0.97	0.88	0.98
1900		0.99	0.98	0.95	0.95
3900		0.95	0.94	0.96	0.97
7700		0.93	0.95	0.92	0.92
15000		0.66	0.88	0.92	0.88
31000		0.57	0.6	0.15	0.2
Proportion Normal Binomials					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
6.1	Lab Control	98/100	97/100	88/100	98/100
1900		99/100	98/100	95/100	95/100
3900		95/100	94/100	96/100	97/100
7700		93/100	95/100	92/100	92/100
15000		66/100	88/100	92/100	88/100
31000		57/100	60/100	15/100	20/100



CETIS Summary Report

Report Date: 03 Jun-16 08:22 (p 1 of 1)
Test Code: 33A983A3 | 08-6674-7299

Echinoid Embryo-Larval Development Test								SPAWAR Systems Center			
Batch ID:	18-8664-8575	Test Type:	Development				Analyst:	Jacob Munson-Decker			
Start Date:	25 Mar-16 09:30	Protocol:	EPA/600/R-95/136 (1995)				Diluent:	Laboratory Seawater			
Ending Date:		Species:	Strongylocentrotus purpuratus				Brine:	Not Applicable			
Duration:	NA	Source:	Field Collected				Age:				
Sample ID:	04-6883-2591	Code:	1BF1D14F				Client:	SPAWAR			
Sample Date:	25 Mar-16 09:30	Material:	Zinc sulfate				Project:	Pulsed Exposure			
Receive Date:		Source:	Pulsed Exposure								
Sample Age:	NA	Station:	12 Hour								
Comparison Summary											
Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method				
08-6446-2391	Proportion Normal	3900	7700	5480	16.7%		Dunnett Multiple Comparison Test				
Point Estimate Summary											
Analysis ID	Endpoint	Level	µg/L	95% LCL	95% UCL	TU	Method				
06-1384-7340	Proportion Normal	EC50	16330	12890	20420		Linear Regression (MLE)				
Test Acceptability											
Analysis ID	Endpoint	Attribute		Test Stat	TAC Limits		Overlap	Decision			
06-1384-7340	Proportion Normal	Control Resp		0.9525	0.8 - NL		Yes	Passes Acceptability Criteria			
08-6446-2391	Proportion Normal	Control Resp		0.9525	0.8 - NL		Yes	Passes Acceptability Criteria			
08-6446-2391	Proportion Normal	PMSD		0.1672	NL - 0.25		No	Passes Acceptability Criteria			
Proportion Normal Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	% Effect
6.1	Lab Control	4	0.9525	0.8752	1	0.88	0.98	0.02428	0.04856	5.1%	0.0%
1900		4	0.94	0.9109	0.9691	0.92	0.96	0.009129	0.01826	1.94%	1.31%
3900		4	0.9175	0.8666	0.9684	0.89	0.95	0.01601	0.03202	3.49%	3.68%
7700		4	0.735	0.56	0.91	0.57	0.79	0.055	0.11	14.97%	22.83%
15000		4	0.6175	0.3029	0.9321	0.34	0.8	0.09886	0.1977	32.02%	35.17%
31000		4	0.145	0	0.4345	0	0.4	0.09097	0.1819	125.5%	84.78%
Proportion Normal Detail											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
6.1	Lab Control	0.98	0.97	0.88	0.98						
1900		0.96	0.93	0.95	0.92						
3900		0.95	0.94	0.89	0.89						
7700		0.79	0.57	0.79	0.79						
15000		0.8	0.34	0.63	0.7						
31000		0.15	0	0.4	0.03						
Proportion Normal Binomials											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
6.1	Lab Control	98/100	97/100	88/100	98/100						
1900		96/100	93/100	95/100	92/100						
3900		95/100	94/100	89/100	89/100						
7700		79/100	57/100	79/100	79/100						
15000		80/100	34/100	63/100	70/100						
31000		15/100	0/100	40/100	3/100						

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CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Analytical Report

Report Date: 03 Jun-16 08:21 (p 1 of 2)
Test Code: 33A983A3 | 08-6674-7299

Echinoid Embryo-Larval Development Test										SPAWAR Systems Center	
Analysis ID: 08-6446-2391		Endpoint: Proportion Normal		CETIS Version: CETISv1.8.7							
Analyzed: 03 Jun-16 8:20		Analysis: Parametric-Control vs Treatments		Official Results: Yes							
Batch ID: 18-8664-8575		Test Type: Development		Analyst: Jacob Munson-Decker							
Start Date: 25 Mar-16 09:30		Protocol: EPA/600/R-95/136 (1995)		Diluent: Laboratory Seawater							
Ending Date:		Species: Strongylocentrotus purpuratus		Brine: Not Applicable							
Duration: NA		Source: Field Collected		Age:							
Sample ID: 04-6883-2591		Code: 1BF1D14F		Client: SPAWAR							
Sample Date: 25 Mar-16 09:30		Material: Zinc sulfate		Project: Pulsed Exposure							
Receive Date:		Source: Pulsed Exposure									
Sample Age: NA		Station: 12 Hour									
Data Transform		Zeta	Alt Hyp	Trials	Seed		PMSD	NOEL	LOEL	TOEL	TU
Angular (Corrected)		NA	C > T	NA	NA		16.7%	3900	7700	5480	
Dunnett Multiple Comparison Test											
Control	vs	C-µg/L	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)		
6.1		1900	0.3795	2.407	0.269	6	0.6985	CDF	Non-Significant Effect		
6.1		3900	0.7545	2.407	0.269	6	0.5331	CDF	Non-Significant Effect		
6.1		7700*	2.977	2.407	0.269	6	0.0162	CDF	Significant Effect		
6.1		15000*	4.1	2.407	0.269	6	0.0015	CDF	Significant Effect		
6.1		31000*	9.311	2.407	0.269	6	<0.0001	CDF	Significant Effect		
Test Acceptability Criteria											
Attribute	Test Stat	TAC Limits		Overlap	Decision						
Control Resp	0.9525	0.8 - NL		Yes	Passes Acceptability Criteria						
PMSD	0.1672	NL - 0.25		No	Passes Acceptability Criteria						
ANOVA Table											
Source	Sum Squares		Mean Square		DF	F Stat	P-Value	Decision(α:5%)			
Between	3.09701		0.619402		5	24.76	<0.0001	Significant Effect			
Error	0.4502186		0.02501214		18						
Total	3.547229				23						
Distributional Tests											
Attribute	Test			Test Stat	Critical	P-Value	Decision(α:1%)				
Variances	Bartlett Equality of Variance			12.05	15.09	0.0341	Equal Variances				
Distribution	Shapiro-Wilk W Normality			0.9124	0.884	0.0397	Normal Distribution				
Proportion Normal Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
6.1	Lab Control	4	0.9525	0.8752	1	0.975	0.88	0.98	0.02428	5.1%	0.0%
1900		4	0.94	0.9109	0.9691	0.94	0.92	0.96	0.009129	1.94%	1.31%
3900		4	0.9175	0.8666	0.9684	0.915	0.89	0.95	0.01601	3.49%	3.68%
7700		4	0.735	0.56	0.91	0.79	0.57	0.79	0.055	14.97%	22.83%
15000		4	0.6175	0.3029	0.9321	0.665	0.34	0.8	0.09886	32.02%	35.17%
31000		4	0.145	0	0.4345	0.09	0	0.4	0.09097	125.5%	84.78%
Angular (Corrected) Transformed Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
6.1	Lab Control	4	1.368	1.206	1.53	1.413	1.217	1.429	0.05085	7.44%	0.0%
1900		4	1.325	1.264	1.387	1.324	1.284	1.369	0.01946	2.94%	3.1%
3900		4	1.284	1.189	1.378	1.278	1.233	1.345	0.02966	4.62%	6.17%
7700		4	1.035	0.8447	1.225	1.095	0.8556	1.095	0.05978	11.55%	24.34%
15000		4	0.9094	0.5806	1.238	0.954	0.6225	1.107	0.1033	22.73%	33.52%
31000		4	0.3266	-0.1169	0.7701	0.2859	0.05002	0.6847	0.1394	85.33%	76.12%

CETIS Analytical Report

Report Date: 03 Jun-16 08:21 (p 2 of 2)
Test Code: 33A983A3 | 08-6674-7299

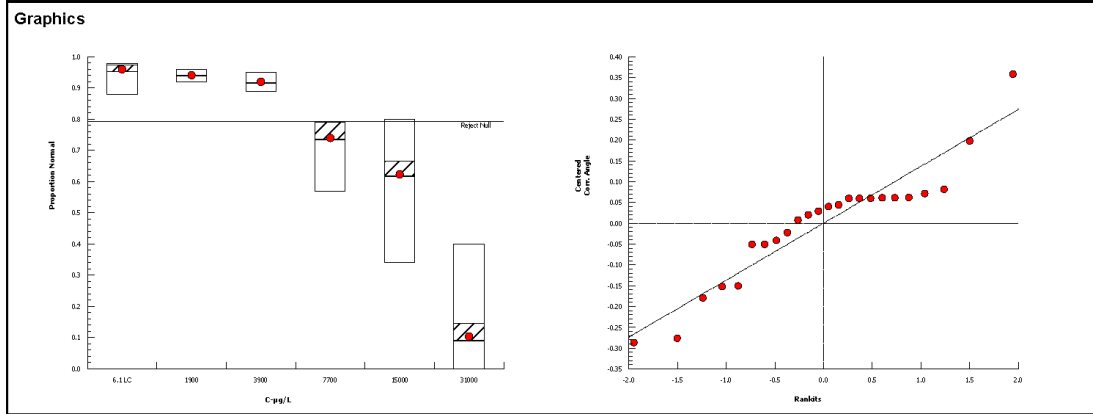
Echinoid Embryo-Larval Development Test SPAWAR Systems Center

Analysis ID: 08-6446-2391 Endpoint: Proportion Normal CETIS Version: CETISv1.8.7
Analyzed: 03 Jun-16 8:20 Analysis: Parametric-Control vs Treatments Official Results: Yes

Proportion Normal Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
6.1	Lab Control	0.98	0.97	0.88	0.98
1900		0.96	0.93	0.95	0.92
3900		0.95	0.94	0.89	0.89
7700		0.79	0.57	0.79	0.79
15000		0.8	0.34	0.63	0.7
31000		0.15	0	0.4	0.03

Angular (Corrected) Transformed Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
6.1	Lab Control	1.429	1.397	1.217	1.429
1900		1.369	1.303	1.345	1.284
3900		1.345	1.323	1.233	1.233
7700		1.095	0.8556	1.095	1.095
15000		1.107	0.6225	0.9169	0.9912
31000		0.3977	0.05002	0.6847	0.1741

Proportion Normal Binomials					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
6.1	Lab Control	98/100	97/100	88/100	98/100
1900		96/100	93/100	95/100	92/100
3900		95/100	94/100	89/100	89/100
7700		79/100	57/100	79/100	79/100
15000		80/100	34/100	63/100	70/100
31000		15/100	0/100	40/100	3/100



CETIS Analytical Report

Report Date: 03 Jun-16 08:22 (p 1 of 2)
Test Code: 33A983A3 | 08-6674-7299

Echinoid Embryo-Larval Development Test								SPAWAR Systems Center			
Analysis ID: 06-1384-7340		Endpoint: Proportion Normal		CETIS Version: CETISv1.8.7							
Analyzed: 03 Jun-16 8:21		Analysis: Linear Regression (MLE)		Official Results: Yes							
Batch ID: 18-8664-8575		Test Type: Development		Analyst: Jacob Munson-Decker							
Start Date: 25 Mar-16 09:30		Protocol: EPA/600/R-95/136 (1995)		Diluent: Laboratory Seawater							
Ending Date:		Species: Strongylocentrotus purpuratus		Brine: Not Applicable							
Duration: NA		Source: Field Collected		Age:							
Sample ID: 04-6883-2591		Code: 1BF1D14F		Client: SPAWAR							
Sample Date: 25 Mar-16 09:30		Material: Zinc sulfate		Project: Pulsed Exposure							
Receive Date:		Source: Pulsed Exposure									
Sample Age: NA		Station: 12 Hour									
Linear Regression Options											
Model Function				Threshold Option		Threshold	Optimized	Pooled	Het Corr	Weighted	
Log-Normal [NED=A+B*log(X)]				Control Threshold		0.0475	Yes	No	Yes	Yes	
Regression Summary											
Iters	LL	AICc	BIC	Mu	Sigma	Adj R2	F Stat	Critical	P-Value	Decision(α:5%)	
8	-959.4	1926	1928	4.213	0.329	0.8141	0.4986	3.16	0.6879	Non-Significant Lack of Fit	
Point Estimates											
Level	µg/L	95% LCL	95% UCL								
EC50	16330	12890	20420								
Test Acceptability Criteria											
Attribute		Test Stat	TAC Limits		Overlap	Decision					
Control Resp		0.9525	0.8 - NL		Yes	Passes Acceptability Criteria					
Regression Parameters											
Parameter	Estimate	Std Error	95% LCL	95% UCL	t Stat	P-Value	Decision(α:5%)				
Threshold	0.05568	0.0235	0.006802	0.1046	2.369	0.0275	Significant Parameter				
Slope	3.04	0.5398	1.917	4.162	5.631	<0.0001	Significant Parameter				
Intercept	-12.81	2.266	-17.52	-8.095	-5.652	<0.0001	Significant Parameter				
ANOVA Table											
Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)					
Model	900.0076	900.0076	1	102.7	<0.0001	Significant					
Lack of Fit	14.11501	4.705004	3	0.4986	0.6879	Non-Significant					
Pure Error	169.8587	9.436595	18								
Residual	183.9737	8.760653	21								
Residual Analysis											
Attribute	Method			Test Stat	Critical	P-Value	Decision(α:5%)				
Goodness-of-Fit	Pearson Chi-Sq GOF			184	32.67	<0.0001	Significant Heterogeneity				
	Likelihood Ratio GOF			202.4	32.67	<0.0001	Significant Heterogeneity				
Variances	Bartlett Equality of Variance			9.908	11.07	0.0779	Equal Variances				
	Mod Levene Equality of Variance			0.9376	2.773	0.4804	Equal Variances				
Distribution	Shapiro-Wilk W Normality			0.9631	0.9169	0.5041	Normal Distribution				
	Anderson-Darling A2 Normality			0.448	2.492	0.2834	Normal Distribution				
Proportion Normal Summary				Calculated Variate(A/B)							
C-µg/L	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
6.1	Lab Control	4	0.9525	0.88	0.98	0.02428	0.04856	5.1%	0.0%	381	400
1900		4	0.94	0.92	0.96	0.009129	0.01826	1.94%	1.31%	376	400
3900		4	0.9175	0.89	0.95	0.01601	0.03202	3.49%	3.68%	367	400
7700		4	0.735	0.57	0.79	0.055	0.11	14.97%	22.83%	294	400
15000		4	0.6175	0.34	0.8	0.09886	0.1977	32.02%	35.17%	247	400
31000		4	0.145	0	0.4	0.09097	0.1819	125.5%	84.78%	58	400

000-010-187-1

CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Analytical Report

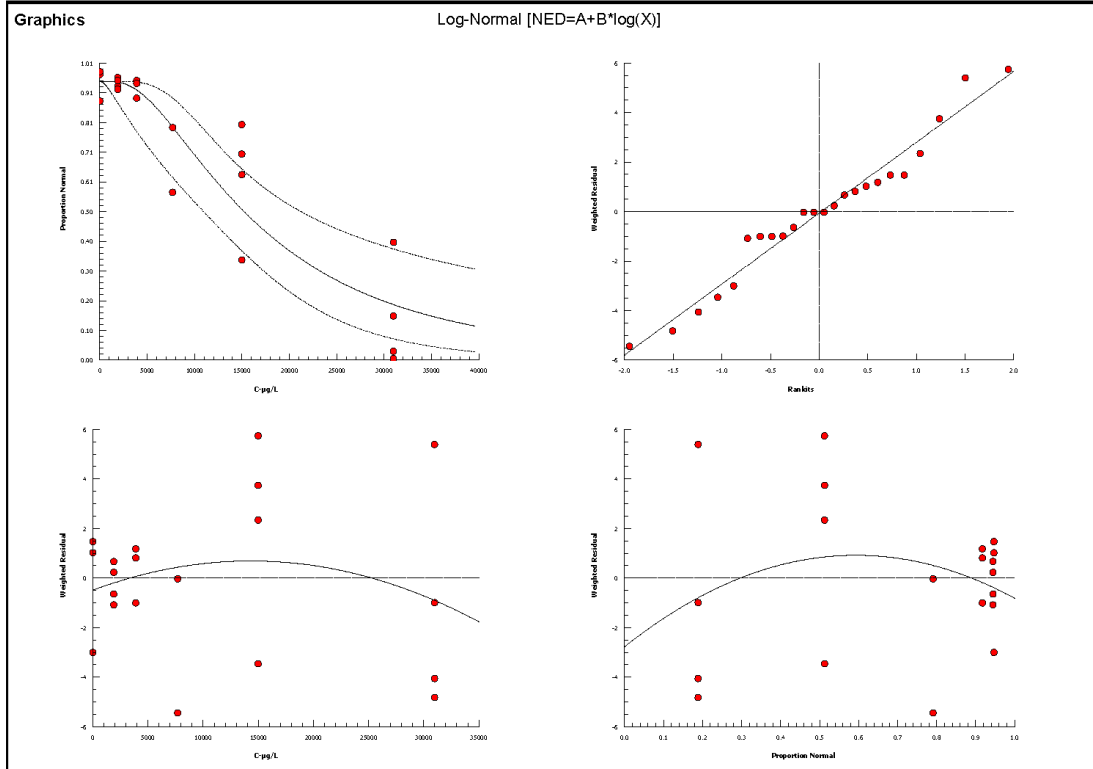
Report Date: 03 Jun-16 08:22 (p 2 of 2)
Test Code: 33A983A3 | 08-6674-7299

Echinoid Embryo-Larval Development Test SPAWAR Systems Center

Analysis ID: 06-1384-7340 Endpoint: Proportion Normal CETIS Version: CETISv1.8.7
Analyzed: 03 Jun-16 8:21 Analysis: Linear Regression (MLE) Official Results: Yes

Proportion Normal Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
6.1	Lab Control	0.98	0.97	0.88	0.98
1900		0.96	0.93	0.95	0.92
3900		0.95	0.94	0.89	0.89
7700		0.79	0.57	0.79	0.79
15000		0.8	0.34	0.63	0.7
31000		0.15	0	0.4	0.03

Proportion Normal Binomials					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
6.1	Lab Control	98/100	97/100	88/100	98/100
1900		96/100	93/100	95/100	92/100
3900		95/100	94/100	89/100	89/100
7700		79/100	57/100	79/100	79/100
15000		80/100	34/100	63/100	70/100
31000		15/100	0/100	40/100	3/100



000-010-187-1

CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Summary Report

Report Date: 03 Jun-16 08:24 (p 1 of 1)
 Test Code: 71BC5008 | 19-0816-6664

Echinoid Embryo-Larval Development Test								SPAWAR Systems Center			
Batch ID:	18-8664-8575	Test Type:	Development				Analyst:	Jacob Munson-Decker			
Start Date:	25 Mar-16 09:30	Protocol:	EPA/600/R-95/136 (1995)				Diluent:	Laboratory Seawater			
Ending Date:		Species:	Strongylocentrotus purpuratus				Brine:	Not Applicable			
Duration:	NA	Source:	Field Collected				Age:				
Sample ID:	16-8655-8329	Code:	6486D679				Client:	SPAWAR			
Sample Date:	25 Mar-16	Material:	Zinc sulfate				Project:	Pulsed Exposure			
Receive Date:		Source:	Pulsed Exposure								
Sample Age:	10h	Station:	Static								
Comparison Summary											
Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method				
11-1562-4001	Proportion Normal	63	120	86.95	6.66%		Dunnett Multiple Comparison Test				
Point Estimate Summary											
Analysis ID	Endpoint	Level	µg/L	95% LCL	95% UCL	TU	Method				
12-1121-3761	Proportion Normal	EC50	146.2	134.4	158.1		Linear Regression (MLE)				
Test Acceptability											
Analysis ID	Endpoint	Attribute		Test Stat	TAC Limits		Overlap	Decision			
11-1562-4001	Proportion Normal	Control Resp		0.9825	0.8 - NL		Yes	Passes Acceptability Criteria			
12-1121-3761	Proportion Normal	Control Resp		0.9825	0.8 - NL		Yes	Passes Acceptability Criteria			
11-1562-4001	Proportion Normal	PMSD		0.06662	NL - 0.25		No	Passes Acceptability Criteria			
Proportion Normal Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
6.1	Lab Control	4	0.9825	0.9586	1	0.96	0.99	0.0075	0.015	1.53%	0.0%
37		4	0.9725	0.9372	1	0.95	1	0.01109	0.02217	2.28%	1.02%
63		4	0.98	0.9456	1	0.95	1	0.0108	0.0216	2.2%	0.25%
120		4	0.6375	0.4344	0.8406	0.47	0.78	0.06382	0.1276	20.02%	35.11%
220		4	0.1775	0.01297	0.342	0.08	0.32	0.0517	0.1034	58.25%	81.93%
480		4	0	0	0	0	0	0	0		100.0%
Proportion Normal Detail											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
6.1	Lab Control	0.96	0.99	0.99	0.99						
37		0.96	1	0.98	0.95						
63		0.99	0.98	0.95	1						
120		0.78	0.64	0.47	0.66						
220		0.18	0.13	0.08	0.32						
480		0	0	0	0						
Proportion Normal Binomials											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
6.1	Lab Control	96/100	99/100	99/100	99/100						
37		96/100	100/100	98/100	95/100						
63		99/100	98/100	95/100	100/100						
120		78/100	64/100	47/100	66/100						
220		18/100	13/100	8/100	32/100						
480		0/100	0/100	0/100	0/100						

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CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Analytical Report

Report Date: 03 Jun-16 08:24 (p 1 of 2)
Test Code: 71BC5008 | 19-0816-6664

Echinoid Embryo-Larval Development Test										SPAWAR Systems Center	
Analysis ID:	11-1562-4001	Endpoint:	Proportion Normal					CETIS Version:	CETISv1.8.7		
Analyzed:	03 Jun-16 8:24	Analysis:	Parametric-Control vs Treatments					Official Results:	Yes		
Batch ID:	18-8664-8575	Test Type:	Development					Analyst:	Jacob Munson-Decker		
Start Date:	25 Mar-16 09:30	Protocol:	EPA/600/R-95/136 (1995)					Diluent:	Laboratory Seawater		
Ending Date:		Species:	Strongylocentrotus purpuratus					Brine:	Not Applicable		
Duration:	NA	Source:	Field Collected					Age:			
Sample ID:	16-8655-8329	Code:	6486D679					Client:	SPAWAR		
Sample Date:	25 Mar-16	Material:	Zinc sulfate					Project:	Pulsed Exposure		
Receive Date:		Source:	Pulsed Exposure								
Sample Age:	10h	Station:	Static								
Data Transform	Zeta	Alt Hyp	Trials	Seed			PMSD	NOEL	LOEL	TOEL	TU
Angular (Corrected)	NA	C > T	NA	NA			6.66%	63	120	86.95	
Dunnett Multiple Comparison Test											
Control	vs	C-µg/L	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)		
6.1		37	0.4132	2.356	0.167	6	0.6422	CDF	Non-Significant Effect		
6.1		63	0.05562	2.356	0.167	6	0.7815	CDF	Non-Significant Effect		
6.1		120*	7.307	2.356	0.167	6	<0.0001	CDF	Significant Effect		
6.1		220*	14.44	2.356	0.167	6	<0.0001	CDF	Significant Effect		
Test Acceptability Criteria											
Attribute	Test Stat	TAC Limits		Overlap	Decision						
Control Resp	0.9825	0.8 - NL		Yes	Passes Acceptability Criteria						
PMSD	0.06662	NL - 0.25		No	Passes Acceptability Criteria						
ANOVA Table											
Source	Sum Squares	Mean Square		DF	F Stat	P-Value	Decision(α:5%)				
Between	3.270706	0.8176765		4	81.69	<0.0001	Significant Effect				
Error	0.1501473	0.01000982		15							
Total	3.420853			19							
Distributional Tests											
Attribute	Test	Test Stat		Critical	P-Value	Decision(α:1%)					
Variances	Bartlett Equality of Variance	3.409		13.28	0.4919	Equal Variances					
Distribution	Shapiro-Wilk W Normality	0.9708		0.866	0.7710	Normal Distribution					
Proportion Normal Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
6.1	Lab Control	4	0.9825	0.9586	1	0.99	0.96	0.99	0.0075	1.53%	0.0%
37		4	0.9725	0.9372	1	0.97	0.95	1	0.01109	2.28%	1.02%
63		4	0.98	0.9456	1	0.985	0.95	1	0.0108	2.2%	0.25%
120		4	0.6375	0.4344	0.8406	0.65	0.47	0.78	0.06382	20.02%	35.11%
220		4	0.1775	0.01297	0.342	0.155	0.08	0.32	0.0517	58.25%	81.93%
480		4	0	0	0	0	0	0	0		100.0%
Angular (Corrected) Transformed Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
6.1	Lab Control	4	1.445	1.365	1.526	1.471	1.369	1.471	0.0253	3.5%	0.0%
37		4	1.416	1.292	1.54	1.399	1.345	1.521	0.03907	5.52%	2.02%
63		4	1.441	1.323	1.56	1.45	1.345	1.521	0.03714	5.15%	0.27%
120		4	0.9284	0.7147	1.142	0.9378	0.7554	1.083	0.06715	14.47%	35.77%
220		4	0.4238	0.2113	0.6362	0.4035	0.2868	0.6013	0.06677	31.51%	70.68%
480		4	0.05002	0.05001	0.05003	0.05002	0.05002	0.05002	0	0.0%	96.54%

CETIS Analytical Report

Report Date: 03 Jun-16 08:24 (p 2 of 2)
Test Code: 71BC5008 | 19-0816-6664

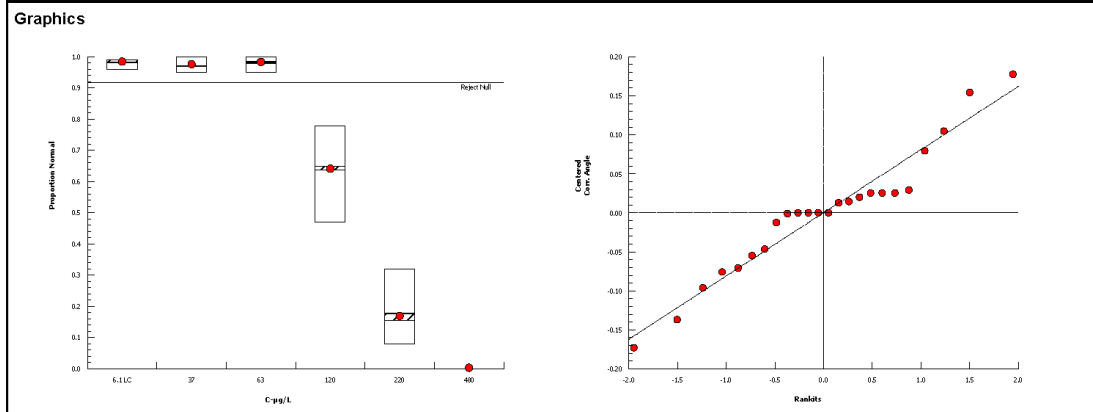
Echinoid Embryo-Larval Development Test SPAWAR Systems Center

Analysis ID: 11-1562-4001 Endpoint: Proportion Normal CETIS Version: CETISv1.8.7
Analyzed: 03 Jun-16 8:24 Analysis: Parametric-Control vs Treatments Official Results: Yes

Proportion Normal Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
6.1	Lab Control	0.96	0.99	0.99	0.99
37		0.96	1	0.98	0.95
63		0.99	0.98	0.95	1
120		0.78	0.64	0.47	0.66
220		0.18	0.13	0.08	0.32
480		0	0	0	0

Angular (Corrected) Transformed Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
6.1	Lab Control	1.369	1.471	1.471	1.471
37		1.369	1.521	1.429	1.345
63		1.471	1.429	1.345	1.521
120		1.083	0.9273	0.7554	0.9483
220		0.4381	0.3689	0.2868	0.6013
480		0.05002	0.05002	0.05002	0.05002

Proportion Normal Binomials					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
6.1	Lab Control	96/100	99/100	99/100	99/100
37		96/100	100/100	98/100	95/100
63		99/100	98/100	95/100	100/100
120		78/100	64/100	47/100	66/100
220		18/100	13/100	8/100	32/100
480		0/100	0/100	0/100	0/100



CETIS Analytical Report

Report Date: 03 Jun-16 08:24 (p 1 of 2)
 Test Code: 71BC5008 | 19-0816-6664

Echinoid Embryo-Larval Development Test							SPAWAR Systems Center				
Analysis ID:	12-1121-3761		Endpoint:	Proportion Normal			CETIS Version:	CETISv1.8.7			
Analyzed:	03 Jun-16 8:24		Analysis:	Linear Regression (MLE)			Official Results:	Yes			
Batch ID:	18-8664-8575		Test Type:	Development			Analyst:	Jacob Munson-Decker			
Start Date:	25 Mar-16 09:30		Protocol:	EPA/600/R-95/136 (1995)			Diluent:	Laboratory Seawater			
Ending Date:			Species:	Strongylocentrotus purpuratus			Brine:	Not Applicable			
Duration:	NA		Source:	Field Collected			Age:				
Sample ID:	16-8655-8329		Code:	6486D679			Client:	SPAWAR			
Sample Date:	25 Mar-16		Material:	Zinc sulfate			Project:	Pulsed Exposure			
Receive Date:			Source:	Pulsed Exposure							
Sample Age:	10h		Station:	Static							
Linear Regression Options											
Model Function			Threshold Option		Threshold	Optimized	Pooled	Het Corr	Weighted		
Log-Normal [NED=A+B*log(X)]			Control Threshold		0.0175	Yes	No	Yes	Yes		
Regression Summary											
Iters	LL	AICc	BIC	Mu	Sigma	Adj R2	F Stat	Critical	P-Value	Decision(α:5%)	
10	-579.2	1166	1168	2.165	0.1783	0.9536	1.17	3.16	0.3488	Non-Significant Lack of Fit	
Point Estimates											
Level	µg/L	95% LCL	95% UCL								
EC50	146.2	134.4	158.1								
Test Acceptability Criteria											
Attribute		Test Stat	TAC Limits		Overlap	Decision					
Control Resp		0.9825	0.8 - NL		Yes	Passes Acceptability Criteria					
Regression Parameters											
Parameter	Estimate	Std Error	95% LCL	95% UCL	t Stat	P-Value	Decision(α:5%)				
Threshold	0.01854	0.008458	0.000955	0.03613	2.193	0.0397	Significant Parameter				
Slope	5.61	0.5503	4.465	6.754	10.19	<0.0001	Significant Parameter				
Intercept	-12.14	1.203	-14.65	-9.643	-10.09	<0.0001	Significant Parameter				
ANOVA Table											
Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)					
Model	1612.709	1612.709	1	474.7	<0.0001	Significant					
Lack of Fit	11.64034	3.880115	3	1.17	0.3488	Non-Significant					
Pure Error	59.70355	3.316864	18								
Residual	71.34389	3.397328	21								
Residual Analysis											
Attribute	Method			Test Stat	Critical	P-Value	Decision(α:5%)				
Goodness-of-Fit	Pearson Chi-Sq GOF			71.34	32.67	<0.0001	Significant Heterogeneity				
	Likelihood Ratio GOF			72.48	32.67	<0.0001	Significant Heterogeneity				
Variances	Mod Levene Equality of Variance			1.538	2.773	0.2278	Equal Variances				
Distribution	Shapiro-Wilk W Normality			0.9656	0.9169	0.5602	Normal Distribution				
	Anderson-Darling A2 Normality			0.4532	2.492	0.2755	Normal Distribution				
Proportion Normal Summary											
			Calculated Variate(A/B)								
C-µg/L	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
6.1	Lab Control	4	0.9825	0.96	0.99	0.0075	0.015	1.53%	0.0%	393	400
37		4	0.9725	0.95	1	0.01109	0.02217	2.28%	1.02%	389	400
63		4	0.98	0.95	1	0.0108	0.0216	2.2%	0.25%	392	400
120		4	0.6375	0.47	0.78	0.06382	0.1276	20.02%	35.11%	255	400
220		4	0.1775	0.08	0.32	0.0517	0.1034	58.25%	81.93%	71	400
480		4	0	0	0	0	0	100.0%	0	0	400

CETIS Analytical Report

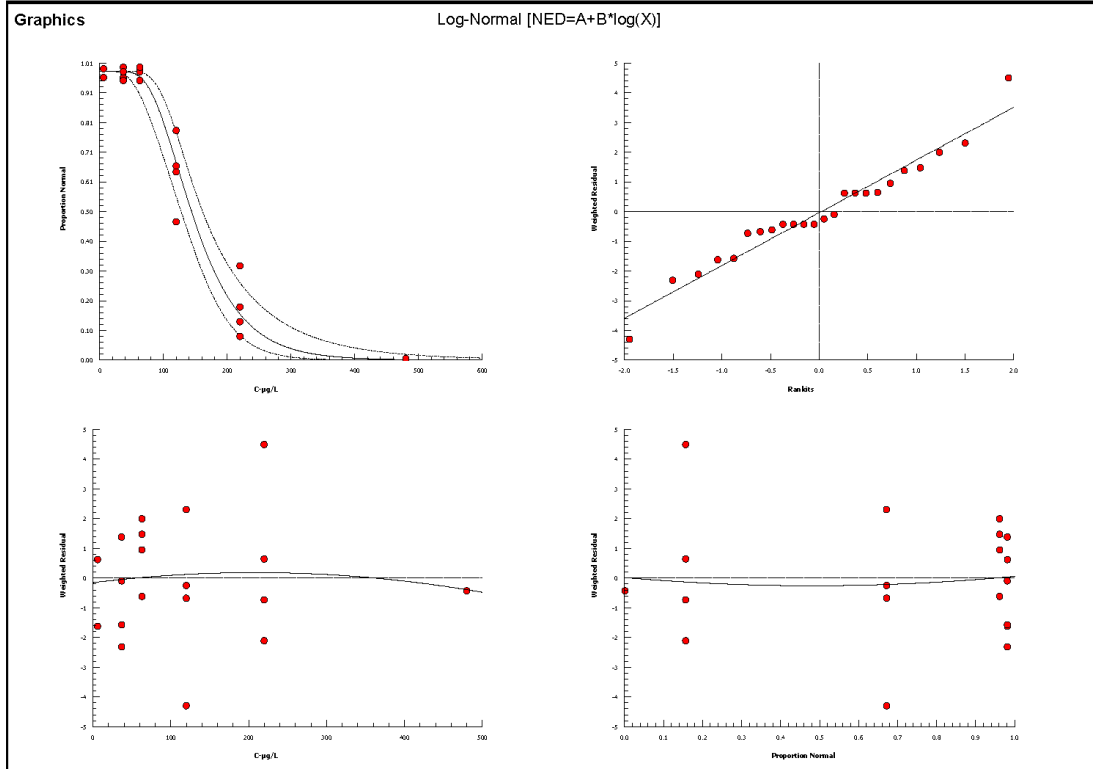
Report Date: 03 Jun-16 08:24 (p 2 of 2)
 Test Code: 71BC5008 | 19-0816-6664

Echinoid Embryo-Larval Development Test SPAWAR Systems Center

Analysis ID: 12-1121-3761 Endpoint: Proportion Normal CETIS Version: CETISv1.8.7
 Analyzed: 03 Jun-16 8:24 Analysis: Linear Regression (MLE) Official Results: Yes

Proportion Normal Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
6.1	Lab Control	0.96	0.99	0.99	0.99
37		0.96	1	0.98	0.95
63		0.99	0.98	0.95	1
120		0.78	0.64	0.47	0.66
220		0.18	0.13	0.08	0.32
480		0	0	0	0

Proportion Normal Binomials					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
6.1	Lab Control	96/100	99/100	99/100	99/100
37		96/100	100/100	98/100	95/100
63		99/100	98/100	95/100	100/100
120		78/100	64/100	47/100	66/100
220		18/100	13/100	8/100	32/100
480		0/100	0/100	0/100	0/100



000-010-187-1

CETIS™ v1.8.7.16

Analyst: _____ QA: _____

Embryo Larval Bioassay

96-Hour Development

Project: Zn Uranium Pulse TestTest Species: S. purpuratus

Sample ID: _____

Start Date: March 29, 2016 0930

Test No.: _____

End Date: March 29, 2016 0930

Random #	Number Counted	Number Normal	Technician Initials
1	100	98	JM
2		2	
3		99	
4		94	
5		0	
6		42	
7		99	
8		0	
9		99	
10		0	
11		96	
12		70	
13		0	
14		6	
15		93	
16		93	
17		0	
18		98	
19		54	
20		2	
21		96	
22		98	
23		97	
24		57	
25		92	
26		97	
27		15	
28		15	
29		70	
30		93	
31		95	
32		95	
33		93	
34		2	
35	100	80	JM

QC Check: NH 4/4/2016Final Review: lcl 5/6/16

Embryo Larval Bioassay

96-Hour Development

Project: Zn Urea Pulse Test
 Sample ID:
 Test No.:

Test Species: S. purpuratus
 Start Date: March 25, 2016 0930
 End Date: March 29, 2016 0930

Random #	Number Counted	Number Normal	Technician Initials
36	100	ml 68 91	JMD
37		66	
38		95	
39		3	
40		88	
41		77	
42		96	
43		57	
44		60	
45		40	
46		79	
47		95	
48		0	
49		63	
50		95	
51		94	
52		96	
53		89	
54		99	
55		ml 72 32	
56		88	
57		20	
58		95	
59		96	
60		92	
61		98	
62		75	
63		93	
64		94	
65		95	
66		95	
67		92	
68		92	
69		97	
70	100	89	JMD

QC Check: NH 4/4/2016

Final Review: dlh 5/6/16

96-Hour Development

Test Species: *S. purpuratus*

Start Date: March 29, 2016 0830

End Date: March 29, 2016 0830

Final Review: lll 5/6/14

A-92

Random #s Zn Pulsed Exposure 3/25/2020

Reference Test			Random #
LC	A	0.8748	7
	B	0.6869	21
	C	0.3910	18
	D	0.4382	1 ⁹³
20	A	0.0037	9
	B	0.5837	22
	C	0.0441	11
	D	0.8849	3 ⁹⁵
40	A	0.7292	16
	B	0.9292	15
	C	0.5733	4 ⁹⁰
	D	0.0445	23
80	A	0.6876	24
	B	0.8564	6
	C	0.7220	12
	D	0.6714	19 ⁸⁰
160	A	0.1709	20
	B	0.3706	13
	C	0.3369	14 ⁹⁹
	D	0.1066	2 ¹²
320	A	0.9091	17 ⁰
	B	0.2122	8
	C	0.2670	5 ⁰
	D	0.8133	10

OK

QA/QC 

			Random #
Lab Control	A	0.5845	61
	B	0.6507	69
	C	0.4249	71
	D	0.9299	82
1280 (3)	A	0.8379	65
	B	0.0162	32
	C	0.7760	86
	D	0.1132	59
1280 (6)	A	0.8304	81
	B	0.7995	54
	C	0.0726	50
	D	0.7270	47
1280 (12)	A	0.2938	52
	B	0.4319	63
	C	0.8490	38
	D	0.6585	68
2560 (3)	A	0.3413	26
	B	0.0507	72
	C	0.3755	79
	D	0.1115	87
2560 (6)	A	0.3180	58
	B	0.1302	64
	C	0.4550	42
	D	0.5330	41
2560 (12)	A	0.8517	31
	B	0.2851	51
	C	0.8529	70
	D	0.0780	74
5120 (3)	A	0.6611	66
	B	0.8533	62
	C	0.2712	85
	D	0.9482	25
5120 (6)	A	0.4405	33
	B	0.2024	73
	C	0.6027	67
	D	0.4736	76
5120 (12)	A	0.8423	78
	B	0.9545	43
	C	0.4812	46
	D	0.6995	88

sc 111

Random #s Zn Pulver Exposure 3/25/2010

R X R R R R R R	10240 (3)	A	0.4941	75	-84
		B	0.9326	30	-86
		C	0.6437	77	-92
		D	0.1938	53	-90
	10240 (6)	A	0.8836	37	
		B	0.3714	56	
		C	0.4978	60	
		D	0.6438	40	
	10240 (12)	A	0.8103	35	-87
		B	0.8089	80	
		C	0.4931	49	809
		D	0.2327	29	-64
	20480 (3)	A	0.6762	34	-81
		B	0.9751	55	-70.5
		C	0.9596	36	-97
		D	0.1544	83	
	20480 (6)	A	0.6905	84	72
		B	0.4058	44	-46
		C	0.0901	27	-10
		D	0.9705	57	63
	20480 (12)	A	0.2912	28	-8
		B	0.5643	48	-210
		C	0.3675	45	
		D	0.2211	39	-4

QA/QC lll

Marine Chronic Bioassay

Water Quality Measurements

Project: Zn Pulse
 Sample ID: Ref tox + 3 hr pulse
 Test No.: /

Test Species: S. purpuratus
 Start Date/Time: 3/25/16 0932
 End Date/Time: 3/29/16 0930

Concentration mg/L	Salinity (ppt)					Temperature (°C)					Dissolved Oxygen (mg/L)					pH (pH units)				
	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96
0 (L)	33.5	33.1	33.4	33.2	33.3	15.0	14.7	15.2	15.0	15.2	7.9	8.2	8.1	8.0	8.3	7.92	8.00	7.95	7.68	7.94
20	33.5	33.4	33.6	33.6	33.4	15.0	14.3	14.7	14.7	15.2	8.2	8.4	8.3	8.1	8.0	7.96	8.04	7.91	7.73	7.85
40	33.4	33.3	33.4	33.5	33.1	15.0	14.4	14.8	14.7	15.2	8.2	8.4	8.3	8.1	8.1	7.96	8.06	7.95	7.78	7.71
80	33.3	33.1	33.3	33.6	34.1	15.0	14.4	14.6	14.4	15.2	8.2	8.4	8.3	8.2	7.9	7.97	8.06	7.77	8.02	7.81
160	33.0	32.9	33.0	33.3	33.7	15.0	15.0	14.7	14.6	15.2	8.1	8.4	8.3	8.2	8.1	7.99	7.99	8.00	8.06	8.02
320	32.5	32.4	32.6	33.0	33.5	15.0	14.7	14.7	14.8	15.2	8.2	8.4	8.4	8.3	8.2	7.97	8.04	8.01	8.06	7.97
LC	33.5	33.3	33.3	33.3	33.4	15.0	15.5	15.2	15.7	15.0	7.9	7.9	7.8	8.2	8.1	7.92	7.91	7.85	7.90	7.93
1280	33.3	33.3	33.3	33.3	33.7	15.0	15.5	15.3	15.7	15.0	7.8	8.0	7.8	8.1	8.0	7.98	7.96	7.95	7.90	7.94
2560	33.3	33.3	33.3	33.3	33.7	15.0	15.3	15.3	15.7	15.0	7.9	8.0	7.8	8.1	8.0	7.94	7.96	7.95	7.80	7.84
5120	33.1	33.3	33.3	33.3	34.1	15.0	15.5	15.4	15.9	15.0	7.9	8.2	8.0	8.1	8.0	7.88	7.90	7.96	8.00	8.00
10240	32.8	33.3	34.1	33.7	34.1	15.0	15.5	15.4	15.9	15.0	7.9	8.1	8.1	8.1	8.0	7.84	7.91	7.86	8.00	8.01
20480	32.4	33.1	33.1	33.7	33.8	15.0	15.5	15.5	15.8	15.0	8.1	8.0	7.9	8.0	7.9	7.73	7.80	7.82	8.00	7.71

Technician Initials: 0 24 48 72 96
 WQ Readings: NH NH NH NH NH
 Dilutions made by: JM

Animal Source/Date Received: Field collected 1/28/2016
 Comments: 0 hrs:
24 hrs:
48 hrs:
72 hrs:
 QC Check: JM 6/1/2016
 Final Review: LL 6/2/16

Water Quality Measurements

Test Species: *S. purpuratus*

Start Date/Time: 3/24/16 0930

End Date/Time: 3/29/16 0930

[illegible]

Technician Initials:	0	24	48	72	96
WQ Readings:	NH	NH	NH	NH	JA
Dilutions made by:	JA				

Animal Source/Date Received: Field Collected 1/28/2016

Comments: 0 hrs:

24 hrs:

48 hrs:

72 hrs:

QC Check: Jan 6/1/2016

Final Review: lll 6/2/18

Water Quality Measurements

Test Species: *S. purpuratus*

Start Date/Time: 3/25/16 0930

End Date/Time: 3/24/16 0932

[illegible]

Technician Initials:	0	24	48	72	96
WQ Readings:	NH	NH	NH	NH	IN
Dilutions made by:	IN				

Animal Source/Date Received:	Field Collected	3/19/2016	1/28/2016

Comments: 0 hrs:

24 hrs:

48 hrs:

72 hrs:

QC Check: JN 6/1/2016

Final Review: U2 6/2/12

Embryo-Larval Development Test – SPAWNING CHECKLIST & CALCULATIONS

Batch ID: 031516 012816SP
Analyst: JM

Spawn/Test Date: 3/25/16
Test Species: S. purpuratus

Task	Time
Spawning Inducement Initiated	0630
Spawning Begins	0640
Females/Males Isolated in Incubator	3/3
Fertilization Initiated	0700
Fertilization Terminated/eggs rinsed	0740
Embryo Counts	0800
Embryo addition to vials	0930

Embryo Counts:

Embryo Stock #1: 46, 31, 34 Mean = 37 / 20 uL * 1000 uL/mL = 1850 cells/mL

Embryo Stock #2: 41, 36, 34 Mean = 37 / 20 uL * 1000 uL/mL = 1850 cells/mL

Embryo Stock #3: 30, 28, 25 Mean = 30 / 20 uL * 1000 uL/mL = 1533 cells/mL

Adjust selected embryo stock to 2000 embryos/mL. Confirm density:

Selected Stock: 38, 37, 34 Mean = 34 / 20 uL * 1000 uL/mL = 1716 cells/mL

Add 100 µl of 2000 embryo/ml stock to obtain 20 embryos/ml in test vials.

Notes:

Stock #1 100% Fertilization

Stock #2 < 90% Fertilization

Stock #3 > 90% Fertilization

Selected Stock #1

1716 (.150 ml) = 257 Embryos / Test

* A Majority of Embryos at two cell stage when added to vials roughly 10% were at the four cell stage.

A.5. ZINC EXPOSURES – MYSID SHRIMP:

CETIS Summary Report

Report Date: 02 Jun-16 16:10 (p 1 of 1)

Test Code: 36B62F78 | 09-1790-9368

Americamysis 96-h Acute Survival Test							SPAWAR Systems Center				
Batch ID:	13-0299-9056	Test Type:	Survival (96h)				Analyst:	Marianne A Colvin			
Start Date:	10 Dec-15 10:00	Protocol:	EPA/821/R-02-012 (2002)				Diluent:	Laboratory Seawater			
Ending Date:	14 Dec-15 08:30	Species:	Americamysis bahia				Brine:	Not Applicable			
Duration:	94h	Source:	Aquatic Research Organisms, NH				Age:	5			
Sample ID:	19-3283-9386	Code:	7334C9DA				Client:	SPAWAR			
Sample Date:	10 Dec-15	Material:	Zinc sulfate				Project:	Pulsed Exposure			
Receive Date:	10 Dec-15	Source:	Pulsed Exposure								
Sample Age:	10h	Station:	3 Hour								
Comparison Summary											
Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method				
15-2693-9165	96h Survival Rate	3280	5430	4220	24.5%		Dunnett Multiple Comparison Test				
Point Estimate Summary											
Analysis ID	Endpoint	Level	µg/L	95% LCL	95% UCL	TU	Method				
06-7575-6139	96h Survival Rate	LC50	10440	7262	15300		Linear Regression (MLE)				
96h Survival Rate Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
13	Lab Control	4	0.95	0.7909	1	0.8	1	0.05	0.1	10.53%	0.0%
398		4	1	1	1	1	1	0	0	0.0%	-5.26%
753		4	0.85	0.5453	1	0.6	1	0.09574	0.1915	22.53%	10.53%
1520		4	0.95	0.7909	1	0.8	1	0.05	0.1	10.53%	0.0%
3280		4	1	1	1	1	1	0	0	0.0%	-5.26%
5430		4	0.7	0.3818	1	0.6	1	0.1	0.2	28.57%	26.32%
16700		4	0.25	0	0.5547	0	0.4	0.09574	0.1915	76.59%	73.68%
96h Survival Rate Detail											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
13	Lab Control	1	1	1	0.8						
398		1	1	1	1						
753		1	0.6	1	0.8						
1520		1	1	0.8	1						
3280		1	1	1	1						
5430		1	0.6	0.6	0.6						
16700		0	0.4	0.4	0.2						
96h Survival Rate Binomials											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
13	Lab Control	5/5	5/5	5/5	4/5						
398		5/5	5/5	5/5	5/5						
753		5/5	3/5	5/5	4/5						
1520		5/5	5/5	4/5	5/5						
3280		5/5	5/5	5/5	5/5						
5430		5/5	3/5	3/5	3/5						
16700		0/5	2/5	2/5	1/5						

CETIS Analytical Report

Report Date: 02 Jun-16 16:10 (p 1 of 2)
 Test Code: 36B62F78 | 09-1790-9368

Americamysis 96-h Acute Survival Test										SPAWAR Systems Center	
Analysis ID:	15-2693-9165	Endpoint:	96h Survival Rate					CETIS Version:	CETISv1.8.7		
Analyzed:	05 May-16 11:43	Analysis:	Parametric-Control vs Treatments					Official Results:	Yes		
Batch ID:	13-0299-9056	Test Type:	Survival (96h)					Analyst:	Marianne A Colvin		
Start Date:	10 Dec-15 10:00	Protocol:	EPA/821/R-02-012 (2002)					Diluent:	Laboratory Seawater		
Ending Date:	14 Dec-15 08:30	Species:	Americamysis bahia					Brine:	Not Applicable		
Duration:	94h	Source:	Aquatic Research Organisms, NH					Age:	5		
Sample ID:	19-3283-9386	Code:	7334C9DA					Client:	SPAWAR		
Sample Date:	10 Dec-15	Material:	Zinc sulfate					Project:	Pulsed Exposure		
Receive Date:	10 Dec-15	Source:	Pulsed Exposure								
Sample Age:	10h	Station:	3 Hour								
Data Transform	Zeta	Alt Hyp	Trials	Seed			PMSD	NOEL	LOEL	TOEL	TU
Angular (Corrected)	NA	C > T	NA	NA			24.5%	3280	5430	4220	
Dunnett Multiple Comparison Test											
Control	vs	C-µg/L	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)		
13		398	-0.5283	2.448	0.276	6	0.9549	CDF	Non-Significant Effect		
13		753	1.019	2.448	0.276	6	0.4453	CDF	Non-Significant Effect		
13		1520	0	2.448	0.276	6	0.8571	CDF	Non-Significant Effect		
13		3280	-0.5283	2.448	0.276	6	0.9549	CDF	Non-Significant Effect		
13		5430*	2.528	2.448	0.276	6	0.0427	CDF	Significant Effect		
13		16700*	6.843	2.448	0.276	6	<0.0001	CDF	Significant Effect		
ANOVA Table											
Source	Sum Squares		Mean Square		DF	F Stat	P-Value	Decision(α:5%)			
Between	2.152008		0.3586679		6	14.12	<0.0001	Significant Effect			
Error	0.5332697		0.0253938		21						
Total	2.685277				27						
Distributional Tests											
Attribute	Test		Test Stat	Critical	P-Value	Decision(α:1%)					
Variances	Mod Levene Equality of Variance		1.381	3.812	0.2678	Equal Variances					
Variances	Levene Equality of Variance		4.421	3.812	0.0048	Unequal Variances					
Distribution	Shapiro-Wilk W Normality		0.9533	0.8975	0.2393	Normal Distribution					
96h Survival Rate Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
13	Lab Control	4	0.95	0.7909	1	1	0.8	1	0.05	10.53%	0.0%
398		4	1	1	1	1	1	1	0	0.0%	-5.26%
753		4	0.85	0.5453	1	0.9	0.6	1	0.09574	22.53%	10.53%
1520		4	0.95	0.7909	1	1	0.8	1	0.05	10.53%	0.0%
3280		4	1	1	1	1	1	1	0	0.0%	-5.26%
5430		4	0.7	0.3818	1	0.6	0.6	1	0.1	28.57%	26.32%
16700		4	0.25	0	0.5547	0.3	0	0.4	0.09574	76.59%	73.68%
Angular (Corrected) Transformed Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
13	Lab Control	4	1.286	1.096	1.475	1.345	1.107	1.345	0.05953	9.26%	0.0%
398		4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	-4.63%
753		4	1.171	0.8199	1.522	1.226	0.8861	1.345	0.1103	18.84%	8.93%
1520		4	1.286	1.096	1.475	1.345	1.107	1.345	0.05953	9.26%	0.0%
3280		4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	-4.63%
5430		4	1.001	0.6355	1.366	0.8861	0.8861	1.345	0.1148	22.94%	22.16%
16700		4	0.5146	0.166	0.8633	0.5742	0.2255	0.6847	0.1096	42.58%	59.97%

000-010-187-1

CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Analytical Report

Report Date: 02 Jun-16 16:10 (p 2 of 2)
Test Code: 36B62F78 | 09-1790-9368

Americamysis 96-h Acute Survival Test					SPAWAR Systems Center
Analysis ID:	15-2693-9165	Endpoint:	96h Survival Rate	CETIS Version:	CETISv1.8.7
Analyzed:	05 May-16 11:43	Analysis:	Parametric-Control vs Treatments	Official Results:	Yes
96h Survival Rate Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
13	Lab Control	1	1	1	0.8
398		1	1	1	1
753		1	0.6	1	0.8
1520		1	1	0.8	1
3280		1	1	1	1
5430		1	0.6	0.6	0.6
16700		0	0.4	0.4	0.2
Angular (Corrected) Transformed Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
13	Lab Control	1.345	1.345	1.345	1.107
398		1.345	1.345	1.345	1.345
753		1.345	0.8861	1.345	1.107
1520		1.345	1.345	1.107	1.345
3280		1.345	1.345	1.345	1.345
5430		1.345	0.8861	0.8861	0.8861
16700		0.2255	0.6847	0.6847	0.4636
96h Survival Rate Binomials					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
13	Lab Control	5/5	5/5	5/5	4/5
398		5/5	5/5	5/5	5/5
753		5/5	3/5	5/5	4/5
1520		5/5	5/5	4/5	5/5
3280		5/5	5/5	5/5	5/5
5430		5/5	3/5	3/5	3/5
16700		0/5	2/5	2/5	1/5
Graphics					

000-010-187-1

CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Analytical Report

Report Date: 02 Jun-16 16:10 (p 1 of 2)
Test Code: 36B62F78 | 09-1790-9368

Americamysis 96-h Acute Survival Test							SPAWAR Systems Center				
Analysis ID:	06-7575-6139		Endpoint:	96h Survival Rate			CETIS Version: CETISv1.8.7				
Analyzed:	05 May-16 11:43		Analysis:	Linear Regression (MLE)			Official Results: Yes				
Batch ID:	13-0299-9056		Test Type:	Survival (96h)			Analyst:	Marianne A Colvin			
Start Date:	10 Dec-15 10:00		Protocol:	EPA/821/R-02-012 (2002)			Diluent:	Laboratory Seawater			
Ending Date:	14 Dec-15 08:30		Species:	Americamysis bahia			Brine:	Not Applicable			
Duration:	94h		Source:	Aquatic Research Organisms, NH			Age:	5			
Sample ID:	19-3283-9386		Code:	7334C9DA			Client:	SPAWAR			
Sample Date:	10 Dec-15		Material:	Zinc sulfate			Project:	Pulsed Exposure			
Receive Date:	10 Dec-15		Source:	Pulsed Exposure							
Sample Age:	10h		Station:	3 Hour							
Linear Regression Options											
Model Function			Threshold Option		Threshold	Optimized	Pooled	Het Corr	Weighted		
Log-Normal [NED=A+B*log(X)]			Control Threshold		0.05	Yes	No	No	Yes		
Regression Summary											
Iters	LL	AICc	BIC	Mu	Sigma	Adj R2	F Stat	Critical	P-Value	Decision(α:5%)	
21	-44.67	96.33	99.33	4.019	0.2874	0.5272	4.72	2.84	0.0071	Significant Lack of Fit	
Point Estimates											
Level	μg/L	95% LCL		95% UCL							
LC50	10440	7262		15300							
Regression Parameters											
Parameter	Estimate	Std Error	95% LCL	95% UCL	t Stat	P-Value	Decision(α:5%)				
Threshold	0.0542	0.02539	0.004426	0.104	2.134	0.0428	Significant Parameter				
Slope	3.48	0.9119	1.692	5.267	3.816	0.0008	Significant Parameter				
Intercept	-13.98	3.639	-21.12	-6.85	-3.842	0.0007	Significant Parameter				
ANOVA Table											
Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)					
Model	40.04662	40.04662	1	32.11	<0.0001	Significant					
Lack of Fit	14.76146	3.690365	4	4.72	0.0071	Significant					
Pure Error	16.41999	0.781904	21								
Residual	31.18145	1.247258	25								
Residual Analysis											
Attribute	Method			Test Stat	Critical	P-Value	Decision(α:5%)				
Goodness-of-Fit	Pearson Chi-Sq GOF			31.18	37.65	0.1831	Non-Significant Heterogeneity				
	Likelihood Ratio GOF			28.93	37.65	0.2667	Non-Significant Heterogeneity				
Variances	Mod Levene Equality of Variance			1.635	2.573	0.1869	Equal Variances				
Distribution	Shapiro-Wilk W Normality			0.7589	0.9264	<0.0001	Non-normal Distribution				
	Anderson-Darling A2 Normality			3.296	2.492	<0.0001	Non-normal Distribution				
96h Survival Rate Summary											
Calculated Variate(A/B)										A	B
C-μg/L	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
13	Lab Control	4	0.95	0.8	1	0.05	0.1	10.53%	0.0%	19	20
398		4	1	1	1	0	0	0.0%	-5.26%	20	20
753		4	0.85	0.6	1	0.09574	0.1915	22.53%	10.53%	17	20
1520		4	0.95	0.8	1	0.05	0.1	10.53%	0.0%	19	20
3280		4	1	1	1	0	0	0.0%	-5.26%	20	20
5430		4	0.7	0.6	1	0.1	0.2	28.57%	26.32%	14	20
16700		4	0.25	0	0.4	0.09574	0.1915	76.59%	73.68%	5	20

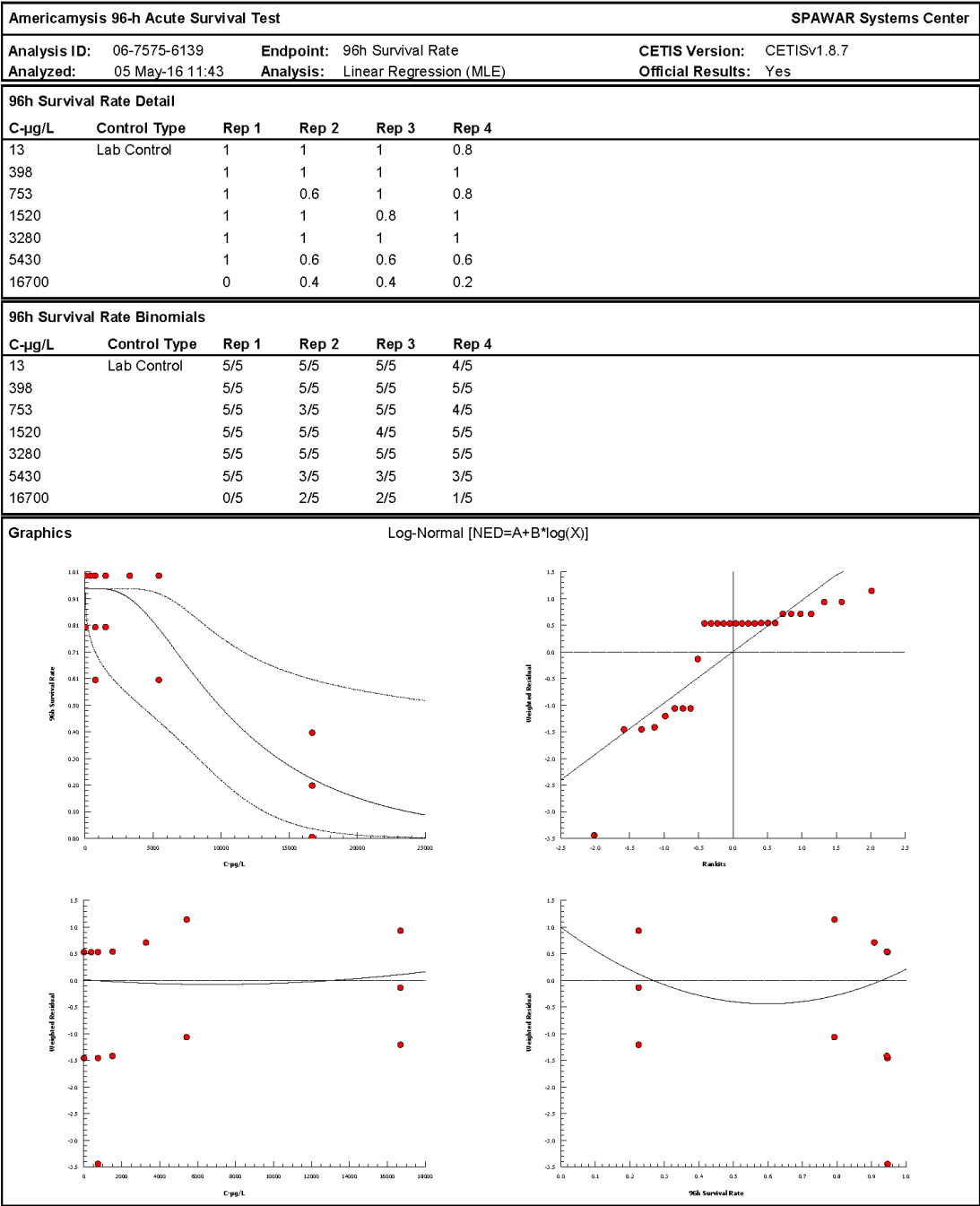
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CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Analytical Report

Report Date: 02 Jun-16 16:10 (p 2 of 2)
Test Code: 36B62F78 | 09-1790-9368



CETIS Summary Report

Report Date: 02 Jun-16 16:10 (p 1 of 1)
 Test Code: 794A30D0 | 20-3490-5296

Americamysis 96-h Acute Survival Test							SPAWAR Systems Center				
Batch ID:	13-0299-9056	Test Type:	Survival (96h)				Analyst:	Jacob Munson-Decker			
Start Date:	10 Dec-15 10:00	Protocol:	EPA/821/R-02-012 (2002)				Diluent:	Laboratory Seawater			
Ending Date:		Species:	Americamysis bahia				Brine:	Not Applicable			
Duration:	NA	Source:	Aquatic Research Organisms, NH				Age:	5			
Sample ID:	14-7223-8677	Code:	57C09455				Client:	SPAWAR			
Sample Date:	10 Dec-15	Material:	Zinc sulfate				Project:	Pulsed Exposure			
Receive Date:		Source:	Pulsed Exposure								
Sample Age:	10h	Station:	6 Hour								
Comparison Summary											
Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method				
06-3505-2453	96h Survival Rate	1520	3280	2233	20.5%		Steel Many-One Rank Sum Test				
Point Estimate Summary											
Analysis ID	Endpoint	Level	µg/L	95% LCL	95% UCL	TU	Method				
02-9090-2398	96h Survival Rate	LC50	3914	3114	4674		Linear Regression (MLE)				
96h Survival Rate Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
13	Lab Control	4	1	1	1	1	1	0	0	0.0%	0.0%
398		4	0.95	0.7909	1	0.8	1	0.05	0.1	10.53%	5.0%
753		4	1	1	1	1	1	0	0	0.0%	0.0%
1520		4	1	1	1	1	1	0	0	0.0%	0.0%
3280		4	0.65	0.4909	0.8091	0.6	0.8	0.05	0.1	15.38%	35.0%
5430		4	0.2	0	0.6501	0	0.6	0.1414	0.2828	141.4%	80.0%
16700		4	0	0	0	0	0	0	0		100.0%
96h Survival Rate Detail											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
13	Lab Control	1	1	1	1						
398		1	0.8	1	1						
753		1	1	1	1						
1520		1	1	1	1						
3280		0.8	0.6	0.6	0.6						
5430		0	0.6	0.2	0						
16700		0	0	0	0						
96h Survival Rate Binomials											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
13	Lab Control	5/5	5/5	5/5	5/5						
398		5/5	4/5	5/5	5/5						
753		5/5	5/5	5/5	5/5						
1520		5/5	5/5	5/5	5/5						
3280		4/5	3/5	3/5	3/5						
5430		0/5	3/5	1/5	0/5						
16700		0/5	0/5	0/5	0/5						

CETIS Analytical Report

Report Date: 02 Jun-16 16:10 (p 1 of 2)
Test Code: 794A30D0 | 20-3490-5296

Americamysis 96-h Acute Survival Test										SPAWAR Systems Center	
Analysis ID: 06-3505-2453		Endpoint: 96h Survival Rate				CETIS Version: CETISv1.8.7					
Analyzed: 05 May-16 11:44		Analysis: Nonparametric-Control vs Treatments				Official Results: Yes					
Batch ID: 13-0299-9056		Test Type: Survival (96h)				Analyst: Jacob Munson-Decker					
Start Date: 10 Dec-15 10:00		Protocol: EPA/821/R-02-012 (2002)				Diluent: Laboratory Seawater					
Ending Date:		Species: Americamysis bahia				Brine: Not Applicable					
Duration: NA		Source: Aquatic Research Organisms, NH				Age: 5					
Sample ID: 14-7223-8677		Code: 57C09455				Client: SPAWAR					
Sample Date: 10 Dec-15		Material: Zinc sulfate				Project: Pulsed Exposure					
Receive Date:		Source: Pulsed Exposure									
Sample Age: 10h		Station: 6 Hour									
Data Transform		Zeta	Alt Hyp	Trials	Seed	PMSD	NOEL	LOEL	TOEL	TU	
Angular (Corrected)		NA	C > T	NA	NA	20.5%	1520	3280	2233		
Steel Many-One Rank Sum Test											
Control	vs	C-µg/L	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)		
13		398	16	10	1	6	0.6105	Asymp	Non-Significant Effect		
13		753	18	10	1	6	0.8333	Asymp	Non-Significant Effect		
13		1520	18	10	1	6	0.8333	Asymp	Non-Significant Effect		
13		3280*	10	10	0	6	0.0417	Asymp	Significant Effect		
13		5430*	10	10	0	6	0.0417	Asymp	Significant Effect		
ANOVA Table											
Source	Sum Squares		Mean Square		DF	F Stat	P-Value	Decision(α:5%)			
Between	2.641152		0.5282304		5	25.68	<0.0001	Significant Effect			
Error	0.3703232		0.02057351		18						
Total	3.011475				23						
Distributional Tests											
Attribute	Test		Test Stat	Critical	P-Value	Decision(α:1%)					
Variances	Mod Levene Equality of Variance		2.56	4.248	0.0643	Equal Variances					
Variances	Levene Equality of Variance		5.161	4.248	0.0041	Unequal Variances					
Distribution	Shapiro-Wilk W Normality		0.7709	0.884	0.0001	Non-normal Distribution					
96h Survival Rate Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
13	Lab Control	4	1	1	1	1	1	1	0	0.0%	0.0%
398		4	0.95	0.7909	1	1	0.8	1	0.05	10.53%	5.0%
753		4	1	1	1	1	1	1	0	0.0%	0.0%
1520		4	1	1	1	1	1	1	0	0.0%	0.0%
3280		4	0.65	0.4909	0.8091	0.6	0.6	0.8	0.05	15.38%	35.0%
5430		4	0.2	0	0.6501	0.1	0	0.6	0.1414	141.4%	80.0%
16700		4	0	0	0	0	0	0	0		100.0%
Angular (Corrected) Transformed Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
13	Lab Control	4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
398		4	1.286	1.096	1.475	1.345	1.107	1.345	0.05953	9.26%	4.43%
753		4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
1520		4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
3280		4	0.9413	0.7655	1.117	0.8861	0.8861	1.107	0.05527	11.74%	30.03%
5430		4	0.4502	-0.04551	0.9459	0.3446	0.2255	0.8861	0.1558	69.2%	66.54%
16700		4	0.2255	0.2255	0.2256	0.2255	0.2255	0.2255	0	0.0%	83.24%

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CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Analytical Report

Report Date: 02 Jun-16 16:10 (p 2 of 2)
Test Code: 794A30D0 | 20-3490-5296

Americamysis 96-h Acute Survival Test					SPAWAR Systems Center
Analysis ID:	06-3505-2453	Endpoint:	96h Survival Rate	CETIS Version:	CETISv1.8.7
Analyzed:	05 May-16 11:44	Analysis:	Nonparametric-Control vs Treatments	Official Results:	Yes
96h Survival Rate Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
13	Lab Control	1	1	1	1
398		1	0.8	1	1
753		1	1	1	1
1520		1	1	1	1
3280		0.8	0.6	0.6	0.6
5430		0	0.6	0.2	0
16700		0	0	0	0
Angular (Corrected) Transformed Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
13	Lab Control	1.345	1.345	1.345	1.345
398		1.345	1.107	1.345	1.345
753		1.345	1.345	1.345	1.345
1520		1.345	1.345	1.345	1.345
3280		1.107	0.8861	0.8861	0.8861
5430		0.2255	0.8861	0.4636	0.2255
16700		0.2255	0.2255	0.2255	0.2255
96h Survival Rate Binomials					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
13	Lab Control	5/5	5/5	5/5	5/5
398		5/5	4/5	5/5	5/5
753		5/5	5/5	5/5	5/5
1520		5/5	5/5	5/5	5/5
3280		4/5	3/5	3/5	3/5
5430		0/5	3/5	1/5	0/5
16700		0/5	0/5	0/5	0/5
Graphics					

CETIS Analytical Report

Report Date: 02 Jun-16 16:10 (p 1 of 2)
Test Code: 794A30D0 | 20-3490-5296

Americamysis 96-h Acute Survival Test							SPAWAR Systems Center				
Analysis ID:	02-9090-2398		Endpoint:	96h Survival Rate			CETIS Version:	CETISv1.8.7			
Analyzed:	05 May-16 11:44		Analysis:	Linear Regression (MLE)			Official Results:	Yes			
Batch ID:	13-0299-9056		Test Type:	Survival (96h)			Analyst:	Jacob Munson-Decker			
Start Date:	10 Dec-15 10:00		Protocol:	EPA/821/R-02-012 (2002)			Diluent:	Laboratory Seawater			
Ending Date:			Species:	Americamysis bahia			Brine:	Not Applicable			
Duration:	NA		Source:	Aquatic Research Organisms, NH			Age:	5			
Sample ID:	14-7223-8677		Code:	57C09455			Client:	SPAWAR			
Sample Date:	10 Dec-15		Material:	Zinc sulfate			Project:	Pulsed Exposure			
Receive Date:			Source:	Pulsed Exposure							
Sample Age:	10h		Station:	6 Hour							
Linear Regression Options											
Model Function			Threshold Option		Threshold	Optimized	Pooled	Het Corr	Weighted		
Log-Normal [NED=A+B*log(X)]			Control Threshold		1E-07	Yes	No	No	Yes		
Regression Summary											
Iters	LL	AICc	BIC	Mu	Sigma	Adj R2	F Stat	Critical	P-Value	Decision(α:5%)	
24	-28.48	63.96	66.96	3.593	0.161	0.7593	5.773	2.84	0.0027	Significant Lack of Fit	
Point Estimates											
Level	μg/L	95% LCL		95% UCL							
LC50	3914	3114		4674							
Regression Parameters											
Parameter	Estimate	Std Error	95% LCL	95% UCL	t Stat	P-Value	Decision(α:5%)				
Threshold	0.01269	0.01335	-0.01348	0.03885	0.9504	0.3510	Non-Significant Parameter				
Slope	6.212	1.867	2.553	9.871	3.328	0.0027	Significant Parameter				
Intercept	-22.32	6.743	-35.54	-9.101	-3.31	0.0028	Significant Parameter				
ANOVA Table											
Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)					
Model	82.83003	82.83003	1	87.15	<0.0001	Significant					
Lack of Fit	12.44364	3.11091	4	5.773	0.0027	Significant					
Pure Error	11.31723	0.538916	21								
Residual	23.76087	0.950435	25								
Residual Analysis											
Attribute	Method	Test Stat	Critical	P-Value	Decision(α:5%)						
Goodness-of-Fit	Pearson Chi-Sq GOF	23.76	37.65	0.5332	Non-Significant Heterogeneity						
	Likelihood Ratio GOF	15.03	37.65	0.9407	Non-Significant Heterogeneity						
Variances	Mod Levene Equality of Variance	1.315	2.573	0.2939	Equal Variances						
Distribution	Shapiro-Wilk W Normality	0.6597	0.9264	<0.0001	Non-normal Distribution						
	Anderson-Darling A2 Normality	4.149	2.492	<0.0001	Non-normal Distribution						
96h Survival Rate Summary											
Calculated Variate(A/B)											
C-μg/L	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
13	Lab Control	4	1	1	1	0	0	0.0%	0.0%	20	20
398		4	0.95	0.8	1	0.05	0.1	10.53%	5.0%	19	20
753		4	1	1	1	0	0	0.0%	0.0%	20	20
1520		4	1	1	1	0	0	0.0%	0.0%	20	20
3280		4	0.65	0.6	0.8	0.05	0.1	15.38%	35.0%	13	20
5430		4	0.2	0	0.6	0.1414	0.2828	141.4%	80.0%	4	20
16700		4	0	0	0	0	0		100.0%	0	20

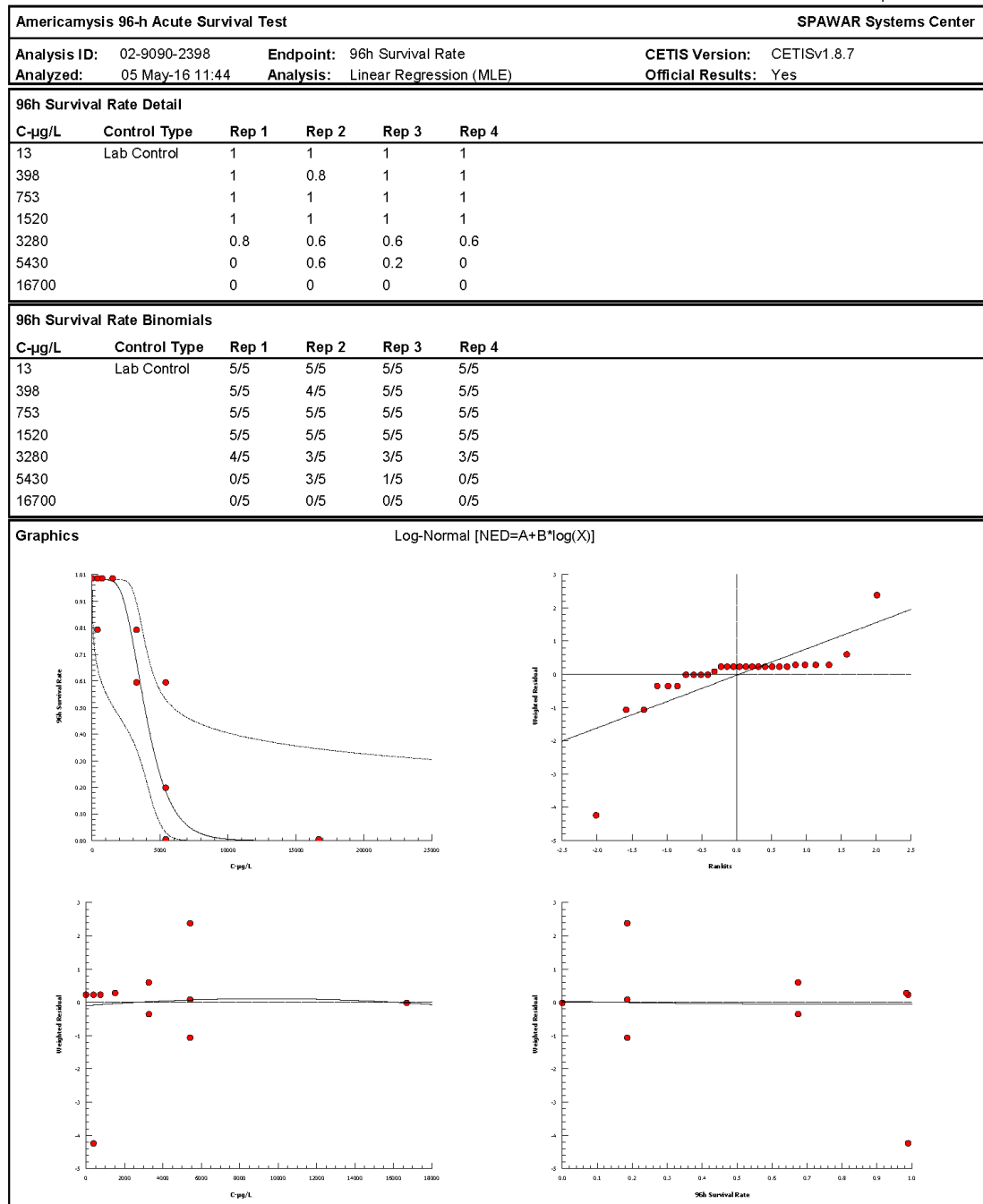
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CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Analytical Report

Report Date: 02 Jun-16 16:10 (p 2 of 2)
 Test Code: 794A30D0 | 20-3490-5296



000-010-187-1

CETIS™ v1.8.7.16

Analyst: _____ QA: _____

CETIS Summary Report

Report Date: 02 Jun-16 16:09 (p 1 of 1)
 Test Code: 5B610A5A | 15-3308-6298

Americamysis 96-h Acute Survival Test							SPAWAR Systems Center				
Batch ID:	13-0299-9056	Test Type:	Survival (96h)				Analyst:	Jacob Munson-Decker			
Start Date:	10 Dec-15 10:00	Protocol:	EPA/821/R-02-012 (2002)				Diluent:	Laboratory Seawater			
Ending Date:		Species:	Americamysis bahia				Brine:	Not Applicable			
Duration:	NA	Source:	Aquatic Research Organisms, NH				Age:	5			
Sample ID:	14-0668-4680	Code:	53D84E08				Client:	SPAWAR			
Sample Date:	10 Dec-15	Material:	Zinc sulfate				Project:	Pulsed Exposure			
Receive Date:	10 Dec-15	Source:	Pulsed Exposure								
Sample Age:	10h	Station:	12 Hour								
Comparison Summary											
Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method				
14-4521-2713	96h Survival Rate	753	1520	1070	21.0%		Steel Many-One Rank Sum Test				
Point Estimate Summary											
Analysis ID	Endpoint	Level	µg/L	95% LCL	95% UCL	TU	Method				
09-4567-2331	96h Survival Rate	LC50	2060	1685	2492		Linear Regression (MLE)				
96h Survival Rate Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
13	Lab Control	4	1	1	1	1	1	0	0	0.0%	0.0%
398		4	1	1	1	1	1	0	0	0.0%	0.0%
753		4	1	1	1	1	1	0	0	0.0%	0.0%
1520		4	0.7	0.5163	0.8837	0.6	0.8	0.05774	0.1155	16.5%	30.0%
3280		4	0.2	0	0.6501	0	0.6	0.1414	0.2828	141.4%	80.0%
5430		4	0	0	0	0	0	0	0		100.0%
16700		4	0	0	0	0	0	0	0		100.0%
96h Survival Rate Detail											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
13	Lab Control	1	1	1	1						
398		1	1	1	1						
753		1	1	1	1						
1520		0.8	0.6	0.8	0.6						
3280		0	0.2	0.6	0						
5430		0	0	0	0						
16700		0	0	0	0						
96h Survival Rate Binomials											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
13	Lab Control	5/5	5/5	5/5	5/5						
398		5/5	5/5	5/5	5/5						
753		5/5	5/5	5/5	5/5						
1520		4/5	3/5	4/5	3/5						
3280		0/5	1/5	3/5	0/5						
5430		0/5	0/5	0/5	0/5						
16700		0/5	0/5	0/5	0/5						

CETIS Analytical Report

Report Date: 02 Jun-16 16:09 (p 1 of 2)
Test Code: 5B610A5A | 15-3308-6298

Americamysis 96-h Acute Survival Test						SPAWAR Systems Center					
Analysis ID: 14-4521-2713		Endpoint: 96h Survival Rate				CETIS Version: CETISv1.8.7					
Analyzed: 05 May-16 11:45		Analysis: Nonparametric-Control vs Treatments				Official Results: Yes					
Batch ID: 13-0299-9056		Test Type: Survival (96h)				Analyst: Jacob Munson-Decker					
Start Date: 10 Dec-15 10:00		Protocol: EPA/821/R-02-012 (2002)				Diluent: Laboratory Seawater					
Ending Date:		Species: Americamysis bahia				Brine: Not Applicable					
Duration: NA		Source: Aquatic Research Organisms, NH				Age: 5					
Sample ID: 14-0668-4680		Code: 53D84E08				Client: SPAWAR					
Sample Date: 10 Dec-15		Material: Zinc sulfate				Project: Pulsed Exposure					
Receive Date: 10 Dec-15		Source: Pulsed Exposure									
Sample Age: 10h		Station: 12 Hour									
Data Transform		Zeta	Alt Hyp	Trials	Seed		PMSD	NOEL	LOEL	TOEL	TU
Angular (Corrected)		NA	C > T	NA	NA		21.0%	753	1520	1070	
Steel Many-One Rank Sum Test											
Control	vs	C-µg/L	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)		
13		398	18	10	1	6	0.8000	Asymp	Non-Significant Effect		
13		753	18	10	1	6	0.8000	Asymp	Non-Significant Effect		
13		1520*	10	10	0	6	0.0350	Asymp	Significant Effect		
13		3280*	10	10	0	6	0.0350	Asymp	Significant Effect		
ANOVA Table											
Source	Sum Squares		Mean Square		DF	F Stat	P-Value	Decision(α:5%)			
Between	2.453502		0.6133756		4	27.06	<0.0001	Significant Effect			
Error	0.3400105		0.02266737		15						
Total	2.793513				19						
Distributional Tests											
Attribute	Test			Test Stat	Critical	P-Value	Decision(α:1%)				
Variances	Mod Levene Equality of Variance			4.508	4.893	0.0137	Equal Variances				
Variances	Levene Equality of Variance			6.762	4.893	0.0026	Unequal Variances				
Distribution	Shapiro-Wilk W Normality			0.7438	0.866	0.0001	Non-normal Distribution				
96h Survival Rate Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
13	Lab Control	4	1	1	1	1	1	1	0	0.0%	0.0%
398		4	1	1	1	1	1	1	0	0.0%	0.0%
753		4	1	1	1	1	1	1	0	0.0%	0.0%
1520		4	0.7	0.5163	0.8837	0.7	0.6	0.8	0.05774	16.5%	30.0%
3280		4	0.2	0	0.6501	0.1	0	0.6	0.1414	141.4%	80.0%
5430		4	0	0	0	0	0	0	0		100.0%
16700		4	0	0	0	0	0	0	0		100.0%
Angular (Corrected) Transformed Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
13	Lab Control	4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
398		4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
753		4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
1520		4	0.9966	0.7935	1.2	0.9966	0.8861	1.107	0.06382	12.81%	25.92%
3280		4	0.4502	-0.04551	0.9459	0.3446	0.2255	0.8861	0.1558	69.2%	66.54%
5430		4	0.2255	0.2255	0.2256	0.2255	0.2255	0.2255	0	0.0%	83.24%
16700		4	0.2255	0.2255	0.2256	0.2255	0.2255	0.2255	0	0.0%	83.24%

CETIS Analytical Report

Report Date: 02 Jun-16 16:09 (p 2 of 2)
Test Code: 5B610A5A | 15-3308-6298

Americamysis 96-h Acute Survival Test					SPAWAR Systems Center
Analysis ID:	14-4521-2713	Endpoint:	96h Survival Rate	CETIS Version:	CETISv1.8.7
Analyzed:	05 May-16 11:45	Analysis:	Nonparametric-Control vs Treatments	Official Results:	Yes
96h Survival Rate Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
13	Lab Control	1	1	1	1
398		1	1	1	1
753		1	1	1	1
1520		0.8	0.6	0.8	0.6
3280		0	0.2	0.6	0
5430		0	0	0	0
16700		0	0	0	0
Angular (Corrected) Transformed Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
13	Lab Control	1.345	1.345	1.345	1.345
398		1.345	1.345	1.345	1.345
753		1.345	1.345	1.345	1.345
1520		1.107	0.8861	1.107	0.8861
3280		0.2255	0.4636	0.8861	0.2255
5430		0.2255	0.2255	0.2255	0.2255
16700		0.2255	0.2255	0.2255	0.2255
96h Survival Rate Binomials					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
13	Lab Control	5/5	5/5	5/5	5/5
398		5/5	5/5	5/5	5/5
753		5/5	5/5	5/5	5/5
1520		4/5	3/5	4/5	3/5
3280		0/5	1/5	3/5	0/5
5430		0/5	0/5	0/5	0/5
16700		0/5	0/5	0/5	0/5
Graphics					

000-010-187-1

CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Analytical Report

Report Date: 02 Jun-16 16:09 (p 1 of 2)
Test Code: 5B610A5A | 15-3308-6298

Americamysis 96-h Acute Survival Test							SPAWAR Systems Center				
Analysis ID:	09-4567-2331		Endpoint:		96h Survival Rate		CETIS Version:		CETISv1.8.7		
Analyzed:	05 May-16 11:46		Analysis:		Linear Regression (MLE)		Official Results:		Yes		
Batch ID:	13-0299-9056		Test Type:		Survival (96h)		Analyst:		Jacob Munson-Decker		
Start Date:	10 Dec-15 10:00		Protocol:		EPA/821/R-02-012 (2002)		Diluent:		Laboratory Seawater		
Ending Date:			Species:		Americamysis bahia		Brine:		Not Applicable		
Duration:	NA		Source:		Aquatic Research Organisms, NH		Age:		5		
Sample ID:	14-0668-4680		Code:		53D84E08		Client:		SPAWAR		
Sample Date:	10 Dec-15		Material:		Zinc sulfate		Project:		Pulsed Exposure		
Receive Date:	10 Dec-15		Source:		Pulsed Exposure						
Sample Age:	10h		Station:		12 Hour						
Linear Regression Options											
Model Function			Threshold Option		Threshold	Optimized	Pooled	Het Corr	Weighted		
Log-Normal [NED=A+B*log(X)]			Control Threshold		1E-07	No	No	No	Yes		
Regression Summary											
Iters	LL	AICc	BIC	Mu	Sigma	Adj R2	F Stat	Critical	P-Value	Decision(α:5%)	
8	-23.1	50.68	52.87	3.314	0.194	0.8941	1.663	2.685	0.1874	Non-Significant Lack of Fit	
Point Estimates											
Level	μg/L	95% LCL	95% UCL								
LC50	2060	1685	2492								
Regression Parameters											
Parameter	Estimate	Std Error	95% LCL	95% UCL	t Stat	P-Value	Decision(α:5%)				
Slope	5.153	0.9096	3.371	6.936	5.666	<0.0001	Significant Parameter				
Intercept	-17.08	3.036	-23.03	-11.13	-5.625	<0.0001	Significant Parameter				
ANOVA Table											
Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)					
Model	103.8834	103.8834	1	228.9	<0.0001	Significant					
Lack of Fit	3.346611	0.669322	5	1.663	0.1874	Non-Significant					
Pure Error	8.452381	0.402494	21								
Residual	11.79899	0.453807	26								
Residual Analysis											
Attribute	Method			Test Stat	Critical	P-Value	Decision(α:5%)				
Goodness-of-Fit	Pearson Chi-Sq GOF			11.8	38.89	0.9922	Non-Significant Heterogeneity				
	Likelihood Ratio GOF			11	38.89	0.9955	Non-Significant Heterogeneity				
Variances	Mod Levene Equality of Variance			4.129	2.573	0.0068	Unequal Variances				
Distribution	Shapiro-Wilk W Normality			0.6633	0.9264	<0.0001	Non-normal Distribution				
	Anderson-Darling A2 Normality			3.175	2.492	<0.0001	Non-normal Distribution				
96h Survival Rate Summary											
			Calculated Variate(A/B)								
C-μg/L	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
13	Lab Control	4	1	1	1	0	0	0.0%	0.0%	20	20
398		4	1	1	1	0	0	0.0%	0.0%	20	20
753		4	1	1	1	0	0	0.0%	0.0%	20	20
1520		4	0.7	0.6	0.8	0.05774	0.1155	16.5%	30.0%	14	20
3280		4	0.2	0	0.6	0.1414	0.2828	141.4%	80.0%	4	20
5430		4	0	0	0	0	0		100.0%	0	20
16700		4	0	0	0	0	0		100.0%	0	20

000-010-187-1

CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Analytical Report

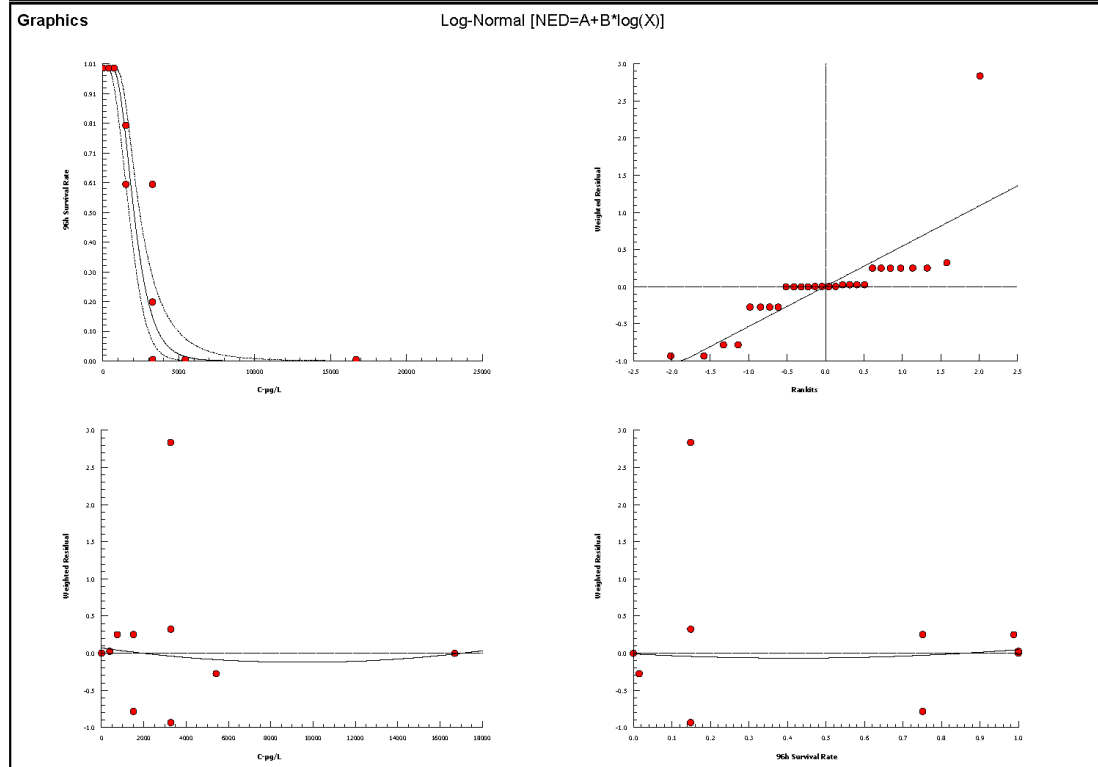
Report Date: 02 Jun-16 16:09 (p 2 of 2)
Test Code: 5B610A5A | 15-3308-6298

Americamysis 96-h Acute Survival Test SPAWAR Systems Center

Analysis ID: 09-4567-2331 Endpoint: 96h Survival Rate CETIS Version: CETISv1.8.7
Analyzed: 05 May-16 11:46 Analysis: Linear Regression (MLE) Official Results: Yes

96h Survival Rate Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
13	Lab Control	1	1	1	1
398		1	1	1	1
753		1	1	1	1
1520		0.8	0.6	0.8	0.6
3280		0	0.2	0.6	0
5430		0	0	0	0
16700		0	0	0	0

96h Survival Rate Binomials					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
13	Lab Control	5/5	5/5	5/5	5/5
398		5/5	5/5	5/5	5/5
753		5/5	5/5	5/5	5/5
1520		4/5	3/5	4/5	3/5
3280		0/5	1/5	3/5	0/5
5430		0/5	0/5	0/5	0/5
16700		0/5	0/5	0/5	0/5



000-010-187-1

CETIS™ v1.8.7.16

Analyst: _____ QA: _____

CETIS Summary Report

Report Date: 02 Jun-16 16:09 (p 1 of 1)
 Test Code: 30F9B89F | 08-2167-2095

Americamysis 96-h Acute Survival Test							SPAWAR Systems Center				
Batch ID:	13-0299-9056	Test Type:	Survival (96h)				Analyst:	Jacob Munson-Decker			
Start Date:	10 Dec-15 10:00	Protocol:	EPA/821/R-02-012 (2002)				Diluent:	Laboratory Seawater			
Ending Date:	14 Dec-15 08:30	Species:	Americamysis bahia				Brine:	Not Applicable			
Duration:	94h	Source:	Aquatic Research Organisms, NH				Age:	5			
Sample ID:	11-1242-4832	Code:	424E4180				Client:	SPAWAR			
Sample Date:	10 Dec-15	Material:	Zinc sulfate				Project:	Pulsed Exposure			
Receive Date:		Source:	Reference Toxicant								
Sample Age:	10h	Station:	Reference Toxicant								
Comparison Summary											
Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method				
16-2240-7981	96h Survival Rate	398	753	547.4	26.8%		Dunnett Multiple Comparison Test				
Point Estimate Summary											
Analysis ID	Endpoint	Level	µg/L	95% LCL	95% UCL	TU	Method				
04-3492-6438	96h Survival Rate	LC50	510.1	415.1	605.9		Linear Regression (MLE)				
96h Survival Rate Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
13	Lab Control	4	0.95	0.7909	1	0.8	1	0.05	0.1	10.53%	0.0%
100		4	1	1	1	1	1	0	0	0.0%	-5.26%
180		4	0.9	0.7163	1	0.8	1	0.05774	0.1155	12.83%	5.26%
398		4	0.75	0.3496	1	0.4	1	0.1258	0.2517	33.55%	21.05%
753		4	0.1	0	0.4182	0	0.4	0.1	0.2	200.0%	89.47%
1520		4	0	0	0	0	0	0	0		100.0%
96h Survival Rate Detail											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
13	Lab Control	1	1	1	0.8						
100		1	1	1	1						
180		1	0.8	0.8	1						
398		0.8	1	0.4	0.8						
753		0.4	0	0	0						
1520		0	0	0	0						
96h Survival Rate Binomials											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
13	Lab Control	5/5	5/5	5/5	4/5						
100		5/5	5/5	5/5	5/5						
180		5/5	4/5	4/5	5/5						
398		4/5	5/5	2/5	4/5						
753		2/5	0/5	0/5	0/5						
1520		0/5	0/5	0/5	0/5						

CETIS Analytical Report

Report Date: 02 Jun-16 16:09 (p 1 of 2)
Test Code: 30F9B89F | 08-2167-2095

Americamysis 96-h Acute Survival Test										SPAWAR Systems Center	
Analysis ID: 16-2240-7981		Endpoint: 96h Survival Rate					CETIS Version: CETISv1.8.7				
Analyzed: 05 May-16 11:46		Analysis: Parametric-Control vs Treatments					Official Results: Yes				
Batch ID: 13-0299-9056		Test Type: Survival (96h)					Analyst: Jacob Munson-Decker				
Start Date: 10 Dec-15 10:00		Protocol: EPA/821/R-02-012 (2002)					Diluent: Laboratory Seawater				
Ending Date: 14 Dec-15 08:30		Species: Americamysis bahia					Brine: Not Applicable				
Duration: 94h		Source: Aquatic Research Organisms, NH					Age: 5				
Sample ID: 11-1242-4832		Code: 424E4180					Client: SPAWAR				
Sample Date: 10 Dec-15		Material: Zinc sulfate					Project: Pulsed Exposure				
Receive Date:		Source: Reference Toxicant									
Sample Age: 10h		Station: Reference Toxicant									
Data Transform		Zeta	Alt Hyp	Trials	Seed		PMSD	NOEL	LOEL	TOEL	TU
Angular (Corrected)		NA	C > T	NA	NA		26.8%	398	753	547.4	
Dunnett Multiple Comparison Test											
Control	vs	C-µg/L	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)		
13		100	-0.4687	2.356	0.299	6	0.9159	CDF	Non-Significant Effect		
13		180	0.4687	2.356	0.299	6	0.6182	CDF	Non-Significant Effect		
13		398	1.769	2.356	0.299	6	0.1360	CDF	Non-Significant Effect		
13		753*	7.443	2.356	0.299	6	<0.0001	CDF	Significant Effect		
ANOVA Table											
Source	Sum Squares		Mean Square		DF	F Stat	P-Value	Decision(α:5%)			
Between	2.71033		0.6775825		4	21	<0.0001	Significant Effect			
Error	0.4840547		0.03227031		15						
Total	3.194385				19						
Distributional Tests											
Attribute	Test			Test Stat	Critical	P-Value	Decision(α:1%)				
Variances	Mod Levene Equality of Variance			0.74	4.893	0.5793	Equal Variances				
Variances	Levene Equality of Variance			2.499	4.893	0.0868	Equal Variances				
Distribution	Shapiro-Wilk W Normality			0.9446	0.866	0.2923	Normal Distribution				
96h Survival Rate Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
13	Lab Control	4	0.95	0.7909	1	1	0.8	1	0.05	10.53%	0.0%
100		4	1	1	1	1	1	1	0	0.0%	-5.26%
180		4	0.9	0.7163	1	0.9	0.8	1	0.05774	12.83%	5.26%
398		4	0.75	0.3496	1	0.8	0.4	1	0.1258	33.55%	21.05%
753		4	0.1	0	0.4182	0	0	0.4	0.1	200.0%	89.47%
1520		4	0	0	0	0	0	0	0		100.0%
Angular (Corrected) Transformed Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
13	Lab Control	4	1.286	1.096	1.475	1.345	1.107	1.345	0.05953	9.26%	0.0%
100		4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	-4.63%
180		4	1.226	1.007	1.445	1.226	1.107	1.345	0.06874	11.21%	4.63%
398		4	1.061	0.6237	1.498	1.107	0.6847	1.345	0.1374	25.91%	17.47%
753		4	0.3403	-0.02503	0.7057	0.2255	0.2255	0.6847	0.1148	67.47%	73.53%
1520		4	0.2255	0.2255	0.2256	0.2255	0.2255	0.2255	0	0.0%	82.46%

000-010-187-1

CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Analytical Report

Report Date: 02 Jun-16 16:09 (p 2 of 2)
Test Code: 30F9B89F | 08-2167-2095

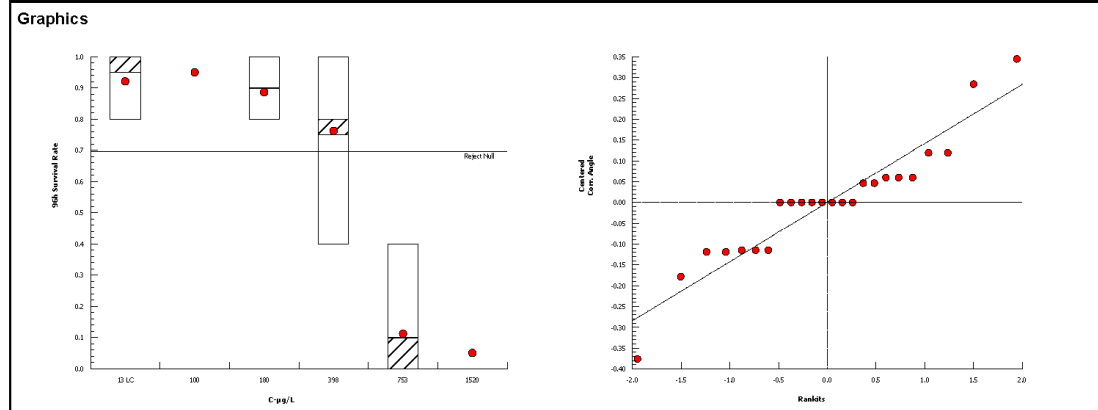
Americamysis 96-h Acute Survival Test SPAWAR Systems Center

Analysis ID: 16-2240-7981 Endpoint: 96h Survival Rate CETIS Version: CETISv1.8.7
Analyzed: 05 May-16 11:46 Analysis: Parametric-Control vs Treatments Official Results: Yes

96h Survival Rate Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
13	Lab Control	1	1	1	0.8
100		1	1	1	1
180		1	0.8	0.8	1
398		0.8	1	0.4	0.8
753		0.4	0	0	0
1520		0	0	0	0

Angular (Corrected) Transformed Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
13	Lab Control	1.345	1.345	1.345	1.107
100		1.345	1.345	1.345	1.345
180		1.345	1.107	1.107	1.345
398		1.107	1.345	0.6847	1.107
753		0.6847	0.2255	0.2255	0.2255
1520		0.2255	0.2255	0.2255	0.2255

96h Survival Rate Binomials					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
13	Lab Control	5/5	5/5	5/5	4/5
100		5/5	5/5	5/5	5/5
180		5/5	4/5	4/5	5/5
398		4/5	5/5	2/5	4/5
753		2/5	0/5	0/5	0/5
1520		0/5	0/5	0/5	0/5



000-010-187-1

CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Analytical Report

Report Date: 02 Jun-16 16:09 (p 1 of 2)
Test Code: 30F9B89F | 08-2167-2095

Americamysis 96-h Acute Survival Test						SPAWAR Systems Center					
Analysis ID:	04-3492-6438		Endpoint:	96h Survival Rate			CETIS Version:	CETISv1.8.7			
Analyzed:	05 May-16 11:47		Analysis:	Linear Regression (MLE)			Official Results:	Yes			
Batch ID:	13-0299-9056		Test Type:	Survival (96h)			Analyst:	Jacob Munson-Decker			
Start Date:	10 Dec-15 10:00		Protocol:	EPA/821/R-02-012 (2002)			Diluent:	Laboratory Seawater			
Ending Date:	14 Dec-15 08:30		Species:	Americamysis bahia			Brine:	Not Applicable			
Duration:	94h		Source:	Aquatic Research Organisms, NH			Age:	5			
Sample ID:	11-1242-4832		Code:	424E4180			Client:	SPAWAR			
Sample Date:	10 Dec-15		Material:	Zinc sulfate			Project:	Pulsed Exposure			
Receive Date:			Source:	Reference Toxicant							
Sample Age:	10h		Station:	Reference Toxicant							
Linear Regression Options											
Model Function			Threshold Option		Threshold	Optimized	Pooled	Het Corr	Weighted		
Log-Normal [NED=A+B*log(X)]			Control Threshold		0.05	Yes	No	No	Yes		
Regression Summary											
Iters	LL	AICc	BIC	Mu	Sigma	Adj R2	F Stat	Critical	P-Value	Decision(α:5%)	
11	-29.66	66.51	68.85	2.708	0.1351	0.7502	1.431	3.16	0.2666	Non-Significant Lack of Fit	
Point Estimates											
Level	µg/L	95% LCL	95% UCL								
LC50	510.1	415.1	605.9								
Regression Parameters											
Parameter	Estimate	Std Error	95% LCL	95% UCL	t Stat	P-Value	Decision(α:5%)				
Threshold	0.04964	0.02815	-0.00554	0.1048	1.763	0.0924	Non-Significant Parameter				
Slope	7.401	1.865	3.746	11.06	3.968	0.0007	Significant Parameter				
Intercept	-20.04	5.093	-30.02	-10.06	-3.935	0.0008	Significant Parameter				
ANOVA Table											
Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)					
Model	71.73054	71.73054	1	71.07	<0.0001	Significant					
Lack of Fit	4.081984	1.360661	3	1.431	0.2666	Non-Significant					
Pure Error	17.11345	0.950747	18								
Residual	21.19543	1.009306	21								
Residual Analysis											
Attribute	Method			Test Stat	Critical	P-Value	Decision(α:5%)				
Goodness-of-Fit	Pearson Chi-Sq GOF			21.2	32.67	0.4471	Non-Significant Heterogeneity				
	Likelihood Ratio GOF			20.83	32.67	0.4693	Non-Significant Heterogeneity				
Variances	Mod Levene Equality of Variance			1.027	2.773	0.4311	Equal Variances				
Distribution	Shapiro-Wilk W Normality			0.902	0.9169	0.0238	Non-normal Distribution				
	Anderson-Darling A2 Normality			1.298	2.492	0.0019	Non-normal Distribution				
96h Survival Rate Summary											
			Calculated Variate(A/B)								
C-µg/L	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
13	Lab Control	4	0.95	0.8	1	0.05	0.1	10.53%	0.0%	19	20
100		4	1	1	1	0	0	0.0%	-5.26%	20	20
180		4	0.9	0.8	1	0.05774	0.1155	12.83%	5.26%	18	20
398		4	0.75	0.4	1	0.1258	0.2517	33.55%	21.05%	15	20
753		4	0.1	0	0.4	0.1	0.2	200.0%	89.47%	2	20
1520		4	0	0	0	0	0	100.0%	100.0%	0	20

000-010-187-1

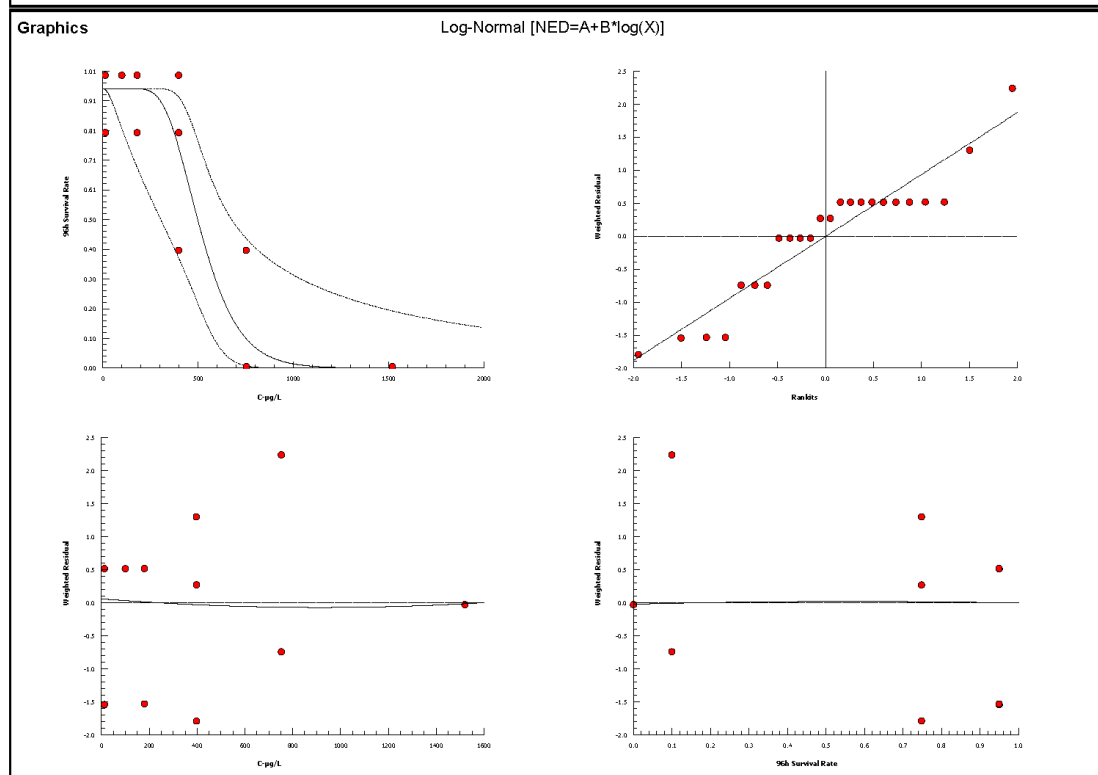
CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Analytical Report

Report Date: 02 Jun-16 16:09 (p 2 of 2)
 Test Code: 30F9B89F | 08-2167-2095

Americamysis 96-h Acute Survival Test					SPAWAR Systems Center	
Analysis ID: 04-3492-6438		Endpoint: 96h Survival Rate			CETIS Version: CETISv1.8.7	
Analyzed: 05 May-16 11:47		Analysis: Linear Regression (MLE)			Official Results: Yes	
96h Survival Rate Detail						
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	
13	Lab Control	1	1	1	0.8	
100		1	1	1	1	
180		1	0.8	0.8	1	
398		0.8	1	0.4	0.8	
753		0.4	0	0	0	
1520		0	0	0	0	
96h Survival Rate Binomials						
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	
13	Lab Control	5/5	5/5	5/5	4/5	
100		5/5	5/5	5/5	5/5	
180		5/5	4/5	4/5	5/5	
398		4/5	5/5	2/5	4/5	
753		2/5	0/5	0/5	0/5	
1520		0/5	0/5	0/5	0/5	



000-010-187-1

CETIS™ v1.8.7.16

Analyst:_____ QA:_____

Marine Acute Bioassay
Static-Renewal Conditions

Water Quality Measurements
& Test Organism Survival

Project: Definitive Pulsed Exposure

Test Species: *A. bahia*

Sample ID: 3 hr Exposure

Start Date/Time: 12/10/2015 1000

Test No.:

End Date/Time: 12/14/2015 0830

Tech Initials				
0	24	48	72	96
JM	NH	JM	JM	JM
JM	NH	JM	JM	JM
JM	NH	JM	JM	JM

Counts:

Readings:

Dilutions made by:

Concentration µg/L	Rep	Number of Live Organisms					Salinity (ppt)					Temperature (°C)					Dissolved Oxygen (mg/L)					pH (units)				
		0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96
Lab Control	A	5	5	5	5	5	34.0	34.1	34.2	34.1	34.4	18.6	18.7	18.5	18.6	18.7	9.3	8.7	9.2	8.1	8.1	7.60	7.74	7.74	7.81	7.95
34 ppt	B	5	5	5	5	5																				
	C	5	5	5	5	5																				
	D	5	5	4	4	4																				
500 µg/L	A	5	5	5	5	5	33.9	34.1	34.4	34.3	34.4	18.8	20.1	18.8	18.8	18.7	9.3	8.7	8.9	8.3	8.0	7.53	7.81	7.88	8.14	7.95
Zinc	B	5	5	5	5	5																				
	C	5	5	5	5	5																				
	D	5	5	5	5	5																				
1000 µg/L	A	5	5	5	5	5	34.1	34.2	34.2	34.3	34.3	19.2	20.1	18.9	18.9	18.8	9.4	9.0	9.1	8.2	8.0	7.64	7.84	7.85	8.21	8.05
Zinc	B	5	5	4	3	3																				
	C	5	5	5	5	5																				
	D	5	5	4	4	4																				
2000 µg/L	A	5	5	5	5	5	33.9	34.2	34.3	34.4	34.6	19.4	20.1	18.9	18.9	18.8	9.3	8.6	8.7	8.4	8.5	7.55	7.88	7.86	8.26	8.05
Zinc	B	5	5	5	5	5																				
	C	5	5	4	4	4																				
	D	5	5	5	5	5																				
4000 µg/L	A	5	5	5	5	5	34.2	34.1	34.5	34.3	34.3	18.4	20.0	18.9	18.9	18.8	9.2	8.3	8.7	8.4	8.4	7.50	7.87	7.86	8.23	8.09
Zinc	B	5	5	5	5	5																				
	C	5	5	5	5	5																				
	D	5	5	5	5	5																				
8000 µg/L	A	5	5	5	5	5	33.2	34.1	34.3	34.2	34.4	19.2	20.1	18.9	18.9	18.8	9.2	8.5	8.3	8.4	8.1	7.51	7.87	7.84	8.16	8.01
Zinc	B	5	5	4	3	3																				
	C	5	5	3	3	3																				
	D	5	5	3	3	3																				
16000 µg/L	A	5	5	0	0	0	34.2	34.2	34.3	34.1	33.9	19.2	20.1	18.8	18.8	18.8	9.1	8.5	8.6	8.2	8.3	7.51	7.88	7.84	8.21	8.00
Zinc	B	5	5	3	3	3																				
	C	5	5	3	3	3																				
	D	5	5	3	3	3																				

Initial Counts

QC'd by: JM/NH

Animal Source/Date Received: ARO 12/8/2015

Age at Initiation: 5 days

Comments:

i = initial reading in fresh test solution, f = final reading in test chamber prior to renewal

Organisms fed prior to initiation, circle one (y/n)

Tests aerated? Circle one (y/n) if yes, sample ID(s):

Duration:

Aeration source:

(A) = 22

QC Check:

JM 6/1/2016

Final Review:

lll 6/2/16

Feeding Times				
0	24	48	72	96
AM: 0730	1100	1130	1100	1130
PM: 1500	1900	1920	1900	1920

Marine Acute Bioassay
Static-Renewal Conditions

Water Quality Measurements
& Test Organism Survival

Project: Definitive Pulsed Exposure
 Sample ID: 6 hr Exposure
 Test No.: _____

Test Species: A. bahia
 Start Date/Time: 12/10/2015 1000
 End Date/Time: 12/14/2015 0830

Tech Initials				
0	24	48	72	96
Counts: <u>JA</u>	<u>NH</u>	<u>JA</u>	<u>JA</u>	<u>JA</u>
Readings: <u>JA</u>	<u>NH</u>	<u>JA</u>	<u>JA</u>	<u>JA</u>
Dilutions made by: <u>JA</u>				

Concentration µg/L	Rep	Number of Live Organisms					Salinity (ppt)					Temperature (°C)					Dissolved Oxygen (mg/L)					pH (units)				
		0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96
Lab Control	A	5	5	5	5	5	34.0	33.9	34.2	34.1	34.8	18.9	18.5	18.6	18.7	9.3	8.9	9.2	8.1	8.1	7.60	7.74	7.76	7.87	7.85	
34 ppt	B	5	5	5	5	5																				
	C	5	5	5	5	5																				
	D	5	5	4	4	4																				
500µg/L	A	5	5	5	5	5	33.9	34.1	34.2	34.3	18.8	20.1	18.9	18.8	20.1	9.3	8.7	8.6	8.7	8.0	7.53	7.81	7.78	8.14	7.97	
Zinc	B	5	5	5	4	4																				
	C	5	5	5	5	5																				
	D	5	5	5	5	5																				
1000µg/L	A	5	5	5	5	5	33.9	34.2	34.1	34.2	18.4	20.1	18.9	18.8	20.1	9.2	9.0	8.6	8.6	8.1	7.66	7.96	7.98	8.11	8.06	
Zinc	B	5	5	5	5	5																				
	C	5	5	5	5	5																				
	D	5	5	5	5	5																				
2000µg/L	A	5	5	5	5	5	33.9	34.2	34.2	34.1	18.4	20.1	18.8	18.8	18.8	9.2	8.6	8.7	8.6	8.3	7.69	7.88	7.98	8.03	8.07	
Zinc	B	5	5	5	5	5																				
	C	5	5	5	5	5																				
	D	5	5	5	5	5																				
4000µg/L	A	5	5	4	4	4	34.1	34.3	34.3	33.9	18.4	20.0	20.1	18.8	18.9	9.1	8.3	8.4	8.5	8.4	7.65	7.87	7.86	8.23	8.07	
Zinc	B	5	4	3	3	3																				
	C	4	4	3	3	3																				
	D	4	3	3	3	3																				
8000µg/L	A	4	3	0	0	0	33.8	34.1	34.1	33.9	18.1	20.1	20.1	18.8	20.1	9.1	8.5	8.4	8.2	8.5	7.61	7.87	7.96	8.15	8.11	
Zinc	B	5	4	4	4	3																				
	C	5	5	1	1	1																				
	D	5	3	1	0	0																				
16000µg/L	A	5	3	0	-	-	33.2	34.1	34.1	-	-	18.4	20.2	18.8	-	-	9.1	8.6	8.7	-	-	7.47	7.89	7.88	-	
Zinc	B	4	3	0	-	-																				
	C	4	2	0	-	-																				
	D	2	1	0	-	-																				

Initial Counts
 QC'd by: JA / NH

Animal Source/Date Received: ARO 12/8/2015 Age at Initiation: 5 days

Comments: i = initial reading in fresh test solution, f = final reading in test chamber prior to renewal
Organisms fed prior to initiation, circle one (y / n)
Tests aerated? Circle one (y / n) If yes, sample ID(s): (A) = Q22 Duration:
Aeration source:

QC Check: JA 6/1/2016

Feeding Times				
0	24	48	72	96
AM: <u>0730</u>	<u>1100</u>	<u>1130</u>	<u>1130</u>	<u>0800</u>
PM: <u>1500</u>	<u>1300</u>	<u>1300</u>	<u>1300</u>	<u>-</u>

Final Review: all 6/2/16

Marine Acute Bioassay
Static-Renewal Conditions

Water Quality Measurements
& Test Organism Survival

Project: Definitive Pulsed Exposure
Sample ID: 12 hr Exposure
Test No.:

Test Species: A. bahia
Start Date/Time: 12/10/2015 1000
End Date/Time: 12/14/2015 0830

Tech Initials				
0	24	48	72	96
Counts: <u>JM</u>	<u>NH</u>	<u>JM</u>	<u>JM</u>	<u>JM</u>
Readings: <u>JM</u>	<u>NH</u>	<u>JM</u>	<u>JM</u>	<u>JM</u>
Dilutions made by: <u>JM</u>				

Concentration µg/L	Rep	Number of Live Organisms					Salinity (ppt)					Temperature (°C)					Dissolved Oxygen (mg/L)					pH (units)				
		0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96
Lab Control	A	5	5	5	5	5	34.0	33.9	34.0	34.1	34.4	18.0	18.9	18.5	18.6	18.7	8.9	8.9	8.2	8.1	8.1	7.60	7.74	7.76	7.89	7.85
34 ppt	B	5	5	5	5	5																				
	C	5	5	5	5	5																				
	D	5	5	5	5	5																				
500µg/L	A	5	5	5	5	5	33.2	34.1	34.5	34.0	34.2	18.5	20.1	18.9	18.8	20.1	9.0	8.7	8.5	8.3	8.0	7.49	7.84	7.78	7.15	7.56
Zinc	B	5	5	5	5	5																				
	C	5	5	5	5	5																				
	D	5	5	5	5	5																				
1000µg/L	A	5	5	5	5	5	33.8	34.2	34.7	34.6	34.7	18.9	20.1	18.8	18.9	19.9	8.9	9.0	8.7	8.1	8.1	7.67	7.86	7.87	8.19	8.02
Zinc	B	5	5	5	5	5																				
	C	5	5	5	5	5																				
	D	5	5	5	5	5																				
2000µg/L	A	5	4	4	4	4	33.8	34.2	34.4	34.3	34.5	18.9	20.1	18.9	18.9	19.9	8.9	8.6	8.5	8.1	8.5	7.71	7.83	7.81	8.20	8.04
Zinc	B	5	4	3	3	3																				
	C	5	5	5	5	4																				
	D	4	3	3	3	3																				
4000µg/L	A	4	2	1	0	0	33.6	34.2	33.9	34.1	34.7	18.8	20.0	20.1	18.9	18.8	8.8	8.3	8.5	8.1	8.5	7.65	7.87	7.96	8.15	8.04
Zinc	B	4	2	2	2	1																				
	C	5	3	3	3	3																				
	D	4	2	0	0	0																				
8000µg/L	A	3	2	0	-	-	33.5	34.1	34.2	-	-	18.6	20.0	18.8	-	-	8.8	8.9	8.5	-	-	7.56	7.87	7.90	-	-
Zinc	B	3	0	-	-	-																				
	C	5	4	0	-	-																				
	D	3	0	-	-	-																				
16000µg/L	A	0	-	-	-	-	33.2	34.1	-	-	-	18.9	20.2	-	-	-	9.1	8.6	-	-	-	7.47	7.89	-	-	-
Zinc	B	0	-	-	-	-																				
	C	0	-	-	-	-																				
	D	0	-	-	-	-																				

Initial Counts
QC'd by: JM/NH

Animal Source/Date Received: ARO 12/8/2015 Age at Initiation: 5 days

Comments: i = initial reading in fresh test solution, f = final reading in test chamber prior to renewal
Organisms fed prior to initiation, circle one (y/n)
Tests aerated? Circle one (y/n) if yes, sample ID(s): Duration:
Aeration source: (A) - O22

QC Check: JM 6/1/2016

Feeding Times				
0	24	48	72	96
AM: <u>200/100</u>	<u>190</u>	<u>200</u>	<u>080</u>	
PM: <u>1500/1700</u>	<u>1900</u>	<u>1505</u>		

Final Review: lll 6/2/16

Marine Acute Bioassay
Static-Renewal Conditions

Water Quality Measurements
& Test Organism Survival

Project: Definitive Pulsed Zinc Exposure Test Test Species: A. bahia
Sample ID: Reflex - 96hr Static Start Date/Time: 12/10/2015 10:00 am
Test No.: _____ End Date/Time: 12/14/2015 8:30 am

Tech Initials				
0	24	48	72	96
Counts: <u>JM</u>	<u>NH</u>	<u>JM</u>	<u>JM</u>	<u>JM</u>
Readings: <u>JM</u>	<u>NH</u>	<u>JM</u>	<u>JM</u>	<u>JM</u>
Dilutions made by: <u>JM</u>				

Zn Concentration (mg/L)	Rep	Number of Live Organisms					Salinity (ppt)					Temperature (°C)					Dissolved Oxygen (mg/L)					pH (units)				
		0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96
Lab Control	A	5	5	5	5	5	33.8	34.0	34.2	34.2	34.2	19.0	20.0	19.9	19.8	20.1	8.8	8.7	8.8	8.5	8.2	7.69	7.89	7.75	8.22	8.03
	B	5	5	5	5	5																				
	C	5	5	5	5	5																				
	D	5	4	4	4	4																				
	E																									
125	A	5	5	5	5	5	33.8	33.8	34.1	34.1	34.1	19.0	20.0	19.9	19.9	20.0	9.0	8.6	8.3	8.4	8.3	7.74	7.89	7.97	8.21	8.03
	B	5	5	5	5	5																				
	C	5	5	5	5	5																				
	D	5	5	5	5	5																				
	E																									
250	A	5	5	5	5	5	33.8	33.8	34.1	34.1	34.1	19.1	20.0	19.9	20.0	19.9	9.0	8.6	8.5	8.2	8.3	7.76	7.89	7.95	8.19	8.02
	B	5	5	4	4	4																				
	C	5	5	4	4	4																				
	D	5	5	5	5	5																				
	E																									
500	A	5	5	5	5	4	33.7	33.8	34.1	34.1	34.1	19.4	20.0	20.1	19.9	19.9	9.0	8.7	8.5	8.5	8.3	7.73	7.87	7.96	8.18	8.02
	B	5	5	5	5	5																				
	C	5	5	4	4	2																				
	D	5	5	5	5	4																				
	E																									
1000	A	5	5	4	4	2	33.9	33.8	34.0	34.0	34.3	19.6	20.0	20.1	20.0	19.9	8.9	8.7	8.5	8.4	8.3	7.75	7.89	7.94	8.09	7.89
	B	5	4	1	1	0																				
	C	5	5	4	2	0																				
	D	5	4	2	0	0																				
	E																									
2000	A	5	3	2	0	-	33.8	33.7	33.8	33.8	34.3	19.8	20.1	19.8	19.9	19.9	8.9	8.6	8.6	8.5	8.3	7.74	7.87	7.94	8.09	7.99
	B	5	5	1	0	-																				
	C	5	5	1	0	-																				
	D	5	4	2	0	-																				
	E																									

Initial Counts
QC'd by: NH/JM

Animal Source/Date Received: ARO 12/8/15 Age at Initiation: 50 days

Comments: i = initial reading in fresh test solution, f = final reading in test chamber prior to renewal
Organisms fed prior to initiation, circle one (y) n)
Tests aerated? Circle one (y) n) if yes, sample ID(s) 4-222 Duration: me

QC Check: JM 12/21/2015 me

Feeding Times				
0	24	48	72	96
AM: <u>9:30</u>	<u>11:00</u>	<u>11:30</u>	<u>12:00</u>	<u>08:30</u>
PM: <u>15:00</u>	<u>13:00</u>	<u>13:00</u>	<u>15:00</u>	<u>-</u>

Final Review: me 4/2/16

A.6. ZINC EXPOSURES – ANALYTICAL CHEMISTRY REPORTS:



CERTIFICATE OF ANALYSIS

Client: U.S. Naval SPAWAR Systems Center Pacific 53475 Strothe Rd., Bldg. 111 Code 71760 San Diego CA, 92152	Report Date: 05/26/16 15:13
	Received Date: 05/12/16 01:10
Attention: Molly Colvin	Turn Around: Normal
Phone: (619) 553-2788	Client Project: Definitive Sea Urchin Pulsed Zinc Toxicity Test
Fax: -	
Work Order(s): 6E12039	

NELAC #4047-002 ORELAP ELAP#1132 NEVADA #CA211 HAWAII LACSD #10143

The results in this report apply to the samples analyzed in accordance with the Chain of Custody document. Weck Laboratories, Inc. certifies that the test results meet all NELAC requirements unless noted in the case narrative. This analytical report is confidential and is only intended for the use of Weck Laboratories, Inc. and its client. This report contains the Chain of Custody document, which is an integral part of it, and can only be reproduced in full with the authorization of Weck Laboratories, Inc.

Dear Molly Colvin :

Enclosed are the results of analyses for samples received 05/12/16 01:10 with the Chain of Custody document. The samples were received in good condition, at 18.8 °C. All analysis met the method criteria except as noted below or in the report with data qualifiers.

Case Narrative:

Reviewed by:



Chris Samatmanakit
Project Manager



Page 1 of 16

Weck Laboratories, Inc 14859 East Clark Avenue, City of Industry, California 91745-1396 (626) 336-2139 FAX (626) 336-2634

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety

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Analytical Laboratory Service - Since 1964

U.S. Naval SPAWAR Systems Center Pacific
53475 Strothe Rd., Bldg. 111 Code 71760
San Diego CA, 92152

Date Received: 05/12/16 01:10
Date Reported: 05/26/16 15:13

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Sampled by:	Lab ID	Matrix	Date Sampled
TO-EPC-0	Molly, Gunther Rosen, Jac	6E12039-01	Water	03/25/16 08:30
TO-EPC-20	Molly, Gunther Rosen, Jac	6E12039-02	Water	03/25/16 08:30
TO-EPC-40	Molly, Gunther Rosen, Jac	6E12039-03	Water	03/25/16 08:30
TO-EPC-80	Molly, Gunther Rosen, Jac	6E12039-04	Water	03/25/16 08:30
TO-EPC-160	Molly, Gunther Rosen, Jac	6E12039-05	Water	03/25/16 08:30
TO-EPC-320	Molly, Gunther Rosen, Jac	6E12039-06	Water	03/25/16 08:30
TO-EPC-1280	Molly, Gunther Rosen, Jac	6E12039-07	Water	03/25/16 08:30
TO-EPC-2560	Molly, Gunther Rosen, Jac	6E12039-08	Water	03/25/16 08:30
TO-EPC-5120	Molly, Gunther Rosen, Jac	6E12039-09	Water	03/25/16 08:30
TO-EPC-10240	Molly, Gunther Rosen, Jac	6E12039-10	Water	03/25/16 08:30
TO-EPC-20180	Molly, Gunther Rosen, Jac	6E12039-11	Water	03/25/16 08:30

ANALYSES

Metals - Low Level by 1600 Series Methods



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San Diego CA, 92152

Date Received: 05/12/16 01:10
Date Reported: 05/26/16 15:13

6E12039-01		TO-EPC-0				
Sampled: 03/25/16 08:30		Sampled By: Molly, Gunther Rosen, Jacob Munson				Matrix: Water
Metals - Low Level by 1600 Series Methods						
Method: EPA 1640		Batch: W6E0823		Prepared: 05/16/16 09:13		Analyst: gza
Analyte	Result	MRL	Units	Dil	Analyzed	Qualifier
Zinc, Total	6.1	0.20	ug/l	1	05/17/16 21:53	



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53475 Strothe Rd., Bldg. 111 Code 71760
San Diego CA, 92152

Date Received: 05/12/16 01:10
Date Reported: 05/26/16 15:13

6E12039-02		TO-EPC-20			
Sampled: 03/25/16 08:30		Sampled By: Molly, Gunther Rosen, Jacob Munson			Matrix: Water
Metals - Low Level by 1600 Series Methods					
Method: EPA 1640		Batch: W6E0823		Prepared: 05/16/16 09:13	
		Analyst: gza			
Analyte	Result	MRL	Units	Dil	Analyzed
Zinc, Total	37	1.0	ug/l	5	05/17/16 22:48



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53475 Strothe Rd., Bldg. 111 Code 71760
San Diego CA, 92152

Date Received: 05/12/16 01:10

Date Reported: 05/26/16 15:13

6E12039-03		TO-EPC-40			
Sampled: 03/25/16 08:30		Sampled By: Molly, Gunther Rosen, Jacob Munson			Matrix: Water
Metals - Low Level by 1600 Series Methods					
Method: EPA 1640		Batch: W6E0823	Prepared: 05/16/16 09:13		Analyst: gza
Analyte	Result	MRL	Units	Dil	Analyzed
Zinc, Total	63	1.0	ug/l	5	05/17/16 23:02
					Qualifier



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U.S. Naval SPAWAR Systems Center Pacific
53475 Strothe Rd., Bldg. 111 Code 71760
San Diego CA, 92152

Date Received: 05/12/16 01:10

Date Reported: 05/26/16 15:13

6E12039-04		TO-EPC-80					
Sampled: 03/25/16 08:30		Sampled By: Molly, Gunther Rosen, Jacob Munson		Matrix: Water			
Metals - Low Level by 1600 Series Methods							
Method: EPA 1640		Batch: W6E0823		Prepared: 05/16/16 09:13		Analyst: gza	
Analyte	Result	MRL	Units	Dil	Analyzed	Qualifier	
Zinc, Total	120	2.0	ug/l	10	05/17/16 23:15		



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U.S. Naval SPAWAR Systems Center Pacific
53475 Strothe Rd., Bldg. 111 Code 71760
San Diego CA, 92152

Date Received: 05/12/16 01:10
Date Reported: 05/26/16 15:13

6E12039-05		TO-EPC-160			
Sampled: 03/25/16 08:30		Sampled By: Molly, Gunther Rosen, Jacob Munson			Matrix: Water
Metals - Low Level by 1600 Series Methods					
Method: EPA 1640		Batch: W6E0823		Prepared: 05/16/16 09:13	
		Analyst: gza			
Analyte	Result	MRL	Units	Dil	Analyzed
Zinc, Total	220	4.0	ug/l	20	05/17/16 23:29



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53475 Strothe Rd., Bldg. 111 Code 71760
San Diego CA, 92152

Date Received: 05/12/16 01:10
Date Reported: 05/26/16 15:13

6E12039-06		TO-EPC-320			
Sampled: 03/25/16 08:30		Sampled By: Molly, Gunther Rosen, Jacob Munson			Matrix: Water
Metals - Low Level by 1600 Series Methods					
Method: EPA 1640		Batch: W6E0823		Prepared: 05/16/16 09:13	
		Analyst: gza			
Analyte	Result	MRL	Units	Dil	Analyzed
Zinc, Total	480	10	ug/l	50	05/17/16 23:43



WECK LABORATORIES, INC.

Analytical Laboratory Service - Since 1964

U.S. Naval SPAWAR Systems Center Pacific
53475 Strothe Rd., Bldg. 111 Code 71760
San Diego CA, 92152

Date Received: 05/12/16 01:10
Date Reported: 05/26/16 15:13

6E12039-07		TO-EPC-1280	
Sampled: 03/25/16 08:30	Sampled By: Molly, Gunther Rosen, Jacob Munson		Matrix: Water
Metals - Low Level by 1600 Series Methods			
Method: EPA 1640	Batch: W6E0823	Prepared: 05/16/16 09:13	Analyst: gza
Analyte	Result	MRL	Units Dil Analyzed Qualifier
Zinc, Total	1900	200	ug/l 1000 05/17/16 23:56



WECK LABORATORIES, INC.

Analytical Laboratory Service - Since 1964

U.S. Naval SPAWAR Systems Center Pacific
53475 Strothe Rd., Bldg. 111 Code 71760
San Diego CA, 92152

Date Received: 05/12/16 01:10
Date Reported: 05/26/16 15:13

6E12039-08		TO-EPC-2560	
Sampled: 03/25/16 08:30	Sampled By: Molly, Gunther Rosen, Jacob Munson		Matrix: Water
Metals - Low Level by 1600 Series Methods			
Method: EPA 1640	Batch: W6E0823	Prepared: 05/16/16 09:13	Analyst: gza
Analyte	Result	MRL	Units
Zinc, Total	3900	200	ug/l
			Dil Analyzed
			1000 05/18/16 00:10
			Qualifier



WECK LABORATORIES, INC.

Analytical Laboratory Service - Since 1964

U.S. Naval SPAWAR Systems Center Pacific
53475 Strothe Rd., Bldg. 111 Code 71760
San Diego CA, 92152

Date Received: 05/12/16 01:10
Date Reported: 05/26/16 15:13

6E12039-09		TO-EPC-5120	
Sampled: 03/25/16 08:30	Sampled By: Molly, Gunther Rosen, Jacob Munson		Matrix: Water
Metals - Low Level by 1600 Series Methods			
Method: EPA 1640	Batch: W6E0823	Prepared: 05/16/16 09:13	Analyst: gza
Analyte	Result	MRL	Units Dil Analyzed Qualifier
Zinc, Total	7700	200	ug/l 1000 05/18/16 00:24



WECK LABORATORIES, INC.

Analytical Laboratory Service - Since 1964

U.S. Naval SPAWAR Systems Center Pacific
53475 Strothe Rd., Bldg. 111 Code 71760
San Diego CA, 92152

Date Received: 05/12/16 01:10
Date Reported: 05/26/16 15:13

6E12039-10		TO-EPC-10240	
Sampled: 03/25/16 08:30	Sampled By: Molly, Gunther Rosen, Jacob Munson		Matrix: Water
Metals - Low Level by 1600 Series Methods			
Method: EPA 1640	Batch: W6E0823	Prepared: 05/16/16 09:13	Analyst: gza
Analyte	Result	MRL	Units Dil Analyzed Qualifier
Zinc, Total	15000	200	ug/l 1000 05/18/16 00:37



WECK LABORATORIES, INC.

Analytical Laboratory Service - Since 1964

U.S. Naval SPAWAR Systems Center Pacific
53475 Strothe Rd., Bldg. 111 Code 71760
San Diego CA, 92152

Date Received: 05/12/16 01:10
Date Reported: 05/26/16 15:13

6E12039-11		TO-EPC-20180	
Sampled: 03/25/16 08:30		Sampled By: Molly, Gunther Rosen, Jacob Munson	
		Matrix: Water	
Metals - Low Level by 1600 Series Methods			
Method: EPA 1640		Batch: W6E0823	
		Prepared: 05/16/16 09:13	
		Analyst: gza	
Analyte	Result	MRL	Units
Zinc, Total	31000	400	ug/l
		Dil	Analyzed
		2000	05/18/16 00:51
		Qualifier	



WECK LABORATORIES, INC.

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U.S. Naval SPAWAR Systems Center Pacific
53475 Strothe Rd., Bldg. 111 Code 71760
San Diego CA, 92152

Date Received: 05/12/16 01:10
Date Reported: 05/26/16 15:13

QUALITY CONTROL SECTION

Page 14 of 16

Weck Laboratories, Inc 14859 East Clark Avenue, City of Industry, California 91745-1396 (626) 336-2139 FAX (626) 336-2634

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety

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WECK LABORATORIES, INC.

Analytical Laboratory Service - Since 1964

U.S. Naval SPAWAR Systems Center Pacific
53475 Strothe Rd., Bldg. 111 Code 71760
San Diego CA, 92152

Date Received: 05/12/16 01:10
Date Reported: 05/26/16 15:13

Metals - Low Level by 1600 Series Methods - Quality Control**Batch W6E0823 - EPA 1640**

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	% REC Limits	RPD	RPD Limit	Data Qualifiers
Blank (W6E0823-BLK1)				Analyzed: 05/17/16 19:50						
Zinc, Total	ND	0.20	ug/l							
LCS (W6E0823-BS1)				Analyzed: 05/17/16 20:03						
Zinc, Total	10.0	0.20	ug/l	10.0		100	75-127			
Matrix Spike (W6E0823-MS1)				Source: 6E10043-01 Analyzed: 05/17/16 20:17						
Zinc, Total	29.0	0.20	ug/l	10.0	20.2	89	68-132			
Matrix Spike (W6E0823-MS2)				Source: 6E12039-01 Analyzed: 05/17/16 20:44						
Zinc, Total	16.4	0.20	ug/l	10.0	6.09	103	68-132			
Matrix Spike Dup (W6E0823-MSD1)				Source: 6E10043-01 Analyzed: 05/17/16 20:31						
Zinc, Total	29.5	0.20	ug/l	10.0	20.2	94	68-132	2	30	
Matrix Spike Dup (W6E0823-MSD2)				Source: 6E12039-01 Analyzed: 05/17/16 20:58						
Zinc, Total	16.4	0.20	ug/l	10.0	6.09	103	68-132	0.09	30	



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Analytical Laboratory Service - Since 1964

U.S. Naval SPAWAR Systems Center Pacific
53475 Strothe Rd., Bldg. 111 Code 71760
San Diego CA, 92152

Date Received: 05/12/16 01:10
Date Reported: 05/26/16 15:13

Notes and Definitions

ND	NOT DETECTED at or above the Method Reporting Limit (MRL). If Method Detection Limit (MDL) is reported, then not detected at or above the MDL.
NR	Not Reportable
Dil	Dilution
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference
% Rec	Percent Recovery
Sub	Subcontracted analysis, original report available upon request
MDL	Method Detection Limit
MDA	Minimum Detectable Activity
MRL	Method Reporting Limit

Any remaining sample(s) will be disposed of one month from the final report date unless other arrangements are made in advance.

An Absence of Total Coliform meets the drinking water standards as established by the California Department of Health Services.

The Reporting Limit (RL) is referenced as the Laboratory's Practical Quantitation Limit (PQL) or the Detection Limit for Reporting Purposes (DLR).

All samples collected by Weck Laboratories have been sampled in accordance to laboratory SOP Number MIS002.

Page 16 of 16

Weck Laboratories, Inc 14859 East Clark Avenue, City of Industry, California 91745-1396 (626) 336-2139 FAX (626) 336-2634
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EnviroMatrix



Analytical, Inc.

29 December 2015

Nautilus Environmental, LLC
Attn: Kellyn Lupfer
4340 Vandever Avenue
San Diego, CA 92120

EMA Log #: 15L0512

Project Name: SPAWAR-Pulsed

Enclosed are the results of analyses for samples received by the laboratory on 12/15/15 10:30. Samples were analyzed pursuant to client request utilizing EPA or other ELAP approved methodologies. I certify that this data is in compliance both technically and for completeness.

A handwritten signature in black ink, appearing to read 'Dan Verdon'.

Dan Verdon
Laboratory Director

CA ELAP Certification #: 2564

4340 Viewridge Avenue, Suite A - San Diego, California 92123 - (858) 560-7717 - Fax (858) 560-7763
Analytical Chemistry Laboratory

Client Name: Nautilus Environmental, LLC
Project Name: SPAWAR-Pulsed

EMA Log #: 15L0512

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
1-Zn (TO-MPC-0)	15L0512-01	Seawater	12/10/15 00:00	12/15/15 10:30
2-Zn (TO-MPC-125)	15L0512-02	Seawater	12/10/15 00:00	12/15/15 10:30
3-Zn (TO-MPC-250)	15L0512-03	Seawater	12/10/15 00:00	12/15/15 10:30
4-Zn (TO-MPC-500)	15L0512-04	Seawater	12/10/15 00:00	12/15/15 10:30
5-Zn (TO-MPC-1000)	15L0512-05	Seawater	12/10/15 00:00	12/15/15 10:30
6-Zn (TO-MPC-2000)	15L0512-06	Seawater	12/10/15 00:00	12/15/15 10:30
7-Zn (TO-MPC-4000)	15L0512-07	Seawater	12/10/15 00:00	12/15/15 10:30
8-Zn (TO-MPC-8000)	15L0512-08	Seawater	12/10/15 00:00	12/15/15 10:30
9-Zn (TO-MPC-16000)	15L0512-09	Seawater	12/10/15 00:00	12/15/15 10:30
10-Zn (TO-EPC-0)	15L0512-10	Seawater	12/10/15 00:00	12/15/15 10:30
11-Zn (TO-EC-20)	15L0512-11	Seawater	12/10/15 00:00	12/15/15 10:30
12-Zn (TO-EC-40)	15L0512-12	Seawater	12/10/15 00:00	12/15/15 10:30
13-Zn (TO-EC-80)	15L0512-13	Seawater	12/10/15 00:00	12/15/15 10:30
14-Zn (TO-EPC-160)	15L0512-14	Seawater	12/10/15 00:00	12/15/15 10:30
15-Zn (TO-EPC-320)	15L0512-15	Seawater	12/10/15 00:00	12/15/15 10:30
16-Zn (TO-EP-640)	15L0512-16	Seawater	12/10/15 00:00	12/15/15 10:30
17-Zn (TO-EP-1280)	15L0512-17	Seawater	12/10/15 00:00	12/15/15 10:30
18-Zn (TO-EP-2560)	15L0512-18	Seawater	12/10/15 00:00	12/15/15 10:30
19-Zn (TO-EP-5120)	15L0512-19	Seawater	12/10/15 00:00	12/15/15 10:30
20-Zn (T96-EP3-0)	15L0512-20	Seawater	12/14/15 00:00	12/15/15 10:30

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

EnviroMatrix  Analytical, Inc.

Client Name: Nautilus Environmental, LLC
Project Name: SPAWAR-Pulsed

EMA Log #: 15L0512

Total Metals by EPA 6000/7000 Series Methods

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
1-Zn (TO-MPC-0) (15L0512-01) Seawater Sampled: 12/10/15 00:00 Received: 12/15/15 10:30										
Zinc	0.013	0.008	0.100	mg/l	2	5122346	12/23/15	12/28/15	EPA 6010	J
2-Zn (TO-MPC-125) (15L0512-02) Seawater Sampled: 12/10/15 00:00 Received: 12/15/15 10:30										
Zinc	0.100	0.008	0.100	mg/l	2	5122346	12/23/15	12/28/15	EPA 6010	
3-Zn (TO-MPC-250) (15L0512-03) Seawater Sampled: 12/10/15 00:00 Received: 12/15/15 10:30										
Zinc	0.180	0.008	0.100	mg/l	2	5122346	12/23/15	12/28/15	EPA 6010	
4-Zn (TO-MPC-500) (15L0512-04) Seawater Sampled: 12/10/15 00:00 Received: 12/15/15 10:30										
Zinc	0.398	0.008	0.100	mg/l	2	5122346	12/23/15	12/28/15	EPA 6010	
5-Zn (TO-MPC-1000) (15L0512-05) Seawater Sampled: 12/10/15 00:00 Received: 12/15/15 10:30										
Zinc	0.753	0.008	0.100	mg/l	2	5122346	12/23/15	12/28/15	EPA 6010	
6-Zn (TO-MPC-2000) (15L0512-06) Seawater Sampled: 12/10/15 00:00 Received: 12/15/15 10:30										
Zinc	1.52	0.008	0.100	mg/l	2	5122346	12/23/15	12/28/15	EPA 6010	
7-Zn (TO-MPC-4000) (15L0512-07) Seawater Sampled: 12/10/15 00:00 Received: 12/15/15 10:30										
Zinc	3.28	0.008	0.100	mg/l	2	5122346	12/23/15	12/28/15	EPA 6010	
8-Zn (TO-MPC-8000) (15L0512-08) Seawater Sampled: 12/10/15 00:00 Received: 12/15/15 10:30										
Zinc	5.43	0.008	0.100	mg/l	2	5122346	12/23/15	12/28/15	EPA 6010	
9-Zn (TO-MPC-16000) (15L0512-09) Seawater Sampled: 12/10/15 00:00 Received: 12/15/15 10:30										
Zinc	16.7	0.008	0.100	mg/l	2	5122346	12/23/15	12/28/15	EPA 6010	

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

EnviroMatrix



Analytical, Inc.

Client Name: Nautilus Environmental, LLC
Project Name: SPAWAR-Pulsed

EMA Log #: 15L0512

Total Metals by EPA 6000/7000 Series Methods

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
10-Zn (TO-EPC-0) (15L0512-10) Seawater Sampled: 12/10/15 00:00 Received: 12/15/15 10:30										
Zinc	ND	0.008	0.100	mg/l	2	5122346	12/23/15	12/28/15	EPA 6010	
11-Zn (TO-EC-20) (15L0512-11) Seawater Sampled: 12/10/15 00:00 Received: 12/15/15 10:30										
Zinc	0.032	0.008	0.100	mg/l	2	5122346	12/23/15	12/28/15	EPA 6010	J
12-Zn (TO-EC-40) (15L0512-12) Seawater Sampled: 12/10/15 00:00 Received: 12/15/15 10:30										
Zinc	0.030	0.008	0.100	mg/l	2	5122346	12/23/15	12/28/15	EPA 6010	J
13-Zn (TO-EC-80) (15L0512-13) Seawater Sampled: 12/10/15 00:00 Received: 12/15/15 10:30										
Zinc	0.059	0.008	0.100	mg/l	2	5122346	12/23/15	12/28/15	EPA 6010	J
14-Zn (TO-EPC-160) (15L0512-14) Seawater Sampled: 12/10/15 00:00 Received: 12/15/15 10:30										
Zinc	0.116	0.008	0.100	mg/l	2	5122346	12/23/15	12/28/15	EPA 6010	
15-Zn (TO-EPC-320) (15L0512-15) Seawater Sampled: 12/10/15 00:00 Received: 12/15/15 10:30										
Zinc	0.252	0.008	0.100	mg/l	2	5122346	12/23/15	12/28/15	EPA 6010	
16-Zn (TO-EP-640) (15L0512-16) Seawater Sampled: 12/10/15 00:00 Received: 12/15/15 10:30										
Zinc	0.479	0.008	0.100	mg/l	2	5122346	12/23/15	12/28/15	EPA 6010	
17-Zn (TO-EP-1280) (15L0512-17) Seawater Sampled: 12/10/15 00:00 Received: 12/15/15 10:30										
Zinc	0.932	0.008	0.100	mg/l	2	5122346	12/23/15	12/28/15	EPA 6010	
18-Zn (TO-EP-2560) (15L0512-18) Seawater Sampled: 12/10/15 00:00 Received: 12/15/15 10:30										
Zinc	1.88	0.008	0.100	mg/l	2	5122346	12/23/15	12/28/15	EPA 6010	

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EnviroMatrix



Analytical, Inc.

Client Name: Nautilus Environmental, LLC
Project Name: SPAWAR-Pulsed

EMA Log #: 15L0512

Total Metals by EPA 6000/7000 Series Methods

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
19-Zn (TO-EP-5120) (15L0512-19) Seawater Sampled: 12/10/15 00:00 Received: 12/15/15 10:30										
Zinc	3.90	0.008	0.100	mg/l	2	5122346	12/23/15	12/28/15	EPA 6010	
20-Zn (T96-EP3-0) (15L0512-20) Seawater Sampled: 12/14/15 00:00 Received: 12/15/15 10:30										
Zinc	ND	0.008	0.100	mg/l	2	5122346	12/23/15	12/28/15	EPA 6010	

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

EnviroMatrix  Analytical, Inc.

Client Name: Nautilus Environmental, LLC
Project Name: SPAWAR-Pulsed

EMA Log #: 15L0512

Total Metals by EPA 6000/7000 Series Methods - Quality Control

Analyte	Result	MDL	Reporting Limit	Units	Spike Level	Source Result	%REC Limits	RPD	RPD Limit	Notes
Batch 5122346										
Blank (5122346-BLK1)					Prepared: 12/23/15 Analyzed: 12/28/15					
Zinc	ND	0.004	0.050	mg/l						
LCS (5122346-BS1)					Prepared: 12/23/15 Analyzed: 12/28/15					
Zinc	1.04	0.004	0.050	mg/l	1.00	104	75-125			
Duplicate (5122346-DUP1)			Source: 15L0512-06		Prepared: 12/23/15 Analyzed: 12/28/15					
Zinc	1.69	0.008	0.100	mg/l	1.52			11	20	

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

EnviroMatrix



Analytical, Inc.

Client Name: Nautilus Environmental, LLC
Project Name: SPAWAR-Pulsed

EMA Log #: 15L0512

Notes and Definitions

J	Detected but below the Reporting Limit; therefore, result is an estimated concentration (CLP J-Flag).
ND	Analyte NOT DETECTED at or above the reporting limit (or method detection limit when specified)
NR	Not Reported
dry	Sample results reported on a dry weight basis (if indicated in units column)
RPD	Relative Percent Difference
MDL	Method detection limit (indicated per client's request)

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

EnviroMatrix  Analytical, Inc.

Page 7 of 7

CHAIN-OF-CUSTODY RECORD

EMA LOG #:				
Client: Nautilus Environmental / SPAWAR				
Attn: Kellyn Lopez				
Sampler(s): Mally Colvin				
Address:				
Phone: 858-587-7333 x 211 Fax:				
Email: Kellyn@nautilusenvironmental.com				
Billing Address:				
Project ID: SPAWAR-NISEP				
Project #:				
ID #	Client Sample ID	Sample Date	Sample Matrix	Container # / Type
1	3-Zn (TO-MC-0)	12/10/15	SW	ADCF
2	2-Zn (TO-MC-125)	12/10/15	SW	
3	3-Zn (TO-MC-250)	12/10/15	SW	
4	4-Zn (TO-MC-500)	12/10/15	SW	
5	5-Zn (TO-MC-1000)	12/10/15	SW	
6	6-Zn (TO-MC-2000)	12/10/15	SW	
7	7-Zn (TO-MC-4000)	12/10/15	SW	
8	8-Zn (TO-MC-8000)	12/10/15	SW	
9	9-Zn (TO-MC-16000)	12/10/15	SW	
10	10-Zn (TO-MC-0)	12/10/15	SW	

Matrix Codes: A = Air, DW = Drinking Water, GW = Groundwater, SW = Storm Water
W = Wastewater, S = Soil, SED = Sediment, SD = Solid, T = Tissue, O = Oil, L = Liquid
Shipped By: ☐ Courier, ☐ UPS, ☐ FedEx, ☐ USPS, ☐ Client Drop Off or Other

Turn-Around Time: ☐ Same Day, ☐ 1 day, ☐ 2 day, ☐ 3 day, ☐ 4 day, ☐ 5 day, ☐ 7 day, ☐ 10 day

Reporting Requirements: ☐ Fax, ☐ PDF, ☐ Excel, ☐ Gettrack/EDF, ☐ Hard Copy, ☐ EDT

Sample Disposal: ☐ By Laboratory, ☐ Return to Client, ☐ PO or Delivery, ☐ Archive

Sample Integrity

Correct Containers: ☐ No, ☒ N/A

Canopy Seals Intact: Yes, ☐ No, ☒ N/A

COC/Labels Agree: Yes, ☐ No, ☒ N/A

Sampled By: ☒ EMA, ☐ Autosampler

Project/Sample Comments: SW = Subwater

Additional costs may apply. Please note there is a \$35 minimum charge for all clients.

EMA reserves the right to return any samples that do not match our waste profile.

NOTE: By relinquishing samples to EMA, Inc., client agrees to pay for the services requested on this CCC form and any additional analyses performed on this project. Payment for services is due within 30 days from date of invoice. Samples will be disposed of 7 days after report has been finalized unless otherwise noted. All work is subject to EMA's terms and conditions.

4340 Viewridge Ave., Ste. A - San Diego, CA 92123 - Phone (858) 560-7717 - Fax (858) 560-7763

CHAIN-OF-CUSTODY RECORD

EMA LOG #: 1510512

Client: Nacthus Environmental / SPANAR

Attn: Kellyn Cooper

Sampler(s): Molly Colvin

Address:

Phone: 858-587-7333 x 211 Fax:

Email: 858-587-7333 x 211 Kellyn@nacthusenvironmental.com

Billing Address:

Project ID: SPANAR - Palsod

Project #:

ID#	Client Sample ID	Sample Date	Sample Time	Sample Matrix	Container # / Type
1	11-Zn (To-EC-20)	12/10/15	SW	SW	400
2	12-Zn (To-EC-40)	12/10/15	SW	SW	400
3	13-Zn (To-EC-80)	12/10/15	SW	SW	400
4	14-Zn (To-EP-160)	12/10/15	SW	SW	400
5	15-Zn (To-EP-320)	12/10/15	SW	SW	400
6	16-Zn (To-EP-640)	12/10/15	SW	SW	400
7	17-Zn (To-EP-1280)	12/10/15	SW	SW	400
8	18-Zn (To-EP-2560)	12/10/15	SW	SW	400
9	19-Zn (To-EP-5120)	12/10/15	SW	SW	400
10	20-Zn (To-EP-10240)	12/10/15	SW	SW	400

Matrix Codes: A = Air, DW = Drinking Water, GW = Groundwater, SW = Storm Water
 WW = Wastewater S = Soil, SED = Sediment, SD = Solid, T = Tissue, O = Oil, L = Liquid

Shipped By: ☒ Courier ☐ UPS ☐ FedEx ☐ USPS ☐ Client Drop Off ☐ Other

Turn-Around-Time: ☐ Same Day ☐ 1 day ☐ 2 day ☐ 3 day ☐ 5 day ☐ 7 day ☐ 10 day

Reporting Requirements: ☐ Full ☐ Partial ☐ Expedited ☐ Contractor/EDF ☐ Hard Copy ☐ EDT

Sample Disposal: ☐ By Laboratory ☐ Return to Client ☐ PU or Delivery ☐ Archive

Correct Container: ☒ No ☐ Yes

Custody Seals Intact: ☒ Yes ☐ No

LOU Labels Agreed: ☒ Yes ☐ No

Sample Integrity: ☒ Preserved ☐ No

Temp @ Receipt: 20.0°C

Sampled By: ☒ EMA Autosampler

Project/Sample Comments: SW = saltwater

Requested Analysis		RELINQUISHED BY	DATE/TIME	RECEIVED BY
8015 (TPH) ☐ Gas ☐ Diesel ☐ Ext	☐	Signature: ☐	12-15-15	Signature: ☐
624/8260 (VOC) Full BTXE MTBE Oxy Nap	☐	Print: ☐	1030	Print: ☐
625 / 8270 (SVOC) ☐ PAH only	☐	Company: ☐		Company: ☐
608 / 8081 (Organochlorine Pesticides)	☐	Signature: ☐		Signature: ☐
608 / 8082 (Polychlorinated Biphenyls)	☐	Print: ☐		Print: ☐
8141 (Organophosphorus Pesticides)	☐	Company: ☐		Company: ☐
TBT (Organotin Compounds)	☐	Signature: ☐		Signature: ☐
pH ☐ EC ☐ TSS ☐ TDS	☐	Print: ☐		Print: ☐
Nitrate ☐ Nitrite ☐ TKN ☐ NH3	☐	Company: ☐		Company: ☐
CAC Title 22/CAM17 Metals ☐ TLIC ☐ STLC	☐	Signature: ☐		Signature: ☐
TCAP (RCRA) ☐ Metals ☐ Organics	☐	Print: ☐		Print: ☐
Cd ☐ Cr ☐ Cu ☐ Pb ☐ Ni ☐ Ag ☐ Zn ☐ Dissolved	☐	Company: ☐		Company: ☐
Coliform, ☐ Total (MTF) ☐ Fecal (MTF)	☐	Signature: ☐		Signature: ☐
Coliform, T+E, Coli ☐ P/A ☐ Enumeration	☐	Print: ☐		Print: ☐
Heterococcus, ☐ MTF ☐ Enterolift	☐	Company: ☐		Company: ☐
BOD ☐ COD ☐ Cyanide	☐	Signature: ☐		Signature: ☐
Normal Concentration (PPB)	☐	Print: ☐		Print: ☐

Additional costs may apply. Please note there is a \$35 minimum charge for all clients.
 EMA reserves the right to return any samples that do not match our waste profile.
 NOTE: By relinquishing samples to EMA, Inc., client agrees to pay for the services requested on this COC form and any additional analyses performed on this project. Payment for services is due within 30 days from date of invoice. Samples will be disposed of 7 days after report has been finalized unless otherwise noted. All work is subject to EMA's terms and conditions.



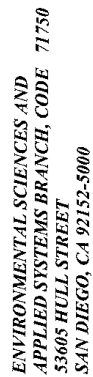
ENVIRONMENTAL SCIENCES AND
APPLIED SYSTEMS BRANCH, CODE 71750
53605 HULL STREET
SAN DIEGO, CA 92152-5000

Systems Center
San Diego

Chain of Custody Record

Date: 5/4/2018
Page: 1 of 1

Project Title/Project Number: Derivative Sea Urchin Pilsod Zinc Toxicity Tes				Project Leader:				
Remarks/Air Bill:				Contact:				
Sampler(s): (Signature) Kelly Colvin, Genter Rosen, Jacob Hanson				Contact Tel:				
Tel:		Fax:		Email:				
Special Instructions: Analysis @ Wack				Requested Analyses				
Field Sample Identification	Date	Time	Matrix	Type Container	Collection Temp (°C)	Arrival Temp (°C)	U N	7/6m vial primary
TO-EPC - 0	March 25, 2016	0830	Seawater	HDPE			X	0
TO-EPC - 20							X	20
TO-EPC - 40							X	40
TO-EPC - 80							X	80
TO-EPC - 160							X	160
TO-EPC - 320							X	320
TO-EPC - 1280							X	1280
TO-EPC - 2560							X	2560
TO-EPC - 5120							X	5120
TO-EPC - 10240							X	10240
TO-EPC - 20480	March 25, 2016	0830	Seawater	HDPE			X	20480
Relinquished by: (Signature) [Signature]				Received by: (Signature)		Date: 5/10/2018		Time: 1000
Relinquished by: (Signature) [Signature]				Received by: (Signature)		Date:		Time:



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Date: 5/4/2018
Page: of

**Systems Center
San Diego**

[illegible]

APPENDIX B
TEST DATA AND STATISTICAL SUMMARIES
MIXED METAL EXPOSURES

OVERVIEW

Items included are included in Appendix B:

1. Mixed Metal Exposures – Mysid Shrimp B-2
2. Mixed Metal Exposures – Reference Toxicant Test Results B-47
3. Mixed Metal Exposures –Analytical Chemistry Reports B-59

B.1. MIXED METAL EXPOSURES – MYSID SHRIMP:

CETIS Summary Report

Report Date: 02 Jun-16 16:16 (p 1 of 1)

Test Code: 5DB7B3EC | 15-7232-0236

Americamysis 96-h Acute Survival Test							SPAWAR Systems Center				
Batch ID:	18-0018-1674	Test Type:	Survival (96h)				Analyst:	Marianne A Colvin			
Start Date:	29 Apr-16 09:00	Protocol:	EPA/821/R-02-012 (2002)				Diluent:	Laboratory Seawater			
Ending Date:	03 May-16 09:00	Species:	Americamysis bahia				Brine:	Not Applicable			
Duration:	96h	Source:	Aquatic Research Organisms, NH				Age:	5			
Sample ID:	16-2835-5904	Code:	610EBD40				Client:	SPAWAR			
Sample Date:	29 Apr-16	Material:	Copper sulfate				Project:	Pulsed Exposure			
Receive Date:	29 Apr-16	Source:	Pulsed Exposure								
Sample Age:	9h	Station:	3 Hour								
Comparison Summary											
Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method				
06-2690-6167	96h Survival Rate	350	880	555	22.1%		Steel Many-One Rank Sum Test				
Point Estimate Summary											
Analysis ID	Endpoint	Level	µg/L	95% LCL	95% UCL	TU	Method				
05-4119-8838	96h Survival Rate	LC50	832.1	661.1	1029		Linear Regression (MLE)				
96h Survival Rate Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
1.6	Lab Control	4	1	1	1	1	1	0	0	0.0%	0.0%
190		4	1	1	1	1	1	0	0	0.0%	0.0%
350		4	1	1	1	1	1	0	0	0.0%	0.0%
880		4	0.3	0	0.7109	0	0.6	0.1291	0.2582	86.07%	70.0%
1500		4	0.15	0	0.4547	0	0.4	0.09574	0.1915	127.7%	85.0%
3100		4	0.05	0	0.2091	0	0.2	0.05	0.1	200.0%	95.0%
96h Survival Rate Detail											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
1.6	Lab Control	1	1	1	1						
190		1	1	1	1						
350		1	1	1	1						
880		0.6	0.2	0	0.4						
1500		0.4	0.2	0	0						
3100		0	0.2	0	0						
96h Survival Rate Binomials											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
1.6	Lab Control	5/5	5/5	5/5	5/5						
190		5/5	5/5	5/5	5/5						
350		5/5	5/5	5/5	5/5						
880		3/5	1/5	0/5	2/5						
1500		2/5	1/5	0/5	0/5						
3100		0/5	1/5	0/5	0/5						

CETIS Summary Report

Report Date: 02 Jun-16 16:16 (p 1 of 1)
 Test Code: 5DB7B3EC | 15-7232-0236

Americamysis 96-h Acute Survival Test								SPAWAR Systems Center			
Batch ID:	18-0018-1674	Test Type:	Survival (96h)				Analyst:	Marianne A Colvin			
Start Date:	29 Apr-16 09:00	Protocol:	EPA/821/R-02-012 (2002)				Diluent:	Laboratory Seawater			
Ending Date:	03 May-16 09:00	Species:	Americamysis bahia				Brine:	Not Applicable			
Duration:	96h	Source:	Aquatic Research Organisms, NH				Age:	5			
Sample ID:	16-2835-5904	Code:	610EBD40				Client:	SPAWAR			
Sample Date:	29 Apr-16	Material:	Copper sulfate				Project:	Pulsed Exposure			
Receive Date:	29 Apr-16	Source:	Pulsed Exposure								
Sample Age:	9h	Station:	3 Hour								
Comparison Summary											
Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method				
06-2690-6167	96h Survival Rate	350	880	555	22.1%		Steel Many-One Rank Sum Test				
Point Estimate Summary											
Analysis ID	Endpoint	Level	µg/L	95% LCL	95% UCL	TU	Method				
05-4119-8838	96h Survival Rate	LC50	832.1	661.1	1029		Linear Regression (MLE)				
96h Survival Rate Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	% Effect
1.6	Lab Control	4	1	1	1	1	1	0	0	0.0%	0.0%
190		4	1	1	1	1	1	0	0	0.0%	0.0%
350		4	1	1	1	1	1	0	0	0.0%	0.0%
880		4	0.3	0	0.7109	0	0.6	0.1291	0.2582	86.07%	70.0%
1500		4	0.15	0	0.4547	0	0.4	0.09574	0.1915	127.7%	85.0%
3100		4	0.05	0	0.2091	0	0.2	0.05	0.1	200.0%	95.0%
96h Survival Rate Detail											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
1.6	Lab Control	1	1	1	1						
190		1	1	1	1						
350		1	1	1	1						
880		0.6	0.2	0	0.4						
1500		0.4	0.2	0	0						
3100		0	0.2	0	0						
96h Survival Rate Binomials											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
1.6	Lab Control	5/5	5/5	5/5	5/5						
190		5/5	5/5	5/5	5/5						
350		5/5	5/5	5/5	5/5						
880		3/5	1/5	0/5	2/5						
1500		2/5	1/5	0/5	0/5						
3100		0/5	1/5	0/5	0/5						

000-010-187-1

CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Analytical Report

Report Date: 02 Jun-16 16:16 (p 1 of 2)
Test Code: 5DB7B3EC | 15-7232-0236

Americamysis 96-h Acute Survival Test						SPAWAR Systems Center					
Analysis ID:	06-2690-6167		Endpoint:	96h Survival Rate			CETIS Version:	CETISv1.8.7			
Analyzed:	28 May-16 10:37		Analysis:	Nonparametric-Control vs Treatments			Official Results:	Yes			
Batch ID:	18-0018-1674		Test Type:	Survival (96h)			Analyst:	Marianne A Colvin			
Start Date:	29 Apr-16 09:00		Protocol:	EPA/821/R-02-012 (2002)			Diluent:	Laboratory Seawater			
Ending Date:	03 May-16 09:00		Species:	Americamysis bahia			Brine:	Not Applicable			
Duration:	96h		Source:	Aquatic Research Organisms, NH			Age:	5			
Sample ID:	16-2835-5904		Code:	610EBD40			Client:	SPAWAR			
Sample Date:	29 Apr-16		Material:	Copper sulfate			Project:	Pulsed Exposure			
Receive Date:	29 Apr-16		Source:	Pulsed Exposure							
Sample Age:	9h		Station:	3 Hour							
Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	NOEL	LOEL	TOEL	TU		
Angular (Corrected)	NA	C > T	NA	NA	22.1%	350	880	555			
Steel Many-One Rank Sum Test											
Control	vs	C-µg/L	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)		
1.6		190	18	10	1	6	0.8333	Asymp	Non-Significant Effect		
1.6		350	18	10	1	6	0.8333	Asymp	Non-Significant Effect		
1.6		880*	10	10	0	6	0.0417	Asymp	Significant Effect		
1.6		1500*	10	10	0	6	0.0417	Asymp	Significant Effect		
1.6		3100*	10	10	0	6	0.0417	Asymp	Significant Effect		
ANOVA Table											
Source	Sum Squares		Mean Square		DF	F Stat	P-Value	Decision(α:5%)			
Between	5.332822		1.066564		5	44.49	<0.0001	Significant Effect			
Error	0.4314847		0.02397137		18						
Total	5.764307				23						
Distributional Tests											
Attribute	Test		Test Stat	Critical	P-Value	Decision(α:1%)					
Variances	Mod Levene Equality of Variance		5.407	4.248	0.0033	Unequal Variances					
Variances	Levene Equality of Variance		8.241	4.248	0.0003	Unequal Variances					
Distribution	Shapiro-Wilk W Normality		0.8778	0.884	0.0075	Non-normal Distribution					
96h Survival Rate Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
1.6	Lab Control	4	1	1	1	1	1	1	0	0.0%	0.0%
190		4	1	1	1	1	1	1	0	0.0%	0.0%
350		4	1	1	1	1	1	1	0	0.0%	0.0%
880		4	0.3	0	0.7109	0.3	0	0.6	0.1291	86.07%	70.0%
1500		4	0.15	0	0.4547	0.1	0	0.4	0.09574	127.7%	85.0%
3100		4	0.05	0	0.2091	0	0	0.2	0.05	200.0%	95.0%
Angular (Corrected) Transformed Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
1.6	Lab Control	4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
190		4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
350		4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
880		4	0.565	0.1122	1.018	0.5742	0.2255	0.8861	0.1423	50.37%	58.0%
1500		4	0.3998	0.04881	0.7509	0.3446	0.2255	0.6847	0.1103	55.17%	70.28%
3100		4	0.285	0.09558	0.4745	0.2255	0.2255	0.4636	0.05953	41.77%	78.81%

CETIS Analytical Report

Report Date: 02 Jun-16 16:16 (p 2 of 2)
 Test Code: 5DB7B3EC | 15-7232-0236

Americamysis 96-h Acute Survival Test					SPAWAR Systems Center
Analysis ID:	06-2690-6167	Endpoint:	96h Survival Rate	CETIS Version:	CETISv1.8.7
Analyzed:	28 May-16 10:37	Analysis:	Nonparametric-Control vs Treatments	Official Results:	Yes
96h Survival Rate Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
1.6	Lab Control	1	1	1	1
190		1	1	1	1
350		1	1	1	1
880		0.6	0.2	0	0.4
1500		0.4	0.2	0	0
3100		0	0.2	0	0
Angular (Corrected) Transformed Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
1.6	Lab Control	1.345	1.345	1.345	1.345
190		1.345	1.345	1.345	1.345
350		1.345	1.345	1.345	1.345
880		0.8861	0.4636	0.2255	0.6847
1500		0.6847	0.4636	0.2255	0.2255
3100		0.2255	0.4636	0.2255	0.2255
96h Survival Rate Binomials					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
1.6	Lab Control	5/5	5/5	5/5	5/5
190		5/5	5/5	5/5	5/5
350		5/5	5/5	5/5	5/5
880		3/5	1/5	0/5	2/5
1500		2/5	1/5	0/5	0/5
3100		0/5	1/5	0/5	0/5
Graphics					
The left plot shows the 96h Survival Rate (y-axis, 0.0 to 1.0) versus C-µg/L (x-axis, 1.6 LC to 3100). The survival rate is 1.0 for 1.6 LC, 190, and 350 µg/L. It drops to approximately 0.6 for 880 µg/L, 0.4 for 1500 µg/L, and 0.2 for 3100 µg/L. The right plot shows the Angular (Corrected) Transformed (y-axis, -0.35 to 0.35) versus Results (x-axis, -2.0 to 2.0). The data points follow a linear trend, indicating a significant difference between the control and treatment groups.					

CETIS Analytical Report

Report Date: 02 Jun-16 16:16 (p 1 of 2)
 Test Code: 5DB7B3EC | 15-7232-0236

Americamysis 96-h Acute Survival Test						SPAWAR Systems Center					
Analysis ID: 05-4119-8838		Endpoint: 96h Survival Rate				CETIS Version: CETISv1.8.7					
Analyzed: 28 May-16 10:37		Analysis: Linear Regression (MLE)				Official Results: Yes					
Batch ID: 18-0018-1674		Test Type: Survival (96h)				Analyst: Marianne A Colvin					
Start Date: 29 Apr-16 09:00		Protocol: EPA/821/R-02-012 (2002)				Diluent: Laboratory Seawater					
Ending Date: 03 May-16 09:00		Species: Americamysis bahia				Brine: Not Applicable					
Duration: 96h		Source: Aquatic Research Organisms, NH				Age: 5					
Sample ID: 16-2835-5904		Code: 610EBD40				Client: SPAWAR					
Sample Date: 29 Apr-16		Material: Copper sulfate				Project: Pulsed Exposure					
Receive Date: 29 Apr-16		Source: Pulsed Exposure									
Sample Age: 9h		Station: 3 Hour									
Linear Regression Options											
Model Function			Threshold Option		Threshold	Optimized	Pooled	Het Corr	Weighted		
Log-Normal [NED=A+B*log(X)]			Control Threshold		1E-07	No	No	No	Yes		
Regression Summary											
Iters	LL	AICc	BIC	Mu	Sigma	Adj R2	F Stat	Critical	P-Value	Decision(α:5%)	
9	-27.93	60.43	62.22	2.92	0.2444	0.6615	6.851	2.928	0.0016	Significant Lack of Fit	
Point Estimates											
Level	µg/L	95% LCL	95% UCL								
LC50	832.1	661.1	1029								
Regression Parameters											
Parameter	Estimate	Std Error	95% LCL	95% UCL	t Stat	P-Value	Decision(α:5%)				
Slope	4.092	0.7023	2.716	5.469	5.827	<0.0001	Significant Parameter				
Intercept	-11.95	2.081	-16.03	-7.872	-5.744	<0.0001	Significant Parameter				
ANOVA Table											
Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)					
Model	64.45606	64.45606	1	45.95	<0.0001	Significant					
Lack of Fit	18.6247	4.656175	4	6.851	0.0016	Significant					
Pure Error	12.23353	0.679640	18								
Residual	30.85822	1.402647	22								
Residual Analysis											
Attribute	Method			Test Stat	Critical	P-Value	Decision(α:5%)				
Goodness-of-Fit	Pearson Chi-Sq GOF			30.86	33.92	0.0991	Non-Significant Heterogenity				
	Likelihood Ratio GOF			20.66	33.92	0.5420	Non-Significant Heterogenity				
Variances	Mod Levene Equality of Variance			1.241	2.773	0.3313	Equal Variances				
Distribution	Shapiro-Wilk W Normality			0.7939	0.9169	0.0002	Non-normal Distribution				
	Anderson-Darling A2 Normality			1.86	2.492	<0.0001	Non-normal Distribution				
96h Survival Rate Summary											
			Calculated Variate(A/B)								
C-µg/L	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
1.6	Lab Control	4	1	1	1	0	0	0.0%	0.0%	20	20
190		4	1	1	1	0	0	0.0%	0.0%	20	20
350		4	1	1	1	0	0	0.0%	0.0%	20	20
880		4	0.3	0	0.6	0.1291	0.2582	86.07%	70.0%	6	20
1500		4	0.15	0	0.4	0.09574	0.1915	127.7%	85.0%	3	20
3100		4	0.05	0	0.2	0.05	0.1	200.0%	95.0%	1	20

CETIS Analytical Report

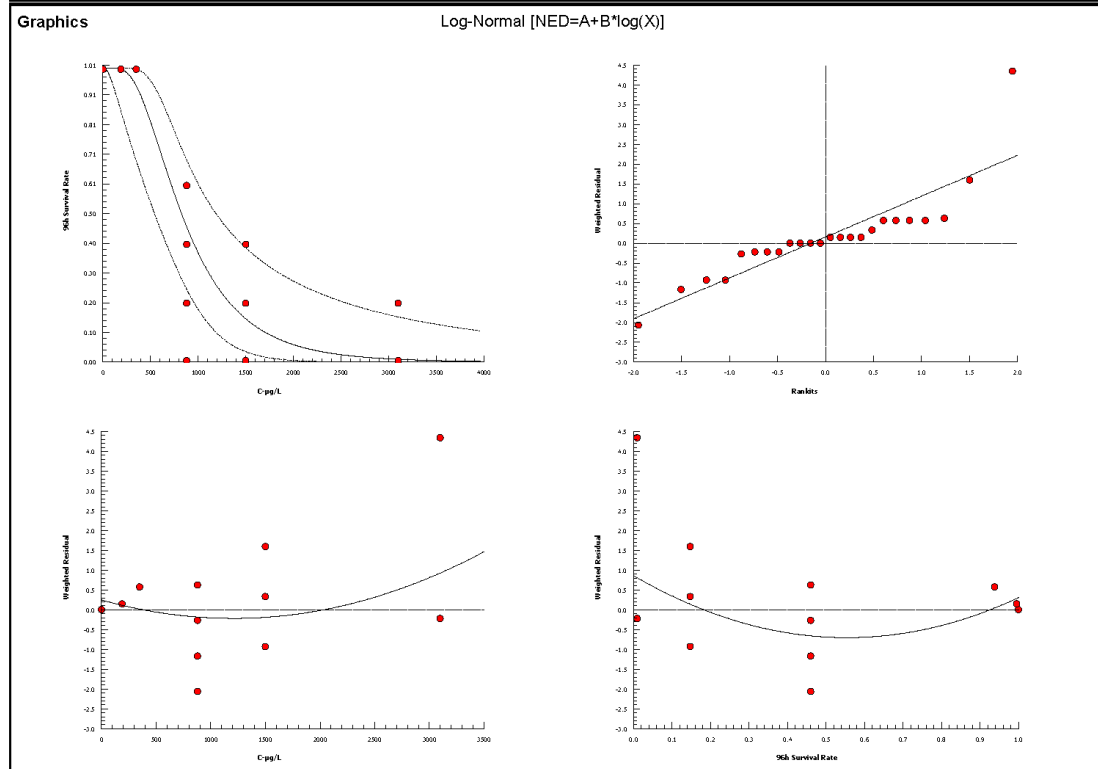
Report Date: 02 Jun-16 16:16 (p 2 of 2)
Test Code: 5DB7B3EC | 15-7232-0236

Americamysis 96-h Acute Survival Test SPAWAR Systems Center

Analysis ID: 05-4119-8838 Endpoint: 96h Survival Rate CETIS Version: CETISv1.8.7
Analyzed: 28 May-16 10:37 Analysis: Linear Regression (MLE) Official Results: Yes

96h Survival Rate Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
1.6	Lab Control	1	1	1	1
190		1	1	1	1
350		1	1	1	1
880		0.6	0.2	0	0.4
1500		0.4	0.2	0	0
3100		0	0.2	0	0

96h Survival Rate Binomials					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
1.6	Lab Control	5/5	5/5	5/5	5/5
190		5/5	5/5	5/5	5/5
350		5/5	5/5	5/5	5/5
880		3/5	1/5	0/5	2/5
1500		2/5	1/5	0/5	0/5
3100		0/5	1/5	0/5	0/5



000-010-187-1

CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Summary Report

Report Date: 02 Jun-16 16:15 (p 1 of 1)
 Test Code: 41FF6FB0 | 11-0725-9312

Americamysis 96-h Acute Survival Test							SPAWAR Systems Center				
Batch ID:	18-0018-1674	Test Type:	Survival (96h)				Analyst:	Marianne A Colvin			
Start Date:	29 Apr-16 09:00	Protocol:	EPA/821/R-02-012 (2002)				Diluent:	Laboratory Seawater			
Ending Date:	03 May-16 09:00	Species:	Americamysis bahia				Brine:	Not Applicable			
Duration:	96h	Source:	Aquatic Research Organisms, NH				Age:	5			
Sample ID:	05-7381-1329	Code:	2233AA81				Client:	SPAWAR			
Sample Date:	29 Apr-16	Material:	Copper sulfate				Project:	Pulsed Exposure			
Receive Date:	29 Apr-16	Source:	Pulsed Exposure								
Sample Age:	9h	Station:	6 Hour								
Comparison Summary											
Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method				
20-9830-3704	96h Survival Rate	200	440	296.6	17.4%		Steel Many-One Rank Sum Test				
Point Estimate Summary											
Analysis ID	Endpoint	Level	µg/L	95% LCL	95% UCL	TU	Method				
07-2199-8580	96h Survival Rate	LC50	527.3	424.9	651.2		Linear Regression (MLE)				
96h Survival Rate Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
1.6	Lab Control	4	1	1	1	1	1	0	0	0.0%	0.0%
99		4	1	1	1	1	1	0	0	0.0%	0.0%
200		4	0.95	0.7909	1	0.8	1	0.05	0.1	10.53%	5.0%
440		4	0.7	0.3818	1	0.4	0.8	0.1	0.2	28.57%	30.0%
770		4	0.15	0	0.3091	0	0.2	0.05	0.1	66.67%	85.0%
1600		4	0.05	0	0.2091	0	0.2	0.05	0.1	200.0%	95.0%
96h Survival Rate Detail											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
1.6	Lab Control	1	1	1	1						
99		1	1	1	1						
200		1	1	1	0.8						
440		0.8	0.4	0.8	0.8						
770		0.2	0.2	0	0.2						
1600		0	0.2	0	0						
96h Survival Rate Binomials											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
1.6	Lab Control	5/5	5/5	5/5	5/5						
99		5/5	5/5	5/5	5/5						
200		5/5	5/5	5/5	4/5						
440		4/5	2/5	4/5	4/5						
770		1/5	1/5	0/5	1/5						
1600		0/5	1/5	0/5	0/5						

CETIS Analytical Report

Report Date: 02 Jun-16 16:15 (p 1 of 2)
Test Code: 41FF6FB0 | 11-0725-9312

Americamysis 96-h Acute Survival Test						SPAWAR Systems Center					
Analysis ID:	20-9830-3704		Endpoint:	96h Survival Rate			CETIS Version:	CETISv1.8.7			
Analyzed:	28 May-16 10:36		Analysis:	Nonparametric-Control vs Treatments			Official Results:	Yes			
Batch ID:	18-0018-1674		Test Type:	Survival (96h)			Analyst:	Marianne A Colvin			
Start Date:	29 Apr-16 09:00		Protocol:	EPA/821/R-02-012 (2002)			Diluent:	Laboratory Seawater			
Ending Date:	03 May-16 09:00		Species:	Americamysis bahia			Brine:	Not Applicable			
Duration:	96h		Source:	Aquatic Research Organisms, NH			Age:	5			
Sample ID:	05-7381-1329		Code:	2233AA81			Client:	SPAWAR			
Sample Date:	29 Apr-16		Material:	Copper sulfate			Project:	Pulsed Exposure			
Receive Date:	29 Apr-16		Source:	Pulsed Exposure							
Sample Age:	9h		Station:	6 Hour							
Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	NOEL	LOEL	TOEL	TU		
Angular (Corrected)	NA	C > T	NA	NA	17.4%	200	440	296.6			
Steel Many-One Rank Sum Test											
Control	vs	C-µg/L	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)		
1.6		99	18	10	1	6	0.8333	Asymp	Non-Significant Effect		
1.6		200	16	10	1	6	0.6105	Asymp	Non-Significant Effect		
1.6		440*	10	10	0	6	0.0417	Asymp	Significant Effect		
1.6		770*	10	10	0	6	0.0417	Asymp	Significant Effect		
1.6		1600*	10	10	0	6	0.0417	Asymp	Significant Effect		
ANOVA Table											
Source	Sum Squares		Mean Square		DF	F Stat	P-Value	Decision(α:5%)			
Between	4.671416		0.9342832		5	64.33	<0.0001	Significant Effect			
Error	0.2614278		0.01452377		18						
Total	4.932844				23						
Distributional Tests											
Attribute	Test		Test Stat	Critical	P-Value	Decision(α:1%)					
Variances	Mod Levene Equality of Variance		0.4585	4.248	0.8018	Equal Variances					
Variances	Levene Equality of Variance		4.126	4.248	0.0113	Equal Variances					
Distribution	Shapiro-Wilk W Normality		0.8782	0.884	0.0076	Non-normal Distribution					
96h Survival Rate Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
1.6	Lab Control	4	1	1	1	1	1	1	0	0.0%	0.0%
99		4	1	1	1	1	1	1	0	0.0%	0.0%
200		4	0.95	0.7909	1	1	0.8	1	0.05	10.53%	5.0%
440		4	0.7	0.3818	1	0.8	0.4	0.8	0.1	28.57%	30.0%
770		4	0.15	0	0.3091	0.2	0	0.2	0.05	66.67%	85.0%
1600		4	0.05	0	0.2091	0	0	0.2	0.05	200.0%	95.0%
Angular (Corrected) Transformed Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
1.6	Lab Control	4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
99		4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
200		4	1.286	1.096	1.475	1.345	1.107	1.345	0.05953	9.26%	4.43%
440		4	1.002	0.6655	1.338	1.107	0.6847	1.107	0.1056	21.09%	25.55%
770		4	0.4041	0.2147	0.5936	0.4636	0.2255	0.4636	0.05953	29.46%	69.96%
1600		4	0.285	0.09558	0.4745	0.2255	0.2255	0.4636	0.05953	41.77%	78.81%

CETIS Analytical Report

Report Date: 02 Jun-16 16:15 (p 2 of 2)
Test Code: 41FF6FB0 | 11-0725-9312

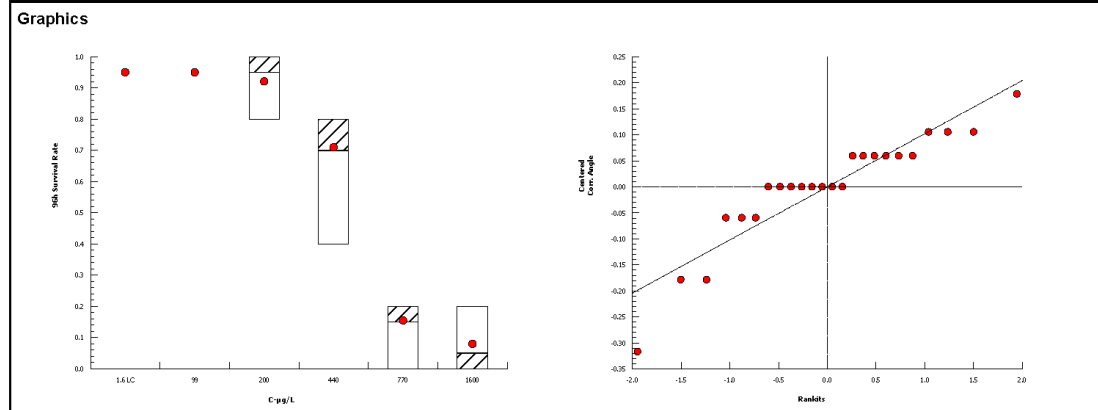
Americamysis 96-h Acute Survival Test SPAWAR Systems Center

Analysis ID: 20-9830-3704 Endpoint: 96h Survival Rate CETIS Version: CETISv1.8.7
Analyzed: 28 May-16 10:36 Analysis: Nonparametric-Control vs Treatments Official Results: Yes

96h Survival Rate Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
1.6	Lab Control	1	1	1	1
99		1	1	1	1
200		1	1	1	0.8
440		0.8	0.4	0.8	0.8
770		0.2	0.2	0	0.2
1600		0	0.2	0	0

Angular (Corrected) Transformed Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
1.6	Lab Control	1.345	1.345	1.345	1.345
99		1.345	1.345	1.345	1.345
200		1.345	1.345	1.345	1.107
440		1.107	0.6847	1.107	1.107
770		0.4636	0.4636	0.2255	0.4636
1600		0.2255	0.4636	0.2255	0.2255

96h Survival Rate Binomials					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
1.6	Lab Control	5/5	5/5	5/5	5/5
99		5/5	5/5	5/5	5/5
200		5/5	5/5	5/5	4/5
440		4/5	2/5	4/5	4/5
770		1/5	1/5	0/5	1/5
1600		0/5	1/5	0/5	0/5



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CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Analytical Report

Report Date: 02 Jun-16 16:15 (p 1 of 2)
Test Code: 41FF6FB0 | 11-0725-9312

Americamysis 96-h Acute Survival Test						SPAWAR Systems Center					
Analysis ID:	07-2199-8580		Endpoint:	96h Survival Rate			CETIS Version:	CETISv1.8.7			
Analyzed:	28 May-16 10:36		Analysis:	Linear Regression (MLE)			Official Results:	Yes			
Batch ID:	18-0018-1674		Test Type:	Survival (96h)			Analyst:	Marianne A Colvin			
Start Date:	29 Apr-16 09:00		Protocol:	EPA/821/R-02-012 (2002)			Diluent:	Laboratory Seawater			
Ending Date:	03 May-16 09:00		Species:	Americamysis bahia			Brine:	Not Applicable			
Duration:	96h		Source:	Aquatic Research Organisms, NH			Age:	5			
Sample ID:	05-7381-1329		Code:	2233AA81			Client:	SPAWAR			
Sample Date:	29 Apr-16		Material:	Copper sulfate			Project:	Pulsed Exposure			
Receive Date:	29 Apr-16		Source:	Pulsed Exposure							
Sample Age:	9h		Station:	6 Hour							
Linear Regression Options											
Model Function			Threshold Option		Threshold	Optimized	Pooled	Het Corr	Weighted		
Log-Normal [NED=A+B*log(X)]			Control Threshold		1E-07	Yes	No	No	Yes		
Regression Summary											
Iters	LL	AICc	BIC	Mu	Sigma	Adj R2	F Stat	Critical	P-Value	Decision(α:5%)	
80	-29.71	66.62	68.95	2.722	0.242	0.7983	3.284	3.16	0.0447	Significant Lack of Fit	
Point Estimates											
Level	μg/L	95% LCL	95% UCL								
LC50	527.3	424.9	651.2								
Regression Parameters											
Parameter	Estimate	Std Error	95% LCL	95% UCL	t Stat	P-Value	Decision(α:5%)				
Threshold	5.35E-08	5.17E-05	-0.00010	0.000101	0.001034	0.9992	Non-Significant Parameter				
Slope	4.133	0.7391	2.684	5.582	5.592	<0.0001	Significant Parameter				
Intercept	-11.25	2.025	-15.22	-7.28	-5.554	<0.0001	Significant Parameter				
ANOVA Table											
Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)					
Model	70.93179	70.93179	1	93.01	<0.0001	Significant					
Lack of Fit	5.66535	1.88845	3	3.284	0.0447	Significant					
Pure Error	10.3494	0.574967	18								
Residual	16.01475	0.762607	21								
Residual Analysis											
Attribute	Method			Test Stat	Critical	P-Value	Decision(α:5%)				
Goodness-of-Fit	Pearson Chi-Sq GOF			16.01	32.67	0.7688	Non-Significant Heterogenity				
	Likelihood Ratio GOF			12.66	32.67	0.9202	Non-Significant Heterogenity				
Variances	Mod Levene Equality of Variance			0.4852	2.773	0.7828	Equal Variances				
Distribution	Shapiro-Wilk W Normality			0.8893	0.9169	0.0128	Non-normal Distribution				
	Anderson-Darling A2 Normality			1.147	2.492	0.0054	Non-normal Distribution				
96h Survival Rate Summary											
		Calculated Variate(A/B)									
C-μg/L	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
1.6	Lab Control	4	1	1	1	0	0	0.0%	0.0%	20	20
99		4	1	1	1	0	0	0.0%	0.0%	20	20
200		4	0.95	0.8	1	0.05	0.1	10.53%	5.0%	19	20
440		4	0.7	0.4	0.8	0.1	0.2	28.57%	30.0%	14	20
770		4	0.15	0	0.2	0.05	0.1	66.67%	85.0%	3	20
1600		4	0.05	0	0.2	0.05	0.1	200.0%	95.0%	1	20

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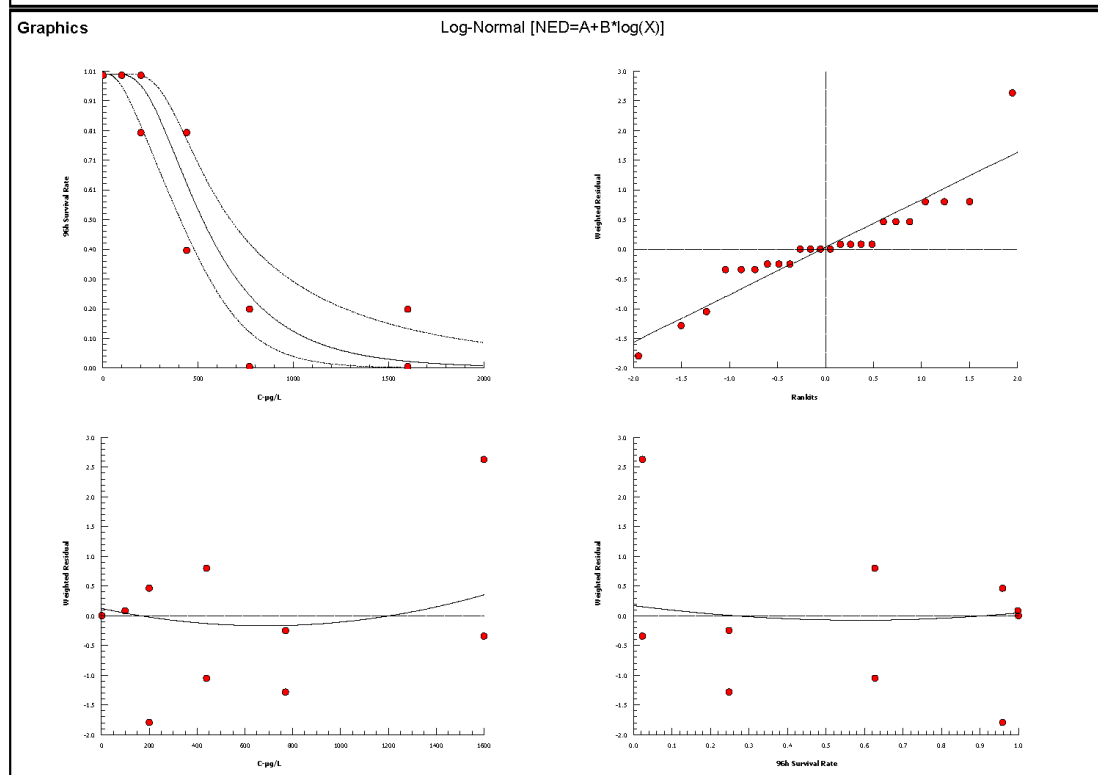
CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Analytical Report

Report Date: 02 Jun-16 16:15 (p 2 of 2)
Test Code: 41FF6FB0 | 11-0725-9312

Americamysis 96-h Acute Survival Test					SPAWAR Systems Center	
Analysis ID: 07-2199-8580		Endpoint: 96h Survival Rate			CETIS Version: CETISv1.8.7	
Analyzed: 28 May-16 10:36		Analysis: Linear Regression (MLE)			Official Results: Yes	
96h Survival Rate Detail						
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	
1.6	Lab Control	1	1	1	1	
99		1	1	1	1	
200		1	1	1	0.8	
440		0.8	0.4	0.8	0.8	
770		0.2	0.2	0	0.2	
1600		0	0.2	0	0	
96h Survival Rate Binomials						
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	
1.6	Lab Control	5/5	5/5	5/5	5/5	
99		5/5	5/5	5/5	5/5	
200		5/5	5/5	5/5	4/5	
440		4/5	2/5	4/5	4/5	
770		1/5	1/5	0/5	1/5	
1600		0/5	1/5	0/5	0/5	



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CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Summary Report

Report Date: 02 Jun-16 16:15 (p 1 of 1)
Test Code: 6AFEDF00 | 17-9508-8128

Americamysis 96-h Acute Survival Test							SPAWAR Systems Center				
Batch ID:	18-0018-1674	Test Type:	Survival (96h)				Analyst:	Marianne A Colvin			
Start Date:	29 Apr-16 09:00	Protocol:	EPA/821/R-02-012 (2002)				Diluent:	Laboratory Seawater			
Ending Date:	03 May-16 09:00	Species:	Americamysis bahia				Brine:	Not Applicable			
Duration:	96h	Source:	Aquatic Research Organisms, NH				Age:	5			
Sample ID:	18-9339-5342	Code:	70DAEB8E				Client:	SPAWAR			
Sample Date:	29 Apr-16	Material:	Copper sulfate				Project:	Pulsed Exposure			
Receive Date:	29 Apr-16	Source:	Pulsed Exposure								
Sample Age:	9h	Station:	12 Hour								
Comparison Summary											
Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method				
15-9818-6438	96h Survival Rate	120	340	202	17.5%		Dunnett Multiple Comparison Test				
Point Estimate Summary											
Analysis ID	Endpoint	Level	µg/L	95% LCL	95% UCL	TU	Method				
19-3745-9491	96h Survival Rate	LC50	266.6	209.2	340.5		Linear Regression (MLE)				
96h Survival Rate Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
1.6	Lab Control	4	1	1	1	1	1	0	0	0.0%	0.0%
34		4	1	1	1	1	1	0	0	0.0%	0.0%
72		4	0.95	0.7909	1	0.8	1	0.05	0.1	10.53%	5.0%
120		4	0.95	0.7909	1	0.8	1	0.05	0.1	10.53%	5.0%
340		4	0.35	0.0453	0.6547	0.2	0.6	0.09574	0.1915	54.71%	65.0%
570		4	0.1	0	0.2837	0	0.2	0.05774	0.1155	115.5%	90.0%
96h Survival Rate Detail											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
1.6	Lab Control	1	1	1	1						
34		1	1	1	1						
72		1	1	0.8	1						
120		1	1	1	0.8						
340		0.2	0.4	0.6	0.2						
570		0	0.2	0.2	0						
96h Survival Rate Binomials											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
1.6	Lab Control	5/5	5/5	5/5	5/5						
34		5/5	5/5	5/5	5/5						
72		5/5	5/5	4/5	5/5						
120		5/5	5/5	5/5	4/5						
340		1/5	2/5	3/5	1/5						
570		0/5	1/5	1/5	0/5						

CETIS Analytical Report

Report Date: 02 Jun-16 16:15 (p 1 of 2)
 Test Code: 6AFEDF00 | 17-9508-8128

Americamysis 96-h Acute Survival Test						SPAWAR Systems Center					
Analysis ID:	15-9818-6438		Endpoint:	96h Survival Rate			CETIS Version:		CETISv1.8.7		
Analyzed:	28 May-16 10:36		Analysis:	Parametric-Control vs Treatments			Official Results:		Yes		
Batch ID:	18-0018-1674		Test Type:	Survival (96h)			Analyst:	Marianne A Colvin			
Start Date:	29 Apr-16 09:00		Protocol:	EPA/821/R-02-012 (2002)			Diluent:	Laboratory Seawater			
Ending Date:	03 May-16 09:00		Species:	Americamysis bahia			Brine:	Not Applicable			
Duration:	96h		Source:	Aquatic Research Organisms, NH			Age:	5			
Sample ID:	18-9339-5342		Code:	70DAEB8E			Client:	SPAWAR			
Sample Date:	29 Apr-16		Material:	Copper sulfate			Project:	Pulsed Exposure			
Receive Date:	29 Apr-16		Source:	Pulsed Exposure							
Sample Age:	9h		Station:	12 Hour							
Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	NOEL	LOEL	TOEL	TU		
Angular (Corrected)	NA	C > T	NA	NA	17.5%	120	340	202			
Dunnett Multiple Comparison Test											
Control	vs	C-µg/L	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)		
1.6	34		0	2.407	0.207	6	0.8333	CDF	Non-Significant Effect		
1.6	72		0.6931	2.407	0.207	6	0.5611	CDF	Non-Significant Effect		
1.6	120		0.6931	2.407	0.207	6	0.5611	CDF	Non-Significant Effect		
1.6	340*		8.392	2.407	0.207	6	<0.0001	CDF	Significant Effect		
1.6	570*		11.65	2.407	0.207	6	<0.0001	CDF	Significant Effect		
ANOVA Table											
Source	Sum Squares		Mean Square		DF	F Stat	P-Value	Decision(α:5%)			
Between	3.853589		0.7707179		5	52.24	<0.0001	Significant Effect			
Error	0.2655657		0.01475365		18						
Total	4.119155				23						
Distributional Tests											
Attribute	Test		Test Stat	Critical	P-Value		Decision(α:1%)				
Variances	Mod Levene Equality of Variance		2.57	4.248	0.0635		Equal Variances				
Variances	Levene Equality of Variance		7.267	4.248	0.0007		Unequal Variances				
Distribution	Shapiro-Wilk W Normality		0.9014	0.884	0.0231		Normal Distribution				
96h Survival Rate Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
1.6	Lab Control	4	1	1	1	1	1	1	0	0.0%	0.0%
34		4	1	1	1	1	1	1	0	0.0%	0.0%
72		4	0.95	0.7909	1	1	0.8	1	0.05	10.53%	5.0%
120		4	0.95	0.7909	1	1	0.8	1	0.05	10.53%	5.0%
340		4	0.35	0.0453	0.6547	0.3	0.2	0.6	0.09574	54.71%	65.0%
570		4	0.1	0	0.2837	0.1	0	0.2	0.05774	115.5%	90.0%
Angular (Corrected) Transformed Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
1.6	Lab Control	4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
34		4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
72		4	1.286	1.096	1.475	1.345	1.107	1.345	0.05953	9.26%	4.43%
120		4	1.286	1.096	1.475	1.345	1.107	1.345	0.05953	9.26%	4.43%
340		4	0.6245	0.3013	0.9478	0.5742	0.4636	0.8861	0.1016	32.53%	53.58%
570		4	0.3446	0.1258	0.5634	0.3446	0.2255	0.4636	0.06874	39.9%	74.39%

CETIS Analytical Report

Report Date: 02 Jun-16 16:15 (p 2 of 2)
Test Code: 6AFEDF00 | 17-9508-8128

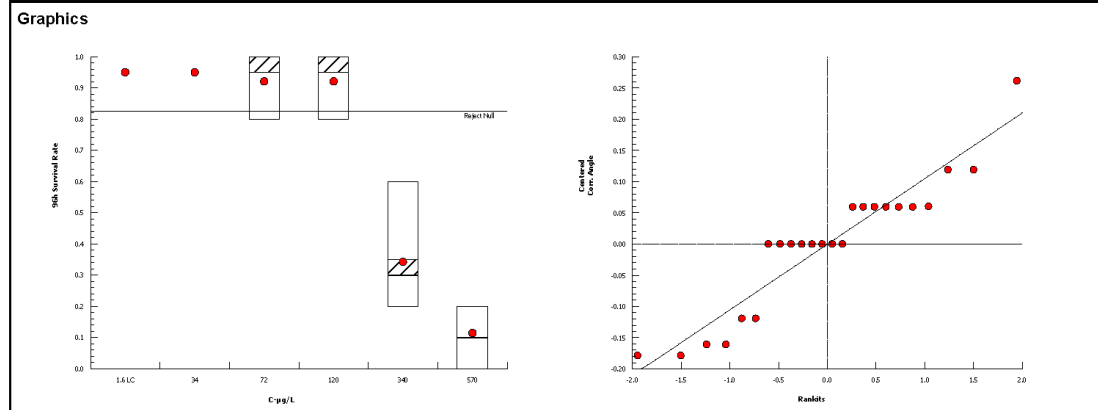
Americamysis 96-h Acute Survival Test SPAWAR Systems Center

Analysis ID: 15-9818-6438 Endpoint: 96h Survival Rate CETIS Version: CETISv1.8.7
Analyzed: 28 May-16 10:36 Analysis: Parametric-Control vs Treatments Official Results: Yes

96h Survival Rate Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
1.6	Lab Control	1	1	1	1
34		1	1	1	1
72		1	1	0.8	1
120		1	1	1	0.8
340		0.2	0.4	0.6	0.2
570		0	0.2	0.2	0

Angular (Corrected) Transformed Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
1.6	Lab Control	1.345	1.345	1.345	1.345
34		1.345	1.345	1.345	1.345
72		1.345	1.345	1.107	1.345
120		1.345	1.345	1.345	1.107
340		0.4636	0.6847	0.8861	0.4636
570		0.2255	0.4636	0.4636	0.2255

96h Survival Rate Binomials					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
1.6	Lab Control	5/5	5/5	5/5	5/5
34		5/5	5/5	5/5	5/5
72		5/5	5/5	4/5	5/5
120		5/5	5/5	5/5	4/5
340		1/5	2/5	3/5	1/5
570		0/5	1/5	1/5	0/5



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CETIS™ v1.8.7.16

Analyst: _____ QA: _____

CETIS Analytical Report

Report Date: 02 Jun-16 16:15 (p 1 of 2)
Test Code: 6AFEDF00 | 17-9508-8128

Americamysis 96-h Acute Survival Test							SPAWAR Systems Center				
Analysis ID:	19-3745-9491		Endpoint:	96h Survival Rate			CETIS Version:	CETISv1.8.7			
Analyzed:	28 May-16 10:36		Analysis:	Linear Regression (MLE)			Official Results:	Yes			
Batch ID:	18-0018-1674		Test Type:	Survival (96h)			Analyst:	Marianne A Colvin			
Start Date:	29 Apr-16 09:00		Protocol:	EPA/821/R-02-012 (2002)			Diluent:	Laboratory Seawater			
Ending Date:	03 May-16 09:00		Species:	Americamysis bahia			Brine:	Not Applicable			
Duration:	96h		Source:	Aquatic Research Organisms, NH			Age:	5			
Sample ID:	18-9339-5342		Code:	70DAEB8E			Client:	SPAWAR			
Sample Date:	29 Apr-16		Material:	Copper sulfate			Project:	Pulsed Exposure			
Receive Date:	29 Apr-16		Source:	Pulsed Exposure							
Sample Age:	9h		Station:	12 Hour							
Linear Regression Options											
Model Function			Threshold Option		Threshold	Optimized	Pooled	Het Corr	Weighted		
Log-Normal [NED=A+B*log(X)]			Control Threshold		1E-07	Yes	No	No	Yes		
Regression Summary											
Iters	LL	AICc	BIC	Mu	Sigma	Adj R2	F Stat	Critical	P-Value	Decision(α:5%)	
12	-28.15	63.49	65.83	2.426	0.2726	0.7907	2.779	3.16	0.0709	Non-Significant Lack of Fit	
Point Estimates											
Level	µg/L	95% LCL	95% UCL								
LC50	266.6	209.2	340.5								
Regression Parameters											
Parameter	Estimate	Std Error	95% LCL	95% UCL	t Stat	P-Value	Decision(α:5%)				
Threshold	1.26E-07	7.93E-05	-0.00016	0.000156	0.001587	0.9987	Non-Significant Parameter				
Slope	3.668	0.6203	2.452	4.883	5.913	<0.0001	Significant Parameter				
Intercept	-8.898	1.514	-11.87	-5.93	-5.877	<0.0001	Significant Parameter				
ANOVA Table											
Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)					
Model	67.8569	67.8569	1	88.89	<0.0001	Significant					
Lack of Fit	5.074647	1.691549	3	2.779	0.0709	Non-Significant					
Pure Error	10.95559	0.608644	18								
Residual	16.03024	0.763345	21								
Residual Analysis											
Attribute	Method		Test Stat	Critical	P-Value	Decision(α:5%)					
Goodness-of-Fit	Pearson Chi-Sq GOF		16.03	32.67	0.7679	Non-Significant Heterogenity					
	Likelihood Ratio GOF		12.81	32.67	0.9152	Non-Significant Heterogenity					
Variances	Mod Levene Equality of Variance		0.9329	2.773	0.4831	Equal Variances					
Distribution	Shapiro-Wilk W Normality		0.8149	0.9169	0.0005	Non-normal Distribution					
	Anderson-Darling A2 Normality		1.418	2.492	0.0006	Non-normal Distribution					
96h Survival Rate Summary											
		Calculated Variate(A/B)									
C-µg/L	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
1.6	Lab Control	4	1	1	1	0	0	0.0%	0.0%	20	20
34		4	1	1	1	0	0	0.0%	0.0%	20	20
72		4	0.95	0.8	1	0.05	0.1	10.53%	5.0%	19	20
120		4	0.95	0.8	1	0.05	0.1	10.53%	5.0%	19	20
340		4	0.35	0.2	0.6	0.09574	0.1915	54.71%	65.0%	7	20
570		4	0.1	0	0.2	0.05774	0.1155	115.5%	90.0%	2	20

000-010-187-1

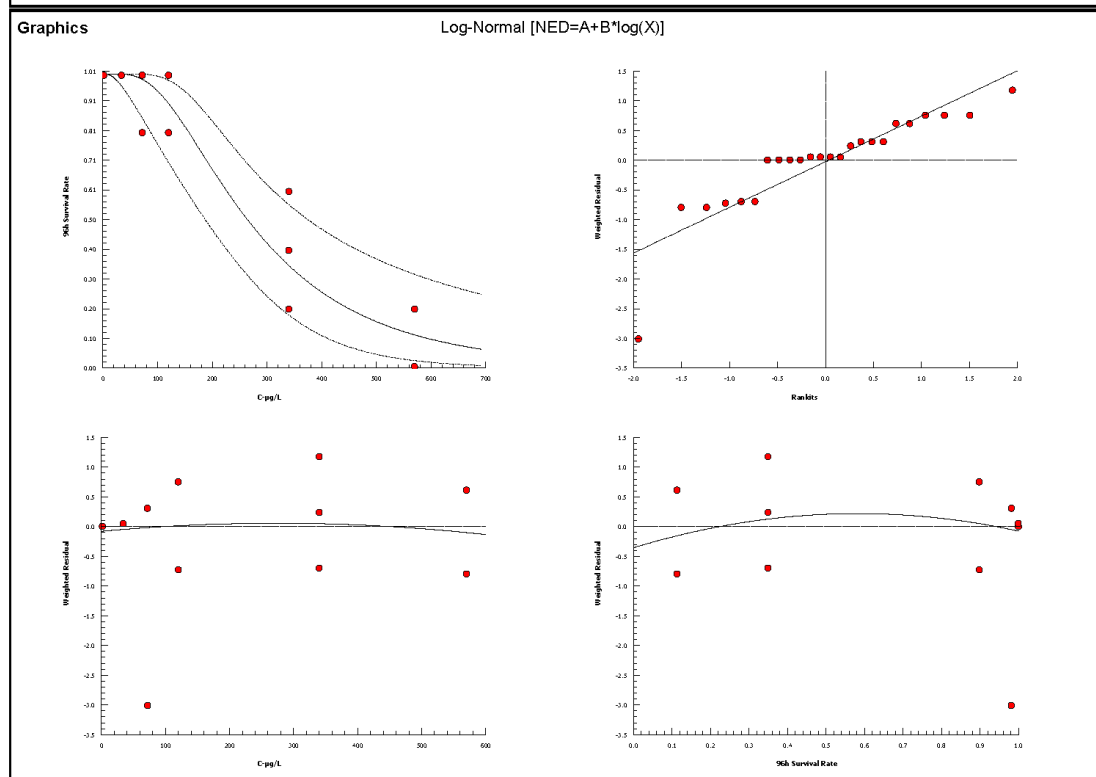
CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Analytical Report

Report Date: 02 Jun-16 16:15 (p 2 of 2)
Test Code: 6AFEDF00 | 17-9508-8128

Americamysis 96-h Acute Survival Test					SPAWAR Systems Center	
Analysis ID: 19-3745-9491		Endpoint: 96h Survival Rate			CETIS Version: CETISv1.8.7	
Analyzed: 28 May-16 10:36		Analysis: Linear Regression (MLE)			Official Results: Yes	
96h Survival Rate Detail						
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	
1.6	Lab Control	1	1	1	1	
34		1	1	1	1	
72		1	1	0.8	1	
120		1	1	1	0.8	
340		0.2	0.4	0.6	0.2	
570		0	0.2	0.2	0	
96h Survival Rate Binomials						
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	
1.6	Lab Control	5/5	5/5	5/5	5/5	
34		5/5	5/5	5/5	5/5	
72		5/5	5/5	4/5	5/5	
120		5/5	5/5	5/5	4/5	
340		1/5	2/5	3/5	1/5	
570		0/5	1/5	1/5	0/5	



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CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Summary Report

Report Date: 02 Jun-16 16:14 (p 1 of 1)
 Test Code: 1E0CBFA1 | 05-0415-1969

Americamysis 96-h Acute Survival Test							SPAWAR Systems Center				
Batch ID:	18-0018-1674	Test Type:	Survival (96h)				Analyst:	Marianne A Colvin			
Start Date:	29 Apr-16 09:00	Protocol:	EPA/821/R-02-012 (2002)				Diluent:	Laboratory Seawater			
Ending Date:	03 May-16 09:00	Species:	Americamysis bahia				Brine:	Not Applicable			
Duration:	96h	Source:	Aquatic Research Organisms, NH				Age:	5			
Sample ID:	18-5066-6099	Code:	6E4EEC73				Client:	SPAWAR			
Sample Date:	29 Apr-16	Material:	Copper sulfate				Project:	Pulsed Exposure			
Receive Date:	29 Apr-16	Source:	Pulsed Exposure								
Sample Age:	9h	Station:	Static								
Comparison Summary											
Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method				
01-9167-8084	96h Survival Rate	71	140	99.7	14.3%		Steel Many-One Rank Sum Test				
Point Estimate Summary											
Analysis ID	Endpoint	Level	µg/L	95% LCL	95% UCL	TU	Method				
19-3764-2302	96h Survival Rate	LC50	105.9	84.58	122.5		Linear Regression (MLE)				
96h Survival Rate Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
1.6	Lab Control	4	1	1	1	1	1	0	0	0.0%	0.0%
21		4	0.95	0.7909	1	0.8	1	0.05	0.1	10.53%	5.0%
34		4	1	1	1	1	1	0	0	0.0%	0.0%
71		4	0.95	0.7909	1	0.8	1	0.05	0.1	10.53%	5.0%
140		4	0.1	0	0.2837	0	0.2	0.05774	0.1155	115.5%	90.0%
280		4	0	0	0	0	0	0	0		100.0%
96h Survival Rate Detail											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
1.6	Lab Control	1	1	1	1						
21		1	1	1	0.8						
34		1	1	1	1						
71		1	1	1	0.8						
140		0	0	0.2	0.2						
280		0	0	0	0						
96h Survival Rate Binomials											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
1.6	Lab Control	5/5	5/5	5/5	5/5						
21		5/5	5/5	5/5	4/5						
34		5/5	5/5	5/5	5/5						
71		5/5	5/5	5/5	4/5						
140		0/5	0/5	1/5	1/5						
280		0/5	0/5	0/5	0/5						

CETIS Analytical Report

Report Date: 02 Jun-16 16:14 (p 1 of 2)
Test Code: 1E0CBFA1 | 05-0415-1969

Americamysis 96-h Acute Survival Test						SPAWAR Systems Center					
Analysis ID:	01-9167-8084		Endpoint:	96h Survival Rate			CETIS Version:	CETISv1.8.7			
Analyzed:	28 May-16 10:30		Analysis:	Nonparametric-Control vs Treatments			Official Results:	Yes			
Batch ID:	18-0018-1674		Test Type:	Survival (96h)			Analyst:	Marianne A Colvin			
Start Date:	29 Apr-16 09:00		Protocol:	EPA/821/R-02-012 (2002)			Diluent:	Laboratory Seawater			
Ending Date:	03 May-16 09:00		Species:	Americamysis bahia			Brine:	Not Applicable			
Duration:	96h		Source:	Aquatic Research Organisms, NH			Age:	5			
Sample ID:	18-5066-6099		Code:	6E4EEC73			Client:	SPAWAR			
Sample Date:	29 Apr-16		Material:	Copper sulfate			Project:	Pulsed Exposure			
Receive Date:	29 Apr-16		Source:	Pulsed Exposure							
Sample Age:	9h		Station:	Static							
Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	NOEL	LOEL	TOEL	TU		
Angular (Corrected)	NA	C > T	NA	NA	14.3%	71	140	99.7			
Steel Many-One Rank Sum Test											
Control	vs	C-µg/L	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)		
1.6		21	16	10	1	6	0.5661	Asymp	Non-Significant Effect		
1.6		34	18	10	1	6	0.8000	Asymp	Non-Significant Effect		
1.6		71	16	10	1	6	0.5661	Asymp	Non-Significant Effect		
1.6		140*	10	10	0	6	0.0350	Asymp	Significant Effect		
ANOVA Table											
Source	Sum Squares		Mean Square		DF	F Stat	P-Value	Decision(α:5%)			
Between	3.030868		0.7577171		4	80.17	<0.0001	Significant Effect			
Error	0.1417698		0.009451317		15						
Total	3.172638				19						
Distributional Tests											
Attribute	Test		Test Stat	Critical	P-Value	Decision(α:1%)					
Variances	Mod Levene Equality of Variance		1.75	4.893	0.1915	Equal Variances					
Variances	Levene Equality of Variance		8.75	4.893	0.0007	Unequal Variances					
Distribution	Shapiro-Wilk W Normality		0.8533	0.866	0.0061	Non-normal Distribution					
96h Survival Rate Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
1.6	Lab Control	4	1	1	1	1	1	1	0	0.0%	0.0%
21		4	0.95	0.7909	1	1	0.8	1	0.05	10.53%	5.0%
34		4	1	1	1	1	1	1	0	0.0%	0.0%
71		4	0.95	0.7909	1	1	0.8	1	0.05	10.53%	5.0%
140		4	0.1	0	0.2837	0.1	0	0.2	0.05774	115.5%	90.0%
280		4	0	0	0	0	0	0	0		100.0%
Angular (Corrected) Transformed Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
1.6	Lab Control	4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
21		4	1.286	1.096	1.475	1.345	1.107	1.345	0.05953	9.26%	4.43%
34		4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
71		4	1.286	1.096	1.475	1.345	1.107	1.345	0.05953	9.26%	4.43%
140		4	0.3446	0.1258	0.5634	0.3446	0.2255	0.4636	0.06874	39.9%	74.39%
280		4	0.2255	0.2255	0.2256	0.2255	0.2255	0.2255	0	0.0%	83.24%

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CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Analytical Report

Report Date: 02 Jun-16 16:14 (p 2 of 2)
 Test Code: 1E0CBFA1 | 05-0415-1969

Americamysis 96-h Acute Survival Test					SPAWAR Systems Center
Analysis ID:	01-9167-8084	Endpoint:	96h Survival Rate	CETIS Version:	CETISv1.8.7
Analyzed:	28 May-16 10:30	Analysis:	Nonparametric-Control vs Treatments	Official Results:	Yes
96h Survival Rate Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
1.6	Lab Control	1	1	1	1
21		1	1	1	0.8
34		1	1	1	1
71		1	1	1	0.8
140		0	0	0.2	0.2
280		0	0	0	0
Angular (Corrected) Transformed Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
1.6	Lab Control	1.345	1.345	1.345	1.345
21		1.345	1.345	1.345	1.107
34		1.345	1.345	1.345	1.345
71		1.345	1.345	1.345	1.107
140		0.2255	0.2255	0.4636	0.4636
280		0.2255	0.2255	0.2255	0.2255
96h Survival Rate Binomials					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
1.6	Lab Control	5/5	5/5	5/5	5/5
21		5/5	5/5	5/5	4/5
34		5/5	5/5	5/5	5/5
71		5/5	5/5	5/5	4/5
140		0/5	0/5	1/5	1/5
280		0/5	0/5	0/5	0/5
Graphics					

CETIS Analytical Report

Report Date: 02 Jun-16 16:14 (p 1 of 2)
Test Code: 1E0CBFA1 | 05-0415-1969

Americamysis 96-h Acute Survival Test							SPAWAR Systems Center				
Analysis ID:	19-3764-2302		Endpoint:	96h Survival Rate			CETIS Version:	CETISv1.8.7			
Analyzed:	28 May-16 10:30		Analysis:	Linear Regression (MLE)			Official Results:	Yes			
Batch ID:	18-0018-1674		Test Type:	Survival (96h)			Analyst:	Marianne A Colvin			
Start Date:	29 Apr-16 09:00		Protocol:	EPA/821/R-02-012 (2002)			Diluent:	Laboratory Seawater			
Ending Date:	03 May-16 09:00		Species:	Americamysis bahia			Brine:	Not Applicable			
Duration:	96h		Source:	Aquatic Research Organisms, NH			Age:	5			
Sample ID:	18-5066-6099		Code:	6E4EEC73			Client:	SPAWAR			
Sample Date:	29 Apr-16		Material:	Copper sulfate			Project:	Pulsed Exposure			
Receive Date:	29 Apr-16		Source:	Pulsed Exposure							
Sample Age:	9h		Station:	Static							
Linear Regression Options											
Model Function			Threshold Option		Threshold	Optimized	Pooled	Het Corr	Weighted		
Log-Normal [NED=A+B*log(X)]			Control Threshold		1E-07	Yes	No	No	Yes		
Regression Summary											
Iters	LL	AICc	BIC	Mu	Sigma	Adj R2	F Stat	Critical	P-Value	Decision(α:5%)	
11	-15.56	38.32	40.65	2.025	0.09516	0.8282	5.642	3.16	0.0066	Significant Lack of Fit	
Point Estimates											
Level	µg/L	95% LCL	95% UCL								
LC50	105.9	84.58	122.5								
Regression Parameters											
Parameter	Estimate	Std Error	95% LCL	95% UCL	t Stat	P-Value	Decision(α:5%)				
Threshold	0.01667	0.01653	-0.01573	0.04906	1.008	0.3247	Non-Significant Parameter				
Slope	10.51	2.676	5.264	15.75	3.927	0.0008	Significant Parameter				
Intercept	-21.28	5.553	-32.16	-10.4	-3.832	0.0010	Significant Parameter				
ANOVA Table											
Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)					
Model	89.03306	89.03306	1	112.9	<0.0001	Significant					
Lack of Fit	8.028933	2.676311	3	5.642	0.0066	Significant					
Pure Error	8.538012	0.474334	18								
Residual	16.56694	0.788902	21								
Residual Analysis											
Attribute	Method			Test Stat	Critical	P-Value	Decision(α:5%)				
Goodness-of-Fit	Pearson Chi-Sq GOF			16.57	32.67	0.7370	Non-Significant Heterogenity				
	Likelihood Ratio GOF			11.1	32.67	0.9608	Non-Significant Heterogenity				
Variances	Mod Levene Equality of Variance			0.964	2.773	0.4654	Equal Variances				
Distribution	Shapiro-Wilk W Normality			0.6482	0.9169	<0.0001	Non-normal Distribution				
	Anderson-Darling A2 Normality			3.533	2.492	<0.0001	Non-normal Distribution				
96h Survival Rate Summary											
			Calculated Variate(A/B)								
C-µg/L	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
1.6	Lab Control	4	1	1	1	0	0	0.0%	0.0%	20	20
21		4	0.95	0.8	1	0.05	0.1	10.53%	5.0%	19	20
34		4	1	1	1	0	0	0.0%	0.0%	20	20
71		4	0.95	0.8	1	0.05	0.1	10.53%	5.0%	19	20
140		4	0.1	0	0.2	0.05774	0.1155	115.5%	90.0%	2	20
280		4	0	0	0	0	0	100.0%	0	0	20

000-010-187-1

CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Analytical Report

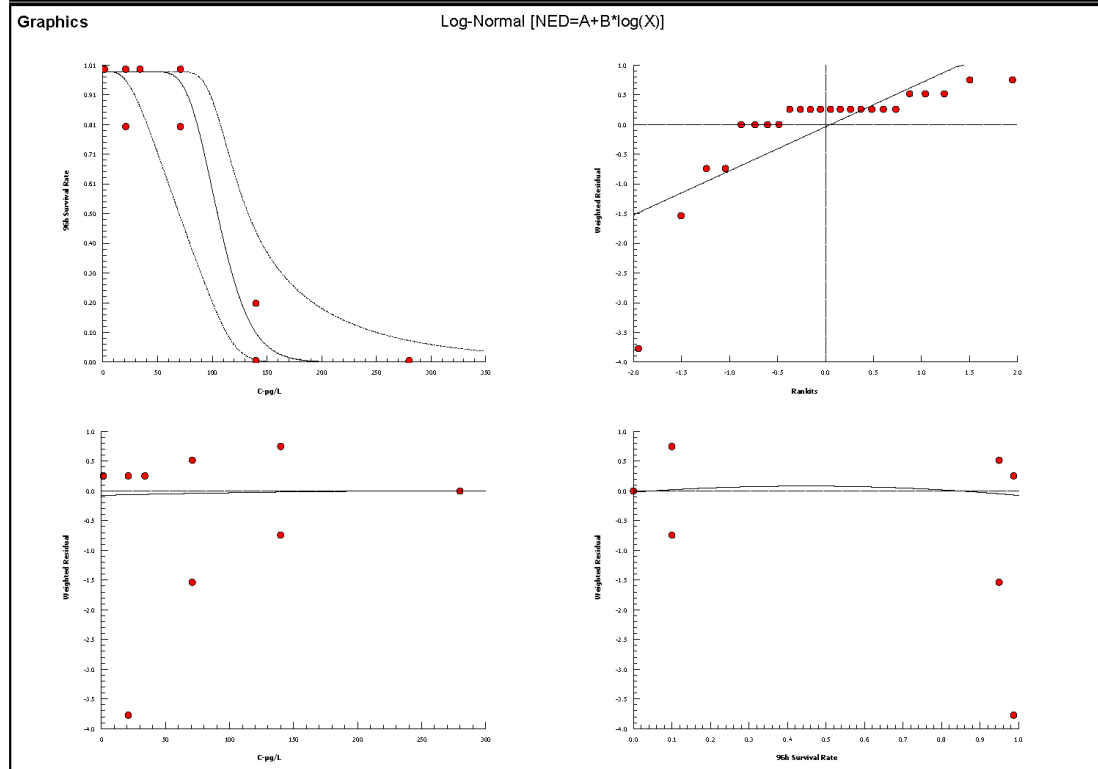
Report Date: 02 Jun-16 16:14 (p 2 of 2)
Test Code: 1E0CBFA1 | 05-0415-1969

Americamysis 96-h Acute Survival Test SPAWAR Systems Center

Analysis ID: 19-3764-2302 Endpoint: 96h Survival Rate CETIS Version: CETISv1.8.7
Analyzed: 28 May-16 10:30 Analysis: Linear Regression (MLE) Official Results: Yes

96h Survival Rate Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
1.6	Lab Control	1	1	1	1
21		1	1	1	0.8
34		1	1	1	1
71		1	1	1	0.8
140		0	0	0.2	0.2
280		0	0	0	0

96h Survival Rate Binomials					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
1.6	Lab Control	5/5	5/5	5/5	5/5
21		5/5	5/5	5/5	4/5
34		5/5	5/5	5/5	5/5
71		5/5	5/5	5/5	4/5
140		0/5	0/5	1/5	1/5
280		0/5	0/5	0/5	0/5



000-010-187-1

CETIS™ v1.8.7.16

Analyst: _____ QA: _____

CETIS Summary Report

Report Date: 02 Jun-16 16:19 (p 1 of 1)
 Test Code: 11AAE0C1 | 02-9641-1329

Americamysis 96-h Acute Survival Test							SPAWAR Systems Center				
Batch ID:	18-0018-1674		Test Type:		Survival (96h)		Analyst:	Marianne A Colvin			
Start Date:	29 Apr-16 09:00		Protocol:		EPA/821/R-02-012 (2002)		Diluent:	Laboratory Seawater			
Ending Date:	03 May-16 09:00		Species:		Americamysis bahia		Brine:	Not Applicable			
Duration:	96h		Source:		Aquatic Research Organisms, NH		Age:	5			
Sample ID:	15-6346-2470		Code:		5D308B46		Client:	SPAWAR			
Sample Date:	29 Apr-16		Material:		Zinc sulfate		Project:	Pulsed Exposure			
Receive Date:	29 Apr-16		Source:		Pulsed Exposure						
Sample Age:	9h		Station:		3 Hour						
Comparison Summary											
Analysis ID	Endpoint		NOEL	LOEL	TOEL	PMSD	TU	Method			
03-8783-1724	96h Survival Rate		3900	7400	5372	22.1%		Steel Many-One Rank Sum Test			
Point Estimate Summary											
Analysis ID	Endpoint		Level	µg/L	95% LCL	95% UCL	TU	Method			
05-2303-6409	96h Survival Rate		LC50	7810	6271	9733		Linear Regression (MLE)			
96h Survival Rate Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
634	Lab Control	4	1	1	1	1	1	0	0	0.0%	0.0%
1800		4	1	1	1	1	1	0	0	0.0%	0.0%
3900		4	1	1	1	1	1	0	0	0.0%	0.0%
7400		4	0.3	0	0.7109	0	0.6	0.1291	0.2582	86.07%	70.0%
15000		4	0.15	0	0.4547	0	0.4	0.09574	0.1915	127.7%	85.0%
30000		4	0.05	0	0.2091	0	0.2	0.05	0.1	200.0%	95.0%
96h Survival Rate Detail											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
634	Lab Control	1	1	1	1						
1800		1	1	1	1						
3900		1	1	1	1						
7400		0.6	0.2	0	0.4						
15000		0.4	0.2	0	0						
30000		0	0.2	0	0						
96h Survival Rate Binomials											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
634	Lab Control	5/5	5/5	5/5	5/5						
1800		5/5	5/5	5/5	5/5						
3900		5/5	5/5	5/5	5/5						
7400		3/5	1/5	0/5	2/5						
15000		2/5	1/5	0/5	0/5						
30000		0/5	1/5	0/5	0/5						

000-010-187-1

CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Analytical Report

Report Date: 02 Jun-16 16:19 (p 1 of 2)
Test Code: 11AAE0C1 | 02-9641-1329

Americamysis 96-h Acute Survival Test						SPAWAR Systems Center					
Analysis ID:	03-8783-1724		Endpoint:	96h Survival Rate			CETIS Version:	CETISv1.8.7			
Analyzed:	28 May-16 10:41		Analysis:	Nonparametric-Control vs Treatments			Official Results:	Yes			
Batch ID:	18-0018-1674		Test Type:	Survival (96h)			Analyst:	Marianne A Colvin			
Start Date:	29 Apr-16 09:00		Protocol:	EPA/821/R-02-012 (2002)			Diluent:	Laboratory Seawater			
Ending Date:	03 May-16 09:00		Species:	Americamysis bahia			Brine:	Not Applicable			
Duration:	96h		Source:	Aquatic Research Organisms, NH			Age:	5			
Sample ID:	15-6346-2470		Code:	5D308B46			Client:	SPAWAR			
Sample Date:	29 Apr-16		Material:	Zinc sulfate			Project:	Pulsed Exposure			
Receive Date:	29 Apr-16		Source:	Pulsed Exposure							
Sample Age:	9h		Station:	3 Hour							
Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	NOEL	LOEL	TOEL	TU		
Angular (Corrected)	NA	C > T	NA	NA	22.1%	3900	7400	5372			
Steel Many-One Rank Sum Test											
Control	vs	C-µg/L	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)		
634		1800	18	10	1	6	0.8333	Asymp	Non-Significant Effect		
634		3900	18	10	1	6	0.8333	Asymp	Non-Significant Effect		
634		7400*	10	10	0	6	0.0417	Asymp	Significant Effect		
634		15000*	10	10	0	6	0.0417	Asymp	Significant Effect		
634		30000*	10	10	0	6	0.0417	Asymp	Significant Effect		
ANOVA Table											
Source	Sum Squares		Mean Square		DF	F Stat	P-Value	Decision(α:5%)			
Between	5.332822		1.066564		5	44.49	<0.0001	Significant Effect			
Error	0.4314847		0.02397137		18						
Total	5.764307				23						
Distributional Tests											
Attribute	Test		Test Stat	Critical	P-Value	Decision(α:1%)					
Variances	Mod Levene Equality of Variance		5.407	4.248	0.0033	Unequal Variances					
Variances	Levene Equality of Variance		8.241	4.248	0.0003	Unequal Variances					
Distribution	Shapiro-Wilk W Normality		0.8778	0.884	0.0075	Non-normal Distribution					
96h Survival Rate Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
634	Lab Control	4	1	1	1	1	1	1	0	0.0%	0.0%
1800		4	1	1	1	1	1	1	0	0.0%	0.0%
3900		4	1	1	1	1	1	1	0	0.0%	0.0%
7400		4	0.3	0	0.7109	0.3	0	0.6	0.1291	86.07%	70.0%
15000		4	0.15	0	0.4547	0.1	0	0.4	0.09574	127.7%	85.0%
30000		4	0.05	0	0.2091	0	0	0.2	0.05	200.0%	95.0%
Angular (Corrected) Transformed Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
634	Lab Control	4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
1800		4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
3900		4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
7400		4	0.565	0.1122	1.018	0.5742	0.2255	0.8861	0.1423	50.37%	58.0%
15000		4	0.3998	0.04881	0.7509	0.3446	0.2255	0.6847	0.1103	55.17%	70.28%
30000		4	0.285	0.09558	0.4745	0.2255	0.2255	0.4636	0.05953	41.77%	78.81%

CETIS Analytical Report

Report Date: 02 Jun-16 16:19 (p 2 of 2)
Test Code: 11AAE0C1 | 02-9641-1329

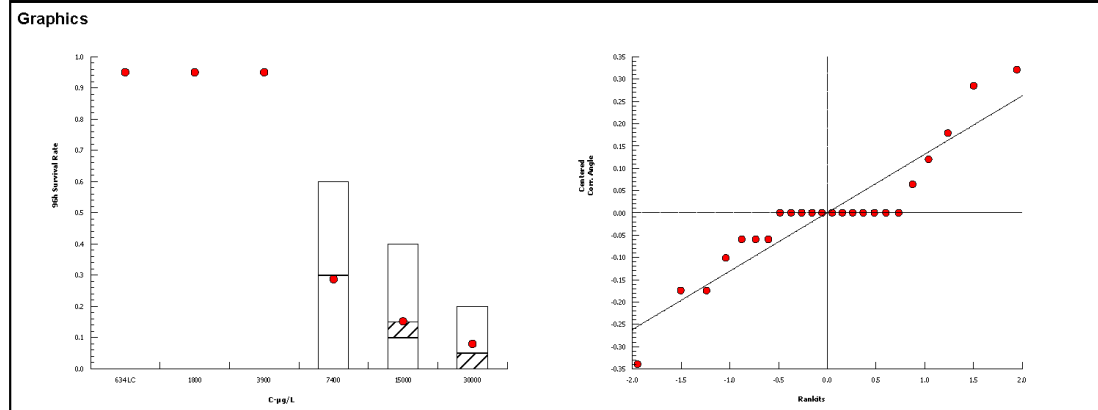
Americamysis 96-h Acute Survival Test SPAWAR Systems Center

Analysis ID: 03-8783-1724 Endpoint: 96h Survival Rate CETIS Version: CETISv1.8.7
Analyzed: 28 May-16 10:41 Analysis: Nonparametric-Control vs Treatments Official Results: Yes

96h Survival Rate Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
634	Lab Control	1	1	1	1
1800		1	1	1	1
3900		1	1	1	1
7400		0.6	0.2	0	0.4
15000		0.4	0.2	0	0
30000		0	0.2	0	0

Angular (Corrected) Transformed Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
634	Lab Control	1.345	1.345	1.345	1.345
1800		1.345	1.345	1.345	1.345
3900		1.345	1.345	1.345	1.345
7400		0.8861	0.4636	0.2255	0.6847
15000		0.6847	0.4636	0.2255	0.2255
30000		0.2255	0.4636	0.2255	0.2255

96h Survival Rate Binomials					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
634	Lab Control	5/5	5/5	5/5	5/5
1800		5/5	5/5	5/5	5/5
3900		5/5	5/5	5/5	5/5
7400		3/5	1/5	0/5	2/5
15000		2/5	1/5	0/5	0/5
30000		0/5	1/5	0/5	0/5



000-010-187-1

CETIS™ v1.8.7.16

Analyst: _____ QA: _____

CETIS Analytical Report

Report Date: 02 Jun-16 16:19 (p 1 of 2)
 Test Code: 11AAE0C1 | 02-9641-1329

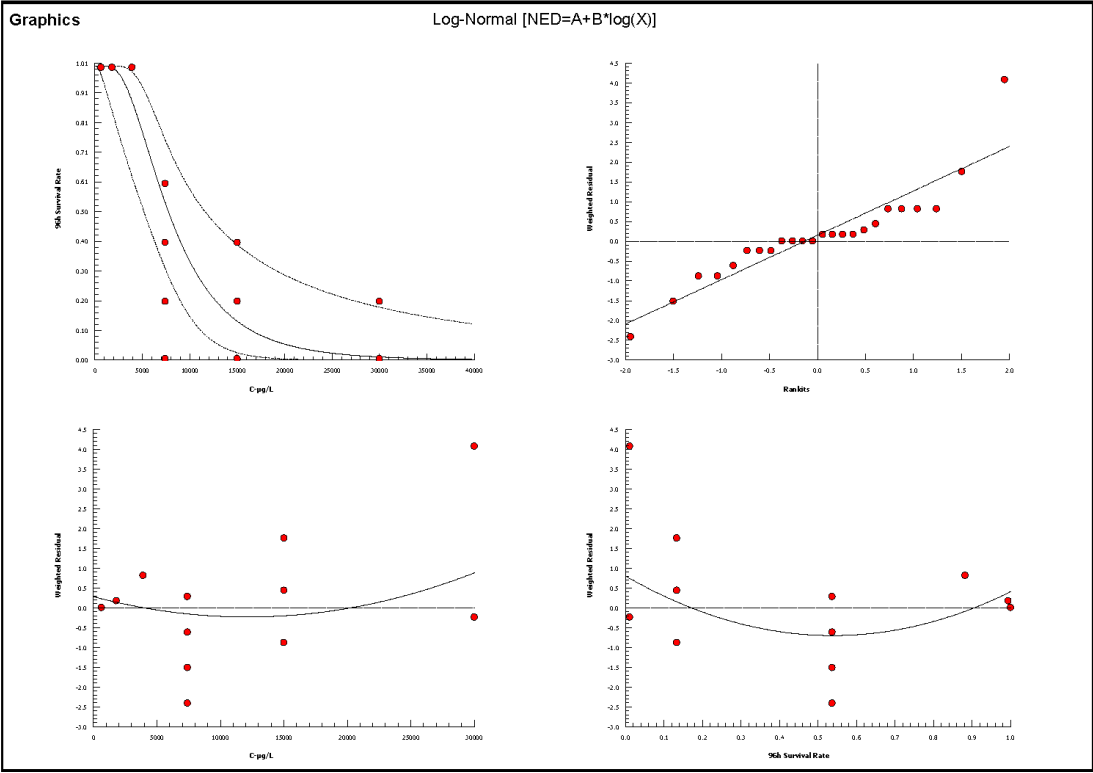
Americamysis 96-h Acute Survival Test						SPAWAR Systems Center					
Analysis ID:	05-2303-6409		Endpoint:	96h Survival Rate			CETIS Version:	CETISv1.8.7			
Analyzed:	28 May-16 10:41		Analysis:	Linear Regression (MLE)			Official Results:	Yes			
Batch ID:	18-0018-1674		Test Type:	Survival (96h)			Analyst:	Marianne A Colvin			
Start Date:	29 Apr-16 09:00		Protocol:	EPA/821/R-02-012 (2002)			Diluent:	Laboratory Seawater			
Ending Date:	03 May-16 09:00		Species:	Americamysis bahia			Brine:	Not Applicable			
Duration:	96h		Source:	Aquatic Research Organisms, NH			Age:	5			
Sample ID:	15-6346-2470		Code:	5D308B46			Client:	SPAWAR			
Sample Date:	29 Apr-16		Material:	Zinc sulfate			Project:	Pulsed Exposure			
Receive Date:	29 Apr-16		Source:	Pulsed Exposure							
Sample Age:	9h		Station:	3 Hour							
Linear Regression Options											
Model Function			Threshold Option		Threshold	Optimized	Pooled	Het Corr	Weighted		
Log-Normal [NED=A+B*log(X)]			Control Threshold		1E-07	No	No	No	Yes		
Regression Summary											
Iters	LL	AICc	BIC	Mu	Sigma	Adj R2	F Stat	Critical	P-Value	Decision(α:5%)	
16	-30.35	65.27	67.06	3.893	0.2547	0.6386	7.619	2.928	0.0009	Significant Lack of Fit	
Point Estimates											
Level	μg/L	95% LCL	95% UCL								
LC50	7810	6271	9733								
Regression Parameters											
Parameter	Estimate	Std Error	95% LCL	95% UCL	t Stat	P-Value	Decision(α:5%)				
Slope	3.926	0.6655	2.622	5.231	5.9	<0.0001	Significant Parameter				
Intercept	-15.28	2.596	-20.37	-10.2	-5.887	<0.0001	Significant Parameter				
ANOVA Table											
Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)					
Model	62.36889	62.36889	1	41.65	<0.0001	Significant					
Lack of Fit	20.71187	5.177967	4	7.619	0.0009	Significant					
Pure Error	12.23353	0.679640	18								
Residual	32.94539	1.497518	22								
Residual Analysis											
Attribute	Method			Test Stat	Critical	P-Value	Decision(α:5%)				
Goodness-of-Fit	Pearson Chi-Sq GOF			32.95	33.92	0.0626	Non-Significant Heterogeneity				
	Likelihood Ratio GOF			25.5	33.92	0.2738	Non-Significant Heterogeneity				
Variances	Mod Levene Equality of Variance			1.327	2.773	0.2972	Equal Variances				
Distribution	Shapiro-Wilk W Normality			0.8677	0.9169	0.0047	Non-normal Distribution				
	Anderson-Darling A2 Normality			1.295	2.492	0.0019	Non-normal Distribution				
96h Survival Rate Summary											
C-μg/L	Control Type	Count	Calculated Variate(A/B)								
			Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
634	Lab Control	4	1	1	1	0	0	0.0%	0.0%	20	20
1800		4	1	1	1	0	0	0.0%	0.0%	20	20
3900		4	1	1	1	0	0	0.0%	0.0%	20	20
7400		4	0.3	0	0.6	0.1291	0.2582	86.07%	70.0%	6	20
15000		4	0.15	0	0.4	0.09574	0.1915	127.7%	85.0%	3	20
30000		4	0.05	0	0.2	0.05	0.1	200.0%	95.0%	1	20

CETIS Analytical Report

Report Date: 02 Jun-16 16:19 (p 2 of 2)
Test Code: 11AAE0C1 | 02-9641-1329

Americamysis 96-h Acute Survival Test					SPAWAR Systems Center
Analysis ID:	05-2303-6409	Endpoint:	96h Survival Rate	CETIS Version:	CETISv1.8.7
Analyzed:	28 May-16 10:41	Analysis:	Linear Regression (MLE)	Official Results:	Yes
96h Survival Rate Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
634	Lab Control	1	1	1	1
1800		1	1	1	1
3900		1	1	1	1
7400		0.6	0.2	0	0.4
15000		0.4	0.2	0	0
30000		0	0.2	0	0

96h Survival Rate Binomials					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
634	Lab Control	5/5	5/5	5/5	5/5
1800		5/5	5/5	5/5	5/5
3900		5/5	5/5	5/5	5/5
7400		3/5	1/5	0/5	2/5
15000		2/5	1/5	0/5	0/5
30000		0/5	1/5	0/5	0/5



CETIS Summary Report

Report Date: 02 Jun-16 16:18 (p 1 of 1)
 Test Code: 64FADE27 | 16-9416-2471

Americamysis 96-h Acute Survival Test							SPAWAR Systems Center				
Batch ID:	18-0018-1674	Test Type:	Survival (96h)				Analyst:	Marianne A Colvin			
Start Date:	29 Apr-16 09:00	Protocol:	EPA/821/R-02-012 (2002)				Diluent:	Laboratory Seawater			
Ending Date:	03 May-16 09:00	Species:	Americamysis bahia				Brine:	Not Applicable			
Duration:	96h	Source:	Aquatic Research Organisms, NH				Age:	5			
Sample ID:	07-6125-3435	Code:	2D5FCE3B				Client:	SPAWAR			
Sample Date:	29 Apr-16	Material:	Zinc sulfate				Project:	Pulsed Exposure			
Receive Date:	29 Apr-16	Source:	Pulsed Exposure								
Sample Age:	9h	Station:	6 Hour								
Comparison Summary											
Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method				
19-0623-5659	96h Survival Rate	1500	2500	1936	17.4%		Steel Many-One Rank Sum Test				
Point Estimate Summary											
Analysis ID	Endpoint	Level	µg/L	95% LCL	95% UCL	TU	Method				
18-7607-5786	96h Survival Rate	LC50	3399	2782	4236		Linear Regression (MLE)				
96h Survival Rate Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
6.4	Lab Control	4	1	1	1	1	1	0	0	0.0%	0.0%
850		4	1	1	1	1	1	0	0	0.0%	0.0%
1500		4	0.95	0.7909	1	0.8	1	0.05	0.1	10.53%	5.0%
2500		4	0.7	0.3818	1	0.4	0.8	0.1	0.2	28.57%	30.0%
5200		4	0.15	0	0.3091	0	0.2	0.05	0.1	66.67%	85.0%
11000		4	0.05	0	0.2091	0	0.2	0.05	0.1	200.0%	95.0%
96h Survival Rate Detail											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
6.4	Lab Control	1	1	1	1						
850		1	1	1	1						
1500		1	1	1	0.8						
2500		0.8	0.4	0.8	0.8						
5200		0.2	0.2	0	0.2						
11000		0	0.2	0	0						
96h Survival Rate Binomials											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
6.4	Lab Control	5/5	5/5	5/5	5/5						
850		5/5	5/5	5/5	5/5						
1500		5/5	5/5	5/5	4/5						
2500		4/5	2/5	4/5	4/5						
5200		1/5	1/5	0/5	1/5						
11000		0/5	1/5	0/5	0/5						

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CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Analytical Report

Report Date: 02 Jun-16 16:18 (p 1 of 2)
Test Code: 64FADE27 | 16-9416-2471

Americamysis 96-h Acute Survival Test						SPAWAR Systems Center					
Analysis ID:	19-0623-5659		Endpoint:	96h Survival Rate			CETIS Version:	CETISv1.8.7			
Analyzed:	28 May-16 10:41		Analysis:	Nonparametric-Control vs Treatments			Official Results:	Yes			
Batch ID:	18-0018-1674		Test Type:	Survival (96h)			Analyst:	Marianne A Colvin			
Start Date:	29 Apr-16 09:00		Protocol:	EPA/821/R-02-012 (2002)			Diluent:	Laboratory Seawater			
Ending Date:	03 May-16 09:00		Species:	Americamysis bahia			Brine:	Not Applicable			
Duration:	96h		Source:	Aquatic Research Organisms, NH			Age:	5			
Sample ID:	07-6125-3435		Code:	2D5FCE3B			Client:	SPAWAR			
Sample Date:	29 Apr-16		Material:	Zinc sulfate			Project:	Pulsed Exposure			
Receive Date:	29 Apr-16		Source:	Pulsed Exposure							
Sample Age:	9h		Station:	6 Hour							
Data Transform	Zeta	Alt Hyp	Trials	Seed		PMSD	NOEL	LOEL	TOEL	TU	
Angular (Corrected)	NA	C > T	NA	NA		17.4%	1500	2500	1936		
Steel Many-One Rank Sum Test											
Control	vs	C-µg/L	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)		
6.4		850	18	10	1	6	0.8333	Asymp	Non-Significant Effect		
6.4		1500	16	10	1	6	0.6105	Asymp	Non-Significant Effect		
6.4		2500*	10	10	0	6	0.0417	Asymp	Significant Effect		
6.4		5200*	10	10	0	6	0.0417	Asymp	Significant Effect		
6.4		11000*	10	10	0	6	0.0417	Asymp	Significant Effect		
ANOVA Table											
Source	Sum Squares		Mean Square		DF	F Stat	P-Value	Decision(α:5%)			
Between	4.671416		0.9342832		5	64.33	<0.0001	Significant Effect			
Error	0.2614278		0.01452377		18						
Total	4.932844				23						
Distributional Tests											
Attribute	Test		Test Stat	Critical	P-Value	Decision(α:1%)					
Variances	Mod Levene Equality of Variance		0.4585	4.248	0.8018	Equal Variances					
Variances	Levene Equality of Variance		4.126	4.248	0.0113	Equal Variances					
Distribution	Shapiro-Wilk W Normality		0.8782	0.884	0.0076	Non-normal Distribution					
96h Survival Rate Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
6.4	Lab Control	4	1	1	1	1	1	1	0	0.0%	0.0%
850		4	1	1	1	1	1	1	0	0.0%	0.0%
1500		4	0.95	0.7909	1	1	0.8	1	0.05	10.53%	5.0%
2500		4	0.7	0.3818	1	0.8	0.4	0.8	0.1	28.57%	30.0%
5200		4	0.15	0	0.3091	0.2	0	0.2	0.05	66.67%	85.0%
11000		4	0.05	0	0.2091	0	0	0.2	0.05	200.0%	95.0%
Angular (Corrected) Transformed Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
6.4	Lab Control	4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
850		4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
1500		4	1.286	1.096	1.475	1.345	1.107	1.345	0.05953	9.26%	4.43%
2500		4	1.002	0.6655	1.338	1.107	0.6847	1.107	0.1056	21.09%	25.55%
5200		4	0.4041	0.2147	0.5936	0.4636	0.2255	0.4636	0.05953	29.46%	69.96%
11000		4	0.285	0.09558	0.4745	0.2255	0.2255	0.4636	0.05953	41.77%	78.81%

CETIS Analytical Report

Report Date: 02 Jun-16 16:18 (p 2 of 2)
 Test Code: 64FADE27 | 16-9416-2471

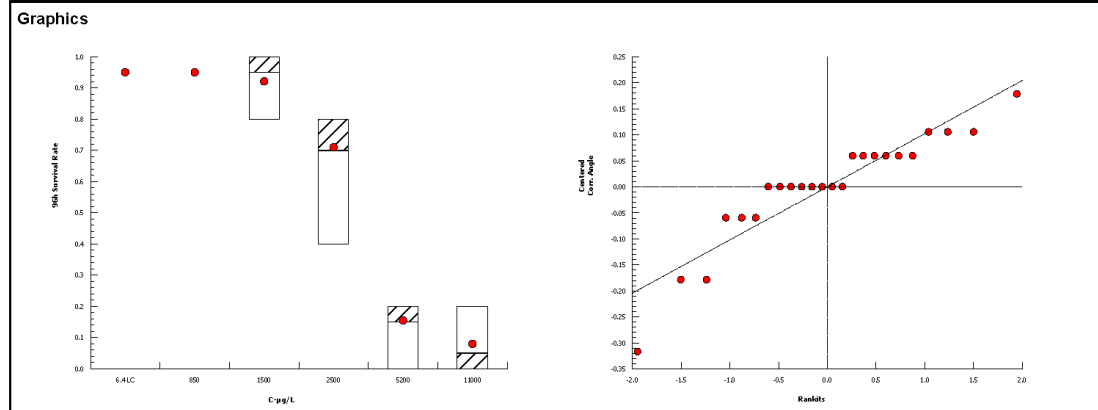
Americamysis 96-h Acute Survival Test SPAWAR Systems Center

Analysis ID: 19-0623-5659 Endpoint: 96h Survival Rate CETIS Version: CETISv1.8.7
 Analyzed: 28 May-16 10:41 Analysis: Nonparametric-Control vs Treatments Official Results: Yes

96h Survival Rate Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
6.4	Lab Control	1	1	1	1
850		1	1	1	1
1500		1	1	1	0.8
2500		0.8	0.4	0.8	0.8
5200		0.2	0.2	0	0.2
11000		0	0.2	0	0

Angular (Corrected) Transformed Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
6.4	Lab Control	1.345	1.345	1.345	1.345
850		1.345	1.345	1.345	1.345
1500		1.345	1.345	1.345	1.107
2500		1.107	0.6847	1.107	1.107
5200		0.4636	0.4636	0.2255	0.4636
11000		0.2255	0.4636	0.2255	0.2255

96h Survival Rate Binomials					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
6.4	Lab Control	5/5	5/5	5/5	5/5
850		5/5	5/5	5/5	5/5
1500		5/5	5/5	5/5	4/5
2500		4/5	2/5	4/5	4/5
5200		1/5	1/5	0/5	1/5
11000		0/5	1/5	0/5	0/5



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CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Analytical Report

Report Date: 02 Jun-16 16:18 (p 1 of 2)
 Test Code: 64FADE27 | 16-9416-2471

Americamysis 96-h Acute Survival Test						SPAWAR Systems Center					
Analysis ID:	18-7607-5786		Endpoint:	96h Survival Rate			CETIS Version:	CETISv1.8.7			
Analyzed:	28 May-16 10:41		Analysis:	Linear Regression (MLE)			Official Results:	Yes			
Batch ID:	18-0018-1674		Test Type:	Survival (96h)			Analyst:	Marianne A Colvin			
Start Date:	29 Apr-16 09:00		Protocol:	EPA/821/R-02-012 (2002)			Diluent:	Laboratory Seawater			
Ending Date:	03 May-16 09:00		Species:	Americamysis bahia			Brine:	Not Applicable			
Duration:	96h		Source:	Aquatic Research Organisms, NH			Age:	5			
Sample ID:	07-6125-3435		Code:	2D5FCE3B			Client:	SPAWAR			
Sample Date:	29 Apr-16		Material:	Zinc sulfate			Project:	Pulsed Exposure			
Receive Date:	29 Apr-16		Source:	Pulsed Exposure							
Sample Age:	9h		Station:	6 Hour							
Linear Regression Options											
Model Function			Threshold Option		Threshold	Optimized	Pooled	Het Corr	Weighted		
Log-Normal [NED=A+B*log(X)]			Control Threshold		1E-07	No	No	No	Yes		
Regression Summary											
Iters	LL	AICc	BIC	Mu	Sigma	Adj R2	F Stat	Critical	P-Value	Decision(α:5%)	
19	-29.56	63.69	65.48	3.531	0.239	0.7879	3.172	2.928	0.0388	Significant Lack of Fit	
Point Estimates											
Level	µg/L	95% LCL	95% UCL								
LC50	3399	2782	4236								
Regression Parameters											
Parameter	Estimate	Std Error	95% LCL	95% UCL	t Stat	P-Value	Decision(α:5%)				
Slope	4.185	0.6923	2.828	5.542	6.045	<0.0001	Significant Parameter				
Intercept	-14.78	2.427	-19.53	-10.02	-6.09	<0.0001	Significant Parameter				
ANOVA Table											
Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)					
Model	69.30309	69.30309	1	86.42	<0.0001	Significant					
Lack of Fit	7.294046	1.823512	4	3.172	0.0388	Significant					
Pure Error	10.3494	0.574967	18								
Residual	17.64345	0.801975	22								
Residual Analysis											
Attribute	Method			Test Stat	Critical	P-Value	Decision(α:5%)				
Goodness-of-Fit	Pearson Chi-Sq GOF			17.64	33.92	0.7269	Non-Significant Heterogeneity				
	Likelihood Ratio GOF			12.36	33.92	0.9495	Non-Significant Heterogeneity				
Variances	Mod Levene Equality of Variance			0.5235	2.773	0.7554	Equal Variances				
Distribution	Shapiro-Wilk W Normality			0.7878	0.9169	0.0002	Non-normal Distribution				
	Anderson-Darling A2 Normality			1.871	2.492	<0.0001	Non-normal Distribution				
96h Survival Rate Summary											
C-µg/L	Control Type	Count	Calculated Variate(A/B)								
			Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
6.4	Lab Control	4	1	1	1	0	0	0.0%	0.0%	20	20
850		4	1	1	1	0	0	0.0%	0.0%	20	20
1500		4	0.95	0.8	1	0.05	0.1	10.53%	5.0%	19	20
2500		4	0.7	0.4	0.8	0.1	0.2	28.57%	30.0%	14	20
5200		4	0.15	0	0.2	0.05	0.1	66.67%	85.0%	3	20
11000		4	0.05	0	0.2	0.05	0.1	200.0%	95.0%	1	20

CETIS Analytical Report

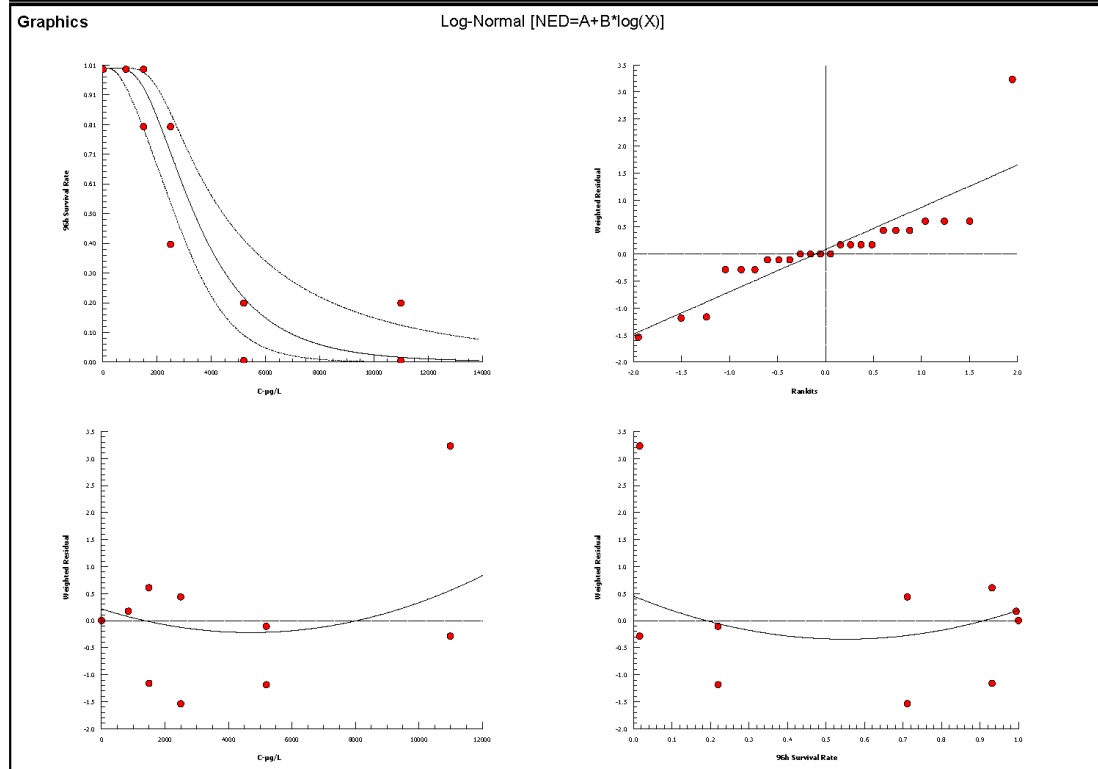
Report Date: 02 Jun-16 16:18 (p 2 of 2)
Test Code: 64FADE27 | 16-9416-2471

Americamysis 96-h Acute Survival Test SPAWAR Systems Center

Analysis ID: 18-7607-5786 Endpoint: 96h Survival Rate CETIS Version: CETISv1.8.7
Analyzed: 28 May-16 10:41 Analysis: Linear Regression (MLE) Official Results: Yes

96h Survival Rate Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
6.4	Lab Control	1	1	1	1
850		1	1	1	1
1500		1	1	1	0.8
2500		0.8	0.4	0.8	0.8
5200		0.2	0.2	0	0.2
11000		0	0.2	0	0

96h Survival Rate Binomials					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
6.4	Lab Control	5/5	5/5	5/5	5/5
850		5/5	5/5	5/5	5/5
1500		5/5	5/5	5/5	4/5
2500		4/5	2/5	4/5	4/5
5200		1/5	1/5	0/5	1/5
11000		0/5	1/5	0/5	0/5



000-010-187-1

CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Summary Report

Report Date: 03 Jun-16 08:56 (p 1 of 1)
 Test Code: AEDBC3C | 01-8335-2380

Americamysis 96-h Acute Survival Test								SPAWAR Systems Center			
Batch ID:	18-0018-1674		Test Type:		Survival (96h)			Analyst:	Marianne A Colvin		
Start Date:	29 Apr-16 09:00		Protocol:		EPA/821/R-02-012 (2002)			Diluent:	Laboratory Seawater		
Ending Date:	03 May-16 09:00		Species:		Americamysis bahia			Brine:	Not Applicable		
Duration:	96h		Source:		Aquatic Research Organisms, NH			Age:	5		
Sample ID:	08-9124-8358		Code:		351F5EE6			Client:	SPAWAR		
Sample Date:	29 Apr-16		Material:		Zinc sulfate			Project:	Pulsed Exposure		
Receive Date:	29 Apr-16		Source:		Pulsed Exposure						
Sample Age:	9h		Station:		12 Hour						
Comparison Summary											
Analysis ID	Endpoint		NOEL	LOEL	TOEL	PM SD	TU	Method			
04-4300-7307	96h Survival Rate		1500	3100	2156	17.5%		Dunnett Multiple Comparison Test			
Point Estimate Summary											
Analysis ID	Endpoint		Level	µg/L	95% LCL	95% UCL	TU	Method			
01-0152-0575	96h Survival Rate		LC50	2774	2260	3456		Linear Regression (MLE)			
96h Survival Rate Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
6.4	Lab Control	4	1	1	1	1	1	0	0	0.0%	0.0%
360		4	1	1	1	1	1	0	0	0.0%	0.0%
910		4	0.95	0.7909	1	0.8	1	0.05	0.1	10.53%	5.0%
1500		4	0.95	0.7909	1	0.8	1	0.05	0.1	10.53%	5.0%
3100		4	0.35	0.0453	0.6547	0.2	0.6	0.09574	0.1915	54.71%	65.0%
5900		4	0.1	0	0.2837	0	0.2	0.05774	0.1155	115.5%	90.0%
96h Survival Rate Detail											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
6.4	Lab Control	1	1	1	1						
360		1	1	1	1						
910		1	1	0.8	1						
1500		1	1	1	0.8						
3100		0.2	0.4	0.6	0.2						
5900		0	0.2	0.2	0						
96h Survival Rate Binomials											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
6.4	Lab Control	5/5	5/5	5/5	5/5						
360		5/5	5/5	5/5	5/5						
910		5/5	5/5	4/5	5/5						
1500		5/5	5/5	5/5	4/5						
3100		1/5	2/5	3/5	1/5						
5900		0/5	1/5	1/5	0/5						

CETIS Analytical Report

Report Date: 02 Jun-16 16:17 (p 1 of 4)
 Test Code: AEDBC3C | 01-8335-2380

Americamysis 96-h Acute Survival Test						SPAWAR Systems Center					
Analysis ID:	04-4300-7307		Endpoint:	96h Survival Rate			CETIS Version:	CETISv1.8.7			
Analyzed:	28 May-16 10:40		Analysis:	Parametric-Control vs Treatments			Official Results:	Yes			
Batch ID:	18-0018-1674		Test Type:	Survival (96h)			Analyst:	Marianne A Colvin			
Start Date:	29 Apr-16 09:00		Protocol:	EPA/821/R-02-012 (2002)			Diluent:	Laboratory Seawater			
Ending Date:	03 May-16 09:00		Species:	Americamysis bahia			Brine:	Not Applicable			
Duration:	96h		Source:	Aquatic Research Organisms, NH			Age:	5			
Sample ID:	08-9124-8358		Code:	351F5EE6			Client:	SPAWAR			
Sample Date:	29 Apr-16		Material:	Zinc sulfate			Project:	Pulsed Exposure			
Receive Date:	29 Apr-16		Source:	Pulsed Exposure							
Sample Age:	9h		Station:	12 Hour							
Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	NOEL	LOEL	TOEL	TU		
Angular (Corrected)	NA	C > T	NA	NA	17.5%	1500	3100	2156			
Dunnnett Multiple Comparison Test											
Control	vs	C-µg/L	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)		
6.4		360	0	2.407	0.207	6	0.8333	CDF	Non-Significant Effect		
6.4		910	0.6931	2.407	0.207	6	0.5611	CDF	Non-Significant Effect		
6.4		1500	0.6931	2.407	0.207	6	0.5611	CDF	Non-Significant Effect		
6.4		3100*	8.392	2.407	0.207	6	<0.0001	CDF	Significant Effect		
6.4		5900*	11.65	2.407	0.207	6	<0.0001	CDF	Significant Effect		
ANOVA Table											
Source	Sum Squares		Mean Square		DF	F Stat	P-Value	Decision(α:5%)			
Between	3.853589		0.7707179		5	52.24	<0.0001	Significant Effect			
Error	0.2655657		0.01475365		18						
Total	4.119155				23						
Distributional Tests											
Attribute	Test		Test Stat	Critical	P-Value		Decision(α:1%)				
Variances	Mod Levene Equality of Variance		2.57	4.248	0.0635		Equal Variances				
Variances	Levene Equality of Variance		7.267	4.248	0.0007		Unequal Variances				
Distribution	Shapiro-Wilk W Normality		0.9014	0.884	0.0231		Normal Distribution				
96h Survival Rate Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
6.4	Lab Control	4	1	1	1	1	1	1	0	0.0%	0.0%
360		4	1	1	1	1	1	1	0	0.0%	0.0%
910		4	0.95	0.7909	1	1	0.8	1	0.05	10.53%	5.0%
1500		4	0.95	0.7909	1	1	0.8	1	0.05	10.53%	5.0%
3100		4	0.35	0.0453	0.6547	0.3	0.2	0.6	0.09574	54.71%	65.0%
5900		4	0.1	0	0.2837	0.1	0	0.2	0.05774	115.5%	90.0%
Angular (Corrected) Transformed Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
6.4	Lab Control	4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
360		4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
910		4	1.286	1.096	1.475	1.345	1.107	1.345	0.05953	9.26%	4.43%
1500		4	1.286	1.096	1.475	1.345	1.107	1.345	0.05953	9.26%	4.43%
3100		4	0.6245	0.3013	0.9478	0.5742	0.4636	0.8861	0.1016	32.53%	53.58%
5900		4	0.3446	0.1258	0.5634	0.3446	0.2255	0.4636	0.06874	39.9%	74.39%

CETIS Analytical Report

Report Date: 02 Jun-16 16:17 (p 2 of 4)
 Test Code: AEDBC3C | 01-8335-2380

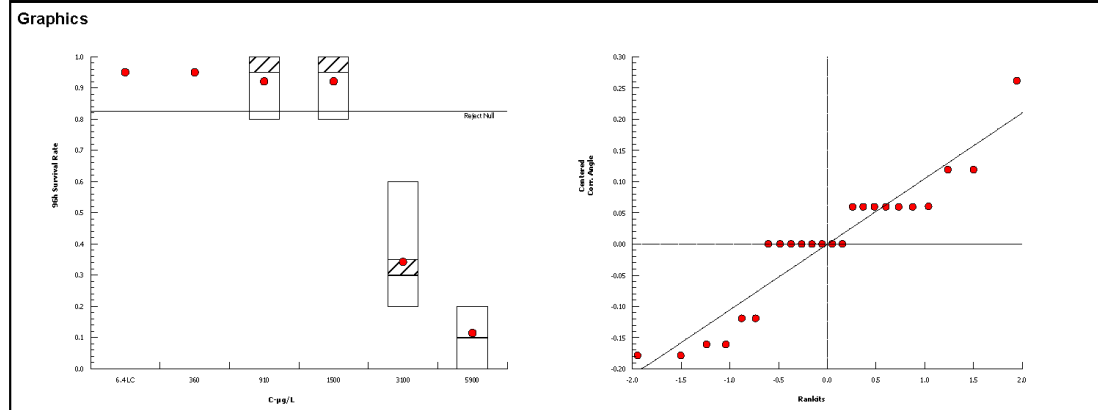
Americamysis 96-h Acute Survival Test SPAWAR Systems Center

Analysis ID: 04-4300-7307 Endpoint: 96h Survival Rate CETIS Version: CETISv1.8.7
 Analyzed: 28 May-16 10:40 Analysis: Parametric-Control vs Treatments Official Results: Yes

96h Survival Rate Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
6.4	Lab Control	1	1	1	1
360		1	1	1	1
910		1	1	0.8	1
1500		1	1	1	0.8
3100		0.2	0.4	0.6	0.2
5900		0	0.2	0.2	0

Angular (Corrected) Transformed Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
6.4	Lab Control	1.345	1.345	1.345	1.345
360		1.345	1.345	1.345	1.345
910		1.345	1.345	1.107	1.345
1500		1.345	1.345	1.345	1.107
3100		0.4636	0.6847	0.8861	0.4636
5900		0.2255	0.4636	0.4636	0.2255

96h Survival Rate Binomials					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
6.4	Lab Control	5/5	5/5	5/5	5/5
360		5/5	5/5	5/5	5/5
910		5/5	5/5	4/5	5/5
1500		5/5	5/5	5/5	4/5
3100		1/5	2/5	3/5	1/5
5900		0/5	1/5	1/5	0/5



000-010-187-1

CETIS™ v1.8.7.16

Analyst: _____ QA: _____

CETIS Analytical Report

Report Date: 02 Jun-16 16:17 (p 1 of 4)
Test Code: AEDBC3C | 01-8335-2380

Americamysis 96-h Acute Survival Test						SPAWAR Systems Center					
Analysis ID:	01-0152-0575		Endpoint:	96h Survival Rate			CETIS Version:	CETISv1.8.7			
Analyzed:	28 May-16 10:40		Analysis:	Linear Regression (MLE)			Official Results:	Yes			
Batch ID:	18-0018-1674		Test Type:	Survival (96h)			Analyst:	Marianne A Colvin			
Start Date:	29 Apr-16 09:00		Protocol:	EPA/821/R-02-012 (2002)			Diluent:	Laboratory Seawater			
Ending Date:	03 May-16 09:00		Species:	Americamysis bahia			Brine:	Not Applicable			
Duration:	96h		Source:	Aquatic Research Organisms, NH			Age:	5			
Sample ID:	08-9124-8358		Code:	351F5EE6			Client:	SPAWAR			
Sample Date:	29 Apr-16		Material:	Zinc sulfate			Project:	Pulsed Exposure			
Receive Date:	29 Apr-16		Source:	Pulsed Exposure							
Sample Age:	9h		Station:	12 Hour							
Linear Regression Options											
Model Function			Threshold Option		Threshold	Optimized	Pooled	Het Corr	Weighted		
Log-Normal [NED=A+B*log(X)]			Control Threshold		1E-07	Yes	No	No	Yes		
Regression Summary											
Iters	LL	AICc	BIC	Mu	Sigma	Adj R2	F Stat	Critical	P-Value	Decision(α:5%)	
9	-28.65	64.51	66.84	3.443	0.2372	0.7903	2.796	3.16	0.0698	Non-Significant Lack of Fit	
Point Estimates											
Level	μg/L	95% LCL	95% UCL								
LC50	2774	2260	3456								
Regression Parameters											
Parameter	Estimate	Std Error	95% LCL	95% UCL	t Stat	P-Value	Decision(α:5%)				
Threshold	9.13E-08	6.75E-05	-0.00013	0.000133	0.001352	0.9989	Non-Significant Parameter				
Slope	4.215	0.738	2.769	5.662	5.711	<0.0001	Significant Parameter				
Intercept	-14.51	2.53	-19.47	-9.554	-5.736	<0.0001	Significant Parameter				
ANOVA Table											
Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)					
Model	67.82536	67.82536	1	88.68	<0.0001	Significant					
Lack of Fit	5.106187	1.702062	3	2.796	0.0698	Non-Significant					
Pure Error	10.95559	0.608644	18								
Residual	16.06178	0.764847	21								
Residual Analysis											
Attribute	Method			Test Stat	Critical	P-Value	Decision(α:5%)				
Goodness-of-Fit	Pearson Chi-Sq GOF			16.06	32.67	0.7662	Non-Significant Heterogeneity				
	Likelihood Ratio GOF			13.82	32.67	0.8772	Non-Significant Heterogeneity				
Variances	Mod Levene Equality of Variance			1.095	2.773	0.3968	Equal Variances				
Distribution	Shapiro-Wilk W Normality			0.841	0.9169	0.0015	Non-normal Distribution				
	Anderson-Darling A2 Normality			1.197	2.492	0.0039	Non-normal Distribution				
96h Survival Rate Summary											
			Calculated Variate(A/B)								
C-μg/L	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
6.4	Lab Control	4	1	1	1	0	0	0.0%	0.0%	20	20
360		4	1	1	1	0	0	0.0%	0.0%	20	20
910		4	0.95	0.8	1	0.05	0.1	10.53%	5.0%	19	20
1500		4	0.95	0.8	1	0.05	0.1	10.53%	5.0%	19	20
3100		4	0.35	0.2	0.6	0.09574	0.1915	54.71%	65.0%	7	20
5900		4	0.1	0	0.2	0.05774	0.1155	115.5%	90.0%	2	20

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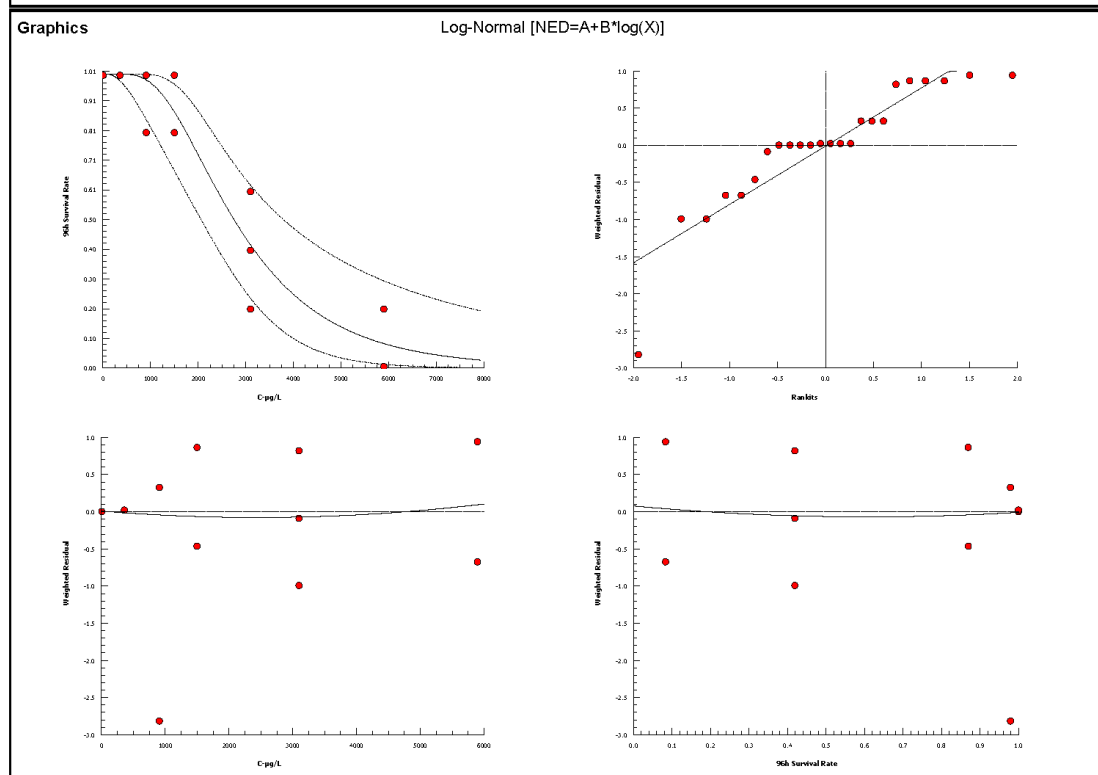
CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Analytical Report

Report Date: 02 Jun-16 16:17 (p 2 of 4)
Test Code: AEDBC3C | 01-8335-2380

Americamysis 96-h Acute Survival Test					SPAWAR Systems Center
Analysis ID:	01-0152-0575	Endpoint:	96h Survival Rate	CETIS Version:	CETISv1.8.7
Analyzed:	28 May-16 10:40	Analysis:	Linear Regression (MLE)	Official Results:	Yes
96h Survival Rate Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
6.4	Lab Control	1	1	1	1
360		1	1	1	1
910		1	1	0.8	1
1500		1	1	1	0.8
3100		0.2	0.4	0.6	0.2
5900		0	0.2	0.2	0
96h Survival Rate Binomials					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
6.4	Lab Control	5/5	5/5	5/5	5/5
360		5/5	5/5	5/5	5/5
910		5/5	5/5	4/5	5/5
1500		5/5	5/5	5/5	4/5
3100		1/5	2/5	3/5	1/5
5900		0/5	1/5	1/5	0/5



000-010-187-1

CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Summary Report

Report Date: 02 Jun-16 16:16 (p 1 of 1)
 Test Code: 355A0788 | 08-9509-2616

Americamysis 96-h Acute Survival Test							SPAWAR Systems Center				
Batch ID:	18-0018-1674		Test Type:	Survival (96h)			Analyst:	Marianne A Colvin			
Start Date:	29 Apr-16 09:00		Protocol:	EPA/821/R-02-012 (2002)			Diluent:	Laboratory Seawater			
Ending Date:	03 May-16 09:00		Species:	Americamysis bahia			Brine:	Not Applicable			
Duration:	96h		Source:	Aquatic Research Organisms, NH			Age:	5			
Sample ID:	19-4574-6907		Code:	73F9BDDDB			Client:	SPAWAR			
Sample Date:	29 Apr-16		Material:	Zinc sulfate			Project:	Pulsed Exposure			
Receive Date:	29 Apr-16		Source:	Pulsed Exposure							
Sample Age:	9h		Station:	Static							
Comparison Summary											
Analysis ID	Endpoint		NOEL	LOEL	TOEL	PMSD	TU		Method		
13-8748-5682	96h Survival Rate		320	860	524.6	14.3%			Steel Many-One Rank Sum Test		
Point Estimate Summary											
Analysis ID	Endpoint		Level	µg/L	95% LCL	95% UCL	TU		Method		
07-3770-3886	96h Survival Rate		LC50	573	412	706.5			Linear Regression (MLE)		
96h Survival Rate Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
6.4	Lab Control	4	1	1	1	1	1	0	0	0.0%	0.0%
81		4	0.95	0.7909	1	0.8	1	0.05	0.1	10.53%	5.0%
150		4	1	1	1	1	1	0	0	0.0%	0.0%
320		4	0.95	0.7909	1	0.8	1	0.05	0.1	10.53%	5.0%
860		4	0.1	0	0.2837	0	0.2	0.05774	0.1155	115.5%	90.0%
1600		4	0	0	0	0	0	0	0		100.0%
96h Survival Rate Detail											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
6.4	Lab Control	1	1	1	1						
81		1	1	1	0.8						
150		1	1	1	1						
320		1	1	1	0.8						
860		0	0	0.2	0.2						
1600		0	0	0	0						
96h Survival Rate Binomials											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
6.4	Lab Control	5/5	5/5	5/5	5/5						
81		5/5	5/5	5/5	4/5						
150		5/5	5/5	5/5	5/5						
320		5/5	5/5	5/5	4/5						
860		0/5	0/5	1/5	1/5						
1600		0/5	0/5	0/5	0/5						

CETIS Analytical Report

Report Date: 02 Jun-16 16:16 (p 1 of 2)
 Test Code: 355A0788 | 08-9509-2616

Americamysis 96-h Acute Survival Test						SPAWAR Systems Center					
Analysis ID:	13-8748-5682		Endpoint:	96h Survival Rate			CETIS Version: CETISv1.8.7				
Analyzed:	28 May-16 10:38		Analysis:	Nonparametric-Control vs Treatments			Official Results: Yes				
Batch ID:	18-0018-1674		Test Type:	Survival (96h)			Analyst:	Marianne A Colvin			
Start Date:	29 Apr-16 09:00		Protocol:	EPA/821/R-02-012 (2002)			Diluent:	Laboratory Seawater			
Ending Date:	03 May-16 09:00		Species:	Americamysis bahia			Brine:	Not Applicable			
Duration:	96h		Source:	Aquatic Research Organisms, NH			Age:	5			
Sample ID:	19-4574-6907		Code:	73F9BDDDB			Client:	SPAWAR			
Sample Date:	29 Apr-16		Material:	Zinc sulfate			Project:	Pulsed Exposure			
Receive Date:	29 Apr-16		Source:	Pulsed Exposure							
Sample Age:	9h		Station:	Static							
Data Transform	Zeta	Alt Hyp	Trials	Seed		PMSD	NOEL	LOEL	TOEL	TU	
Angular (Corrected)	NA	C > T	NA	NA		14.3%	320	860	524.6		
Steel Many-One Rank Sum Test											
Control	vs	C-µg/L	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)		
6.4		81	16	10	1	6	0.5661	Asymp	Non-Significant Effect		
6.4		150	18	10	1	6	0.8000	Asymp	Non-Significant Effect		
6.4		320	16	10	1	6	0.5661	Asymp	Non-Significant Effect		
6.4		860*	10	10	0	6	0.0350	Asymp	Significant Effect		
ANOVA Table											
Source	Sum Squares		Mean Square		DF	F Stat	P-Value	Decision(α:5%)			
Between	3.030868		0.7577171		4	80.17	<0.0001	Significant Effect			
Error	0.1417698		0.009451317		15						
Total	3.172638				19						
Distributional Tests											
Attribute	Test		Test Stat	Critical	P-Value	Decision(α:1%)					
Variances	Mod Levene Equality of Variance		1.75	4.893	0.1915	Equal Variances					
Variances	Levene Equality of Variance		8.75	4.893	0.0007	Unequal Variances					
Distribution	Shapiro-Wilk W Normality		0.8533	0.866	0.0061	Non-normal Distribution					
96h Survival Rate Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
6.4	Lab Control	4	1	1	1	1	1	1	0	0.0%	0.0%
81		4	0.95	0.7909	1	1	0.8	1	0.05	10.53%	5.0%
150		4	1	1	1	1	1	1	0	0.0%	0.0%
320		4	0.95	0.7909	1	1	0.8	1	0.05	10.53%	5.0%
860		4	0.1	0	0.2837	0.1	0	0.2	0.05774	115.5%	90.0%
1600		4	0	0	0	0	0	0	0		100.0%
Angular (Corrected) Transformed Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
6.4	Lab Control	4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
81		4	1.286	1.096	1.475	1.345	1.107	1.345	0.05953	9.26%	4.43%
150		4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
320		4	1.286	1.096	1.475	1.345	1.107	1.345	0.05953	9.26%	4.43%
860		4	0.3446	0.1258	0.5634	0.3446	0.2255	0.4636	0.06874	39.9%	74.39%
1600		4	0.2255	0.2255	0.2256	0.2255	0.2255	0.2255	0	0.0%	83.24%

CETIS Analytical Report

Report Date: 02 Jun-16 16:16 (p 2 of 2)
Test Code: 355A0788 | 08-9509-2616

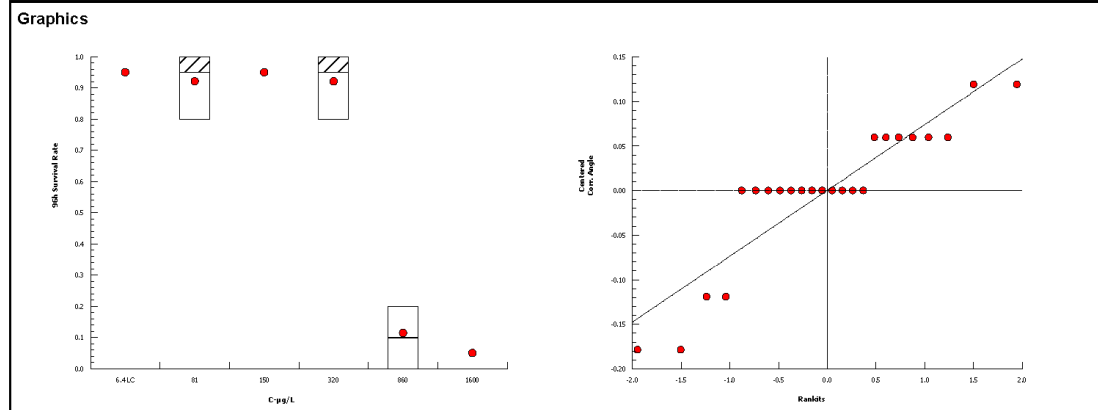
Americamysis 96-h Acute Survival Test SPAWAR Systems Center

Analysis ID: 13-8748-5682 Endpoint: 96h Survival Rate CETIS Version: CETISv1.8.7
Analyzed: 28 May-16 10:38 Analysis: Nonparametric-Control vs Treatments Official Results: Yes

96h Survival Rate Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
6.4	Lab Control	1	1	1	1
81		1	1	1	0.8
150		1	1	1	1
320		1	1	1	0.8
860		0	0	0.2	0.2
1600		0	0	0	0

Angular (Corrected) Transformed Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
6.4	Lab Control	1.345	1.345	1.345	1.345
81		1.345	1.345	1.345	1.107
150		1.345	1.345	1.345	1.345
320		1.345	1.345	1.345	1.107
860		0.2255	0.2255	0.4636	0.4636
1600		0.2255	0.2255	0.2255	0.2255

96h Survival Rate Binomials					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
6.4	Lab Control	5/5	5/5	5/5	5/5
81		5/5	5/5	5/5	4/5
150		5/5	5/5	5/5	5/5
320		5/5	5/5	5/5	4/5
860		0/5	0/5	1/5	1/5
1600		0/5	0/5	0/5	0/5



000-010-187-1

CETIS™ v1.8.7.16

Analyst: _____ QA: _____

CETIS Analytical Report

Report Date: 02 Jun-16 16:16 (p 1 of 2)
Test Code: 355A0788 | 08-9509-2616

Americamysis 96-h Acute Survival Test						SPAWAR Systems Center					
Analysis ID: 07-3770-3886		Endpoint: 96h Survival Rate				CETIS Version: CETISv1.8.7					
Analyzed: 28 May-16 10:38		Analysis: Linear Regression (MLE)				Official Results: Yes					
Batch ID: 18-0018-1674		Test Type: Survival (96h)				Analyst: Marianne A Colvin					
Start Date: 29 Apr-16 09:00		Protocol: EPA/821/R-02-012 (2002)				Diluent: Laboratory Seawater					
Ending Date: 03 May-16 09:00		Species: Americamysis bahia				Brine: Not Applicable					
Duration: 96h		Source: Aquatic Research Organisms, NH				Age: 5					
Sample ID: 19-4574-6907		Code: 73F9BDDDB				Client: SPAWAR					
Sample Date: 29 Apr-16		Material: Zinc sulfate				Project: Pulsed Exposure					
Receive Date: 29 Apr-16		Source: Pulsed Exposure									
Sample Age: 9h		Station: Static									
Linear Regression Options											
Model Function			Threshold Option		Threshold	Optimized	Pooled	Het Corr	Weighted		
Log-Normal [NED=A+B*log(X)]			Control Threshold		1E-07	Yes	No	No	Yes		
Regression Summary											
Iters	LL	AICc	BIC	Mu	Sigma	Adj R2	F Stat	Critical	P-Value	Decision(α:5%)	
11	-15.57	38.34	40.67	2.758	0.1375	0.8278	5.67	3.16	0.0065	Significant Lack of Fit	
Point Estimates											
Level	µg/L	95% LCL	95% UCL								
LC50	573	412	706.5								
Regression Parameters											
Parameter	Estimate	Std Error	95% LCL	95% UCL	t Stat	P-Value	Decision(α:5%)				
Threshold	0.01676	0.01656	-0.0157	0.04922	1.012	0.3231	Non-Significant Parameter				
Slope	7.271	1.807	3.729	10.81	4.023	0.0006	Significant Parameter				
Intercept	-20.05	5.131	-30.11	-9.997	-3.908	0.0008	Significant Parameter				
ANOVA Table											
Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)					
Model	88.99298	88.99298	1	112.5	<0.0001	Significant					
Lack of Fit	8.069011	2.68967	3	5.67	0.0065	Significant					
Pure Error	8.538012	0.474334	18								
Residual	16.60702	0.790811	21								
Residual Analysis											
Attribute	Method	Test Stat	Critical	P-Value	Decision(α:5%)						
Goodness-of-Fit	Pearson Chi-Sq GOF	16.61	32.67	0.7346	Non-Significant Heterogenity						
	Likelihood Ratio GOF	11.12	32.67	0.9603	Non-Significant Heterogenity						
Variances	Mod Levene Equality of Variance	0.9677	2.773	0.4634	Equal Variances						
Distribution	Shapiro-Wilk W Normality	0.6616	0.9169	<0.0001	Non-normal Distribution						
	Anderson-Darling A2 Normality	3.359	2.492	<0.0001	Non-normal Distribution						
96h Survival Rate Summary											
			Calculated Variate(A/B)								
C-µg/L	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
6.4	Lab Control	4	1	1	1	0	0	0.0%	0.0%	20	20
81		4	0.95	0.8	1	0.05	0.1	10.53%	5.0%	19	20
150		4	1	1	1	0	0	0.0%	0.0%	20	20
320		4	0.95	0.8	1	0.05	0.1	10.53%	5.0%	19	20
860		4	0.1	0	0.2	0.05774	0.1155	115.5%	90.0%	2	20
1600		4	0	0	0	0	0	100.0%	0	20	

000-010-187-1

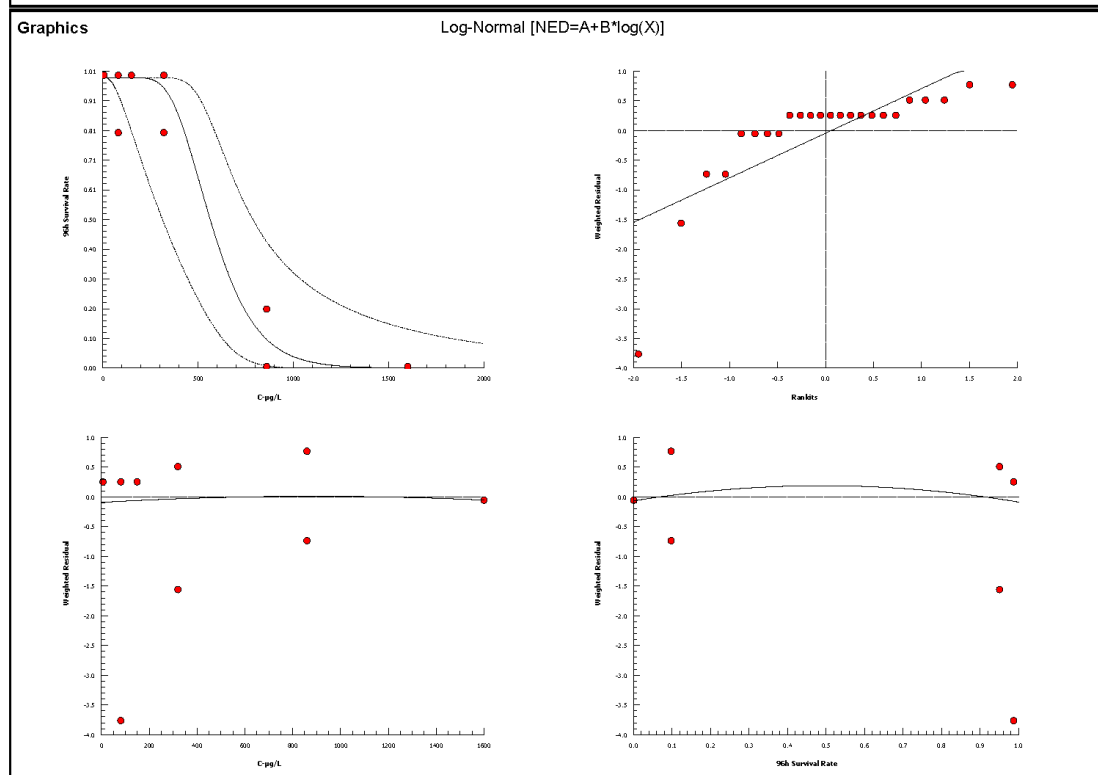
CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Analytical Report

Report Date: 02 Jun-16 16:16 (p 2 of 2)
Test Code: 355A0788 | 08-9509-2616

Americamysis 96-h Acute Survival Test					SPAWAR Systems Center
Analysis ID: 07-3770-3886		Endpoint: 96h Survival Rate		CETIS Version: CETISv1.8.7	
Analyzed: 28 May-16 10:38		Analysis: Linear Regression (MLE)		Official Results: Yes	
96h Survival Rate Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
6.4	Lab Control	1	1	1	1
81		1	1	1	0.8
150		1	1	1	1
320		1	1	1	0.8
860		0	0	0.2	0.2
1600		0	0	0	0
96h Survival Rate Binomials					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
6.4	Lab Control	5/5	5/5	5/5	5/5
81		5/5	5/5	5/5	4/5
150		5/5	5/5	5/5	5/5
320		5/5	5/5	5/5	4/5
860		0/5	0/5	1/5	1/5
1600		0/5	0/5	0/5	0/5



000-010-187-1

CETIS™ v1.8.7.16

Analyst: _____ QA: _____

Marine Acute Bioassay
Static-Renewal Conditions

Water Quality Measurements
& Test Organism Survival

Project: Mix/Metal Pulse Test Cu+Zn Test Species: A. balearica
Sample ID: 3hr Cu+Zn Start Date/Time: 4/24/16 0900
Test No.: End Date/Time: 5/3/16 0900

Tech Initials				
0	24	48	72	96
JA	JA	JA	JA	JA
Readings: JA	JA	JA	JA	JA
Dilutions made by: S/AC				

Sample ID	Rep	Number of Live Organisms					Salinity (ppt)					Temperature (°C)					Dissolved Oxygen (mg/L)					pH (units)				
		0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96
LC	A	5	5	5	5	5	34.2	33.9	33.8	34.9	34.8	18.1	18.1	18.1	18.8	18.4	2.9	2.4	2.4	2.4	2.1	7.88	8.01	8.02	7.97	7.17
	B	5	5	5	5	5																				
	C	5	5	5	5	5																				
	D	5	5	5	5	5																				
TU.125	A	5	5	5	5	5	34.1	34.5	34.5	34.5	34.9	18.2	18.2	18.1	18.9	18.6	2.5	2.7	2.6	2.7	2.0	8.04	8.01	8.01	7.94	7.94
	B	5	5	5	5	5																				
	C	5	5	5	5	5																				
	D	5	5	5	5	5																				
TU.25	A	5	5	5	5	5	34.7	34.3	34.6	34.9	34.8	18.1	18.1	18.1	18.9	18.7	2.6	2.7	2.4	2.7	2.1	7.77	7.79	7.88	7.84	7.71
	B	5	5	5	5	5																				
	C	5	5	5	5	5																				
	D	5	5	5	5	5																				
TU.5	A	5	4	4	3	3	33.9	34.9	34.3	34.5	34.8	18.1	18.2	18.1	18.6	18.8	2.6	2.8	2.5	2.6	2.0	7.77	7.79	7.88	7.84	7.78
	B	5	2	1	1	1																				
	C	5	3	0	-	-																				
	D	5	4	2	2	2																				
TU.1	A	5	3	2	2	2	34.1	34.5	34.7	34.8	34.1	18.0	18.1	18.7	18.9	18.9	2.7	2.8	2.5	2.7	2.3	7.88	7.88	7.84	7.86	
	B	5	3	3	1	1																				
	C	5	0	-	-	-																				
	D	4	1	1	1	0																				
TU.2	A	3	0	0	-	-	34.1	34.3	34.3	34.6	-	18.2	18.1	18.1	18.0	-	2.9	2.9	2.7	2.6	-	7.87	8.01	7.88	7.94	-
	B	5	1	1	1	1																				
	C	4	0	-	-	-																				
	D	5	0	-	-	-																				
A																										
B																										
C																										
D																										

Initial Counts
QC'd by: Jue

Animal Source/Date Received: ARO 4/28/16 Age at Initiation: 5d

Comments: i = initial reading in fresh test solution, f = final reading in test chamber prior to renewal

Organisms fed prior to initiation, circle one (y/n) (y)

Tests aerated? Circle one (y/n) (y) If yes, sample ID(s): Duration:

Aeration source:

QC Check: 6/1/2016 Jue

Final Review: Jue 6/2/16

Feeding Times				
0	24	48	72	96
AM: 0700	1100	1100	0930	0815
PM: 1400	1800	1400	1600	-

Marine Acute Bioassay
Static-Renewal Conditions

Water Quality Measurements
& Test Organism Survival

Project: Mixed Metal Pesticide Test Cu+Zn Test Species: A. bailey
Sample ID: 6 hr Cu+Zn Start Date/Time: 4/2/16 0900
Test No.: _____ End Date/Time: 5/3/16 0900

Tech Initials				
0	24	48	72	96
Counts: <u>JA</u>	<u>JA</u>	<u>JA</u>	<u>JA</u>	<u>JA</u>
Readings: <u>JA</u>	<u>JA</u>	<u>JA</u>	<u>JA</u>	<u>JA</u>
Dilutions made by: <u>JA</u>				

Sample ID	Rep	Number of Live Organisms					Salinity (ppt)					Temperature (°C)					Dissolved Oxygen (mg/L)					pH (units)				
		0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96
LC (Shaded 3 hr)	A	5	5	5	5	5	34.9	34.3	33.9	34.4	34.8	19.0	19.1	19.1	18.8	19.4	7.7	7.8	7.9	7.8	7.1	7.88	7.17	7.88	8.17	7.17
	B	5	5	5	5	5																				
	C	5	5	5	5	5																				
	D	5	5	5	5	5																				
TU-125	A	5	5	5	5	5	34.1	33.9	34.3	34.6	34.8	19.2	19.1	19.1	18.8	19.4	7.8	7.9	7.8	7.7	7.4	7.91	8.01	8.00	8.00	7.88
	B	5	5	5	5	5																				
	C	5	5	5	5	5																				
	D	5	5	5	5	5																				
TU-25	A	5	5	5	5	5	34.5	34.6	34.5	34.7	34.7	19.2	19.0	19.1	18.8	19.6	7.9	7.6	7.5	7.6	7.2	8.01	8.01	8.00	7.86	7.93
	B	5	5	5	5	5																				
	C	5	5	5	5	5																				
	D	5	5	5	4	4																				
TU-5	A	5	4	4	4	4	34.7	34.5	34.6	34.9	34.6	19.2	19.0	19.1	18.8	19.7	7.6	7.5	7.6	7.7	7.2	7.88	7.88	7.87	7.81	7.96
	B	5	4	3	2	2																				
	C	5	5	5	4	4																				
	D	5	4	4	4	4																				
TU-1	A	5	2	1	1	1	34.5	34.3	34.5	34.8	34.8	19.0	19.1	19.1	18.8	19.6	7.5	7.7	7.6	7.8	7.2	7.88	7.97	7.67	7.71	7.96
	B	5	2	1	1	1																				
	C	5	3	0	-	-																				
	D	5	2	1	1	1																				
TU-2	A	5	0	-	-	-	33.9	33.1	34.3	34.7	34.9	19.1	19.1	19.1	18.8	19.6	7.7	7.6	7.7	7.7	7.2	7.90	7.80	7.80	7.81	7.97
	B	5	2	1	1	1																				
	C	4	2	0	-	-																				
	D	5	2	0	-	-																				
	A																									
	B																									
	C																									
	D																									

Initial Counts
QC'd by: JA

Animal Source/Date Received: ARO 4/28/16 Age at Initiation: 5d

Comments: i = initial reading in fresh test solution, f = final reading in test chamber prior to renewal
Organisms fed prior to initiation, circle one (y/n)
Tests aerated? Circle one (y/n) if yes, sample ID(s): Duration: _____
Aeration source: _____

QC Check: JA 6/1/2016

Feeding Times				
0	24	48	72	96
AM: <u>0700/1000</u>	<u>1100</u>	<u>0830</u>	<u>0815</u>	
PM: <u>1900/1600</u>	<u>1400</u>	<u>1600</u>		

Final Review: JA 6/2/16

Marine Acute Bioassay
Static-Renewal Conditions

Water Quality Measurements
& Test Organism Survival

Project: Mixed Metal, Cu+Zn Pellet Test Test Species: A. bahia
Sample ID: Cu+Zn 12 hr Start Date/Time: 4/19/16 0900
Test No.: — End Date/Time: 5/3/16 0900

Tech Initials				
0	24	48	72	96
Counts: <u>JA</u>	<u>JA</u>	<u>JA</u>	<u>JA</u>	<u>JA</u>
Readings: <u>JA</u>	<u>JA</u>	<u>JA</u>	<u>JA</u>	<u>JA</u>
Dilutions made by: <u>JA</u>				

Sample ID	Rep	Number of Live Organisms					Salinity (ppt)					Temperature (°C)					Dissolved Oxygen (mg/L)					pH (units)				
		0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96
<u>LC</u> <u>(Shredded 3hr)</u>	A	5	5	5	5	5	34.1	34.1	33.9	34.9	34.8	19.0	19.1	19.1	19.8	19.4	7.5	7.6	7.7	7.8	7.2	7.89	7.98	7.78	8.1	7.17
	B	5	5	5	5	5																				
	C	5	5	5	5	5																				
	D	5	5	5	5	5																				
	A																									
	B																									
	C																									
	D																									
<u>TU 125</u>	A	5	5	5	5	5	34.2	33.9	34.1	34.5	34.5	19.0	19.1	19.1	19.8	19.2	7.7	7.8	7.4	7.9	7.5	7.71	7.78	7.67	8.00	7.73
	B	5	5	5	5	5																				
	C	5	5	5	5	5																				
	D	5	5	5	5	5																				
<u>TU 25</u>	A	5	5	5	5	5	34.5	34.7	34.7	34.7	34.9	19.2	19.1	19.1	19.8	19.2	7.6	7.7	7.6	7.9	7.3	7.88	7.89	7.81	7.77	7.76
	B	5	5	5	5	5																				
	C	5	5	5	4	4																				
	D	5	5	5	5	5																				
<u>TU 5</u>	A	5	5	5	5	5	34.6	34.7	34.6	34.8	34.0	19.0	19.1	19.1	19.8	19.2	7.5	7.6	7.5	7.8	7.2	7.89	7.90	7.80	7.77	7.72
	B	5	5	5	5	5																				
	C	5	5	5	5	5																				
	D	5	4	4	4	4																				
<u>TU 1</u>	A	5	4	1	1	1	34.5	34.7	34.2	34.7	34.7	19.0	19.1	19.1	19.8	19.2	7.4	7.6	7.6	7.7	7.6	7.89	7.91	7.98	7.86	7.78
	B	4	2	2	2	2																				
	C	5	5	3	3	3																				
	D	5	3	1	1	1																				
<u>TU 2</u>	A	4	1	0	-	-	34.7	34.8	34.8	34.9	34.8	19.0	19.1	19.1	19.8	19.2	7.8	7.9	7.8	7.8	7.6	7.89	7.89	7.78	7.97	7.78
	B	3	1	1	1	1																				
	C	5	2	1	1	1																				
	D	5	3	1	0	-																				

Initial Counts: JA
QC'd by: JA

Animal Source/Date Received: ARO 4/28/16 Age at Initiation: 5d

Comments: i = initial reading in fresh test solution, f = final reading in test chamber prior to renewal
Organisms fed prior to initiation, circle one (y/n)
Tests aerated? Circle one (y/n) if yes, sample ID(s): Duration: —
Aeration source:

QC Check: 6/1/2016 JMD

Feeding Times				
0	24	48	72	96
AM: <u>0900</u>	<u>1100</u>	<u>1100</u>	<u>0800</u>	<u>0915</u>
PM: <u>1600</u>	<u>1500</u>	<u>1400</u>	<u>1600</u>	<u>—</u>

Final Review: lll 6/2/16

Marine Acute Bioassay
Static-Renewal Conditions

Water Quality Measurements
& Test Organism Survival

Project: Mixed Metal Pulsed Test Cu+Zn
 Sample ID: 96 hr Cu+Zn
 Test No.: _____

Test Species: A. bahia
 Start Date/Time: 4/29/16 0900
 End Date/Time: 5/3/16 0900

Tech Initials					
0	24	48	72	96	
Counts: JM	JM	JM	JM	JM	
Readings: JM	JM	JM	JM	JM	
Dilutions made by: JM					

Sample ID	Rep	Number of Live Organisms					Salinity (ppt)					Temperature (°C)					Dissolved Oxygen (mg/L)					pH (units)				
		0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96
LC	A	5	5	5	5	5	34.2	34.1	33.8	34.1	34.8	19.0	19.0	19.1	18.8	19.4	7.8	7.7	7.9	7.8	7.2	7.99	8.01	8.00	8.17	7.17
(shaded w/ 2hr)	B	5	5	5	5	5																				
	C	5	5	5	5	5																				
	D	5	5	5	5	5																				
TU .125	A	5	5	5	5	5	33.8	33.9	34.1	34.5	34.9	19.0	19.0	19.1	18.8	19.2	7.9	7.9	7.7	7.7	7.1	7.98	8.00	8.00	7.99	7.97
	B	5	5	5	5	5																				
	C	5	5	5	5	5																				
	D	5	4	4	4	4																				
TU .25	A	5	5	5	5	5	33.8	34.1	34.2	34.6	34.8	19.0	19.0	19.1	18.8	19.2	7.9	8.0	7.9	7.2	7.99	8.01	7.99	7.96	7.98	
	B	5	5	5	5	5																				
	C	5	5	5	5	5																				
	D	5	5	5	5	5																				
TU 0.5	A	5	5	5	5	5	34.1	34.1	34.7	34.7	34.9	19.1	19.0	19.1	18.8	19.2	7.5	7.6	7.7	8.0	7.4	7.99	7.99	7.98	7.99	7.98
	B	5	5	5	5	5																				
	C	5	5	5	5	5																				
	D	5	4	4	4	4																				
TU 1	A	5	3	1	0	-	34.2	34.1	34.8	34.8	34.9	19.1	19.1	19.1	18.8	19.1	7.7	7.8	7.4	7.6	7.9	7.91	7.91	7.92	7.98	7.98
	B	5	4	4	3	0																				
	C	5	5	4	2	1																				
	D	5	3	2	1	1																				
TU 2	A	5	2	0	-	-	34.1	34.2	34.3	34.9	-	19.1	19.1	19.1	18.8	-	7.7	7.9	7.5	7.6	-	7.77	7.89	7.92	7.99	-
	B	5	4	3	0	-																				
	C	5	4	0	-	-																				
	D	5	3	0	-	-																				
	A																									
	B																									
	C																									
	D																									

Initial Counts
 QC'd by: JM

Animal Source/Date Received: ARO 4/28/16 Age at Initiation: 5d

Comments: i = initial reading in fresh test solution, f = final reading in test chamber prior to renewal
 Organisms fed prior to initiation, circle one (y/n) (y)
 Tests aerated? Circle one (y/n) if yes, sample ID(s): _____ Duration: _____
 Aeration source: _____

QC Check: 5/1/2016 JM

Final Review: ME White

Feeding Times					
0	24	48	72	96	
AM: 0700	1100	1100	0830	0815	
PM: 1400	1500	1400	1600		

B.2. MIXED METAL EXPOSURES – REFERENCE TOXICANT TEST RESULTS:

CETIS Summary Report

Report Date: 03 Jun-16 08:39 (p 1 of 1)
Test Code: 3F986ECD | 10-6695-4445

Americamysis 96-h Acute Survival Test								SPAWAR Systems Center			
Batch ID:	18-0018-1674	Test Type:	Survival (96h)				Analyst:	Marianne A Colvin			
Start Date:	29 Apr-16 09:00	Protocol:	EPA/821/R-02-012 (2002)				Diluent:	Laboratory Seawater			
Ending Date:	03 May-16 09:00	Species:	Americamysis bahia				Brine:	Not Applicable			
Duration:	96h	Source:	Aquatic Research Organisms, NH				Age:	5			
Sample ID:	14-3982-2886	Code:	55D1F426				Client:	SPAWAR			
Sample Date:	29 Apr-16	Material:	Copper sulfate				Project:	Pulsed Exposure			
Receive Date:	29 Apr-16	Source:	Reference Toxicant								
Sample Age:	9h	Station:									
Comparison Summary											
Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method				
13-4499-6255	96h Survival Rate	100	210	144.9	10.0%		Steel Many-One Rank Sum Test				
Point Estimate Summary											
Analysis ID	Endpoint	Level	µg/L	95% LCL	95% UCL	TU	Method				
09-7413-8532	96h Survival Rate	LC50	223.2	181.9	287.9		Linear Regression (MLE)				
96h Survival Rate Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Lab Control	4	1	1	1	1	1	0	0	0.0%	0.0%
56		4	1	1	1	1	1	0	0	0.0%	0.0%
100		4	0.95	0.7909	1	0.8	1	0.05	0.1	10.53%	5.0%
210		4	0.6	0.6	0.6	0.6	0.6	0	0	0.0%	40.0%
620		4	0	0	0	0	0	0	0		100.0%
850		4	0	0	0	0	0	0	0		100.0%
96h Survival Rate Detail											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
0	Lab Control	1	1	1	1						
56		1	1	1	1						
100		0.8	1	1	1						
210		0.6	0.6	0.6	0.6						
620		0	0	0	0						
850		0	0	0	0						
96h Survival Rate Binomials											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
0	Lab Control	5/5	5/5	5/5	5/5						
56		5/5	5/5	5/5	5/5						
100		4/5	5/5	5/5	5/5						
210		3/5	3/5	3/5	3/5						
620		0/5	0/5	0/5	0/5						
850		0/5	0/5	0/5	0/5						

CETIS Analytical Report

Report Date: 03 Jun-16 08:39 (p 1 of 2)
 Test Code: 3F986ECD | 10-6695-4445

Americamysis 96-h Acute Survival Test						SPAWAR Systems Center					
Analysis ID:	13-4499-6255		Endpoint:	96h Survival Rate			CETIS Version:	CETISv1.8.7			
Analyzed:	28 May-16 10:13		Analysis:	Nonparametric-Control vs Treatments			Official Results:	Yes			
Batch ID:	18-0018-1674		Test Type:	Survival (96h)			Analyst:	Marianne A Colvin			
Start Date:	29 Apr-16 09:00		Protocol:	EPA/821/R-02-012 (2002)			Diluent:	Laboratory Seawater			
Ending Date:	03 May-16 09:00		Species:	Americamysis bahia			Brine:	Not Applicable			
Duration:	96h		Source:	Aquatic Research Organisms, NH			Age:	5			
Sample ID:	14-3982-2886		Code:	55D1F426			Client:	SPAWAR			
Sample Date:	29 Apr-16		Material:	Copper sulfate			Project:	Pulsed Exposure			
Receive Date:	29 Apr-16		Source:	Reference Toxicant							
Sample Age:	9h		Station:								
Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	NOEL	LOEL	TOEL	TU		
Angular (Corrected)	NA	C > T	NA	NA	10.0%	100	210	144.9			
Steel Many-One Rank Sum Test											
Control	vs	C-µg/L	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)		
Lab Control	56		18	10	1	6	0.7500	Asymp	Non-Significant Effect		
	100		16	10	1	6	0.5065	Asymp	Non-Significant Effect		
	210*		10	10	0	6	0.0276	Asymp	Significant Effect		
ANOVA Table											
Source	Sum Squares		Mean Square		DF	F Stat	P-Value	Decision(α:5%)			
Between	0.5885663		0.1961888		3	55.35	<0.0001	Significant Effect			
Error	0.04253092		0.003544244		12						
Total	0.6310972				15						
Distributional Tests											
Attribute	Test		Test Stat	Critical	P-Value	Decision(α:1%)					
Variances	Mod Levene Equality of Variance		1	5.953	0.4262	Equal Variances					
Variances	Levene Equality of Variance		9	5.953	0.0021	Unequal Variances					
Distribution	Shapiro-Wilk W Normality		0.5647	0.8408	<0.0001	Non-normal Distribution					
96h Survival Rate Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Lab Control	4	1	1	1	1	1	1	0	0.0%	0.0%
56		4	1	1	1	1	1	1	0	0.0%	0.0%
100		4	0.95	0.7909	1	1	0.8	1	0.05	10.53%	5.0%
210		4	0.6	0.5998	0.6002	0.6	0.6	0.6	0	0.0%	40.0%
620		4	0	0	0	0	0	0	0		100.0%
850		4	0	0	0	0	0	0	0		100.0%
Angular (Corrected) Transformed Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Lab Control	4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
56		4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
100		4	1.286	1.096	1.475	1.345	1.107	1.345	0.05953	9.26%	4.43%
210		4	0.8861	0.8859	0.8862	0.8861	0.8861	0.8861	0	0.0%	34.13%
620		4	0.2255	0.2255	0.2256	0.2255	0.2255	0.2255	0	0.0%	83.24%
850		4	0.2255	0.2255	0.2256	0.2255	0.2255	0.2255	0	0.0%	83.24%

000-010-187-1

CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Analytical Report

Report Date: 03 Jun-16 08:39 (p 2 of 2)
Test Code: 3F986ECD | 10-6695-4445

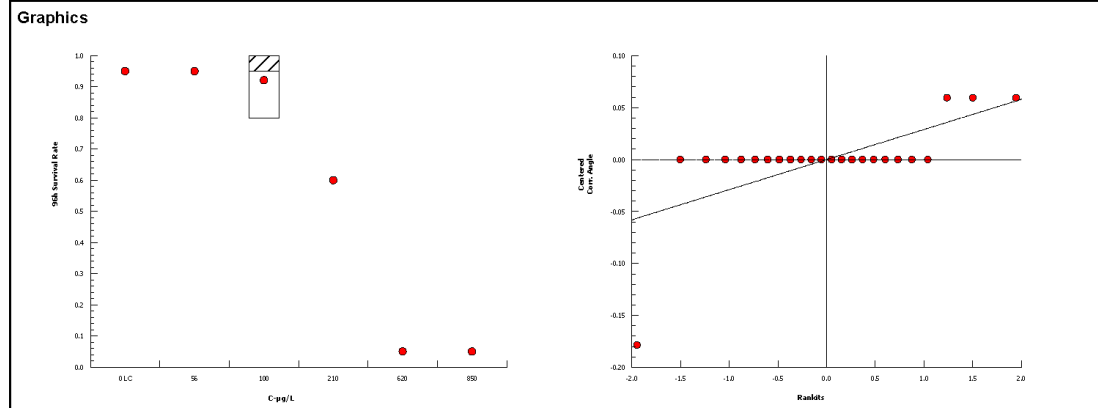
Americamysis 96-h Acute Survival Test SPAWAR Systems Center

Analysis ID: 13-4499-6255 Endpoint: 96h Survival Rate CETIS Version: CETISv1.8.7
Analyzed: 28 May-16 10:13 Analysis: Nonparametric-Control vs Treatments Official Results: Yes

96h Survival Rate Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Control	1	1	1	1
56		1	1	1	1
100		0.8	1	1	1
210		0.6	0.6	0.6	0.6
620		0	0	0	0
850		0	0	0	0

Angular (Corrected) Transformed Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Control	1.345	1.345	1.345	1.345
56		1.345	1.345	1.345	1.345
100		1.107	1.345	1.345	1.345
210		0.8861	0.8861	0.8861	0.8861
620		0.2255	0.2255	0.2255	0.2255
850		0.2255	0.2255	0.2255	0.2255

96h Survival Rate Binomials					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Control	5/5	5/5	5/5	5/5
56		5/5	5/5	5/5	5/5
100		4/5	5/5	5/5	5/5
210		3/5	3/5	3/5	3/5
620		0/5	0/5	0/5	0/5
850		0/5	0/5	0/5	0/5



000-010-187-1

CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Analytical Report

Report Date: 03 Jun-16 08:39 (p 1 of 2)
Test Code: 3F986ECD | 10-6695-4445

Americamysis 96-h Acute Survival Test						SPAWAR Systems Center					
Analysis ID: 09-7413-8532		Endpoint: 96h Survival Rate				CETIS Version: CETISv1.8.7					
Analyzed: 28 May-16 10:21		Analysis: Linear Regression (MLE)				Official Results: Yes					
Batch ID: 18-0018-1674		Test Type: Survival (96h)				Analyst: Marianne A Colvin					
Start Date: 29 Apr-16 09:00		Protocol: EPA/821/R-02-012 (2002)				Diluent: Laboratory Seawater					
Ending Date: 03 May-16 09:00		Species: Americamysis bahia				Brine: Not Applicable					
Duration: 96h		Source: Aquatic Research Organisms, NH				Age: 5					
Sample ID: 14-3982-2886		Code: 55D1F426				Client: SPAWAR					
Sample Date: 29 Apr-16		Material: Copper sulfate				Project: Pulsed Exposure					
Receive Date: 29 Apr-16		Source: Reference Toxicant									
Sample Age: 9h		Station:									
Linear Regression Options											
Model Function			Threshold Option		Threshold	Optimized	Pooled	Het Corr	Weighted		
Log-Normal [NED=A+B*log(X)]			Control Threshold		1E-07	Yes	No	No	Yes		
Regression Summary											
Iters	LL	AICc	BIC	Mu	Sigma	Adj R2	F Stat	Critical	P-Value	Decision(α:5%)	
12	-17.82	42.84	45.17	2.349	0.1866	0.9363	4.701	3.16	0.0136	Significant Lack of Fit	
Point Estimates											
Level	µg/L	95% LCL	95% UCL								
LC50	223.2	181.9	287.9								
Regression Parameters											
Parameter	Estimate	Std Error	95% LCL	95% UCL	t Stat	P-Value	Decision(α:5%)				
Threshold	6.83E-08	5.84E-05	-0.00011	0.000115	0.001169	0.9991	Non-Significant Parameter				
Slope	5.359	1.16	3.086	7.632	4.621	0.0001	Significant Parameter				
Intercept	-12.59	2.677	-17.84	-7.34	-4.701	0.0001	Significant Parameter				
ANOVA Table											
Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)					
Model	91.18885	91.18885	1	340	<0.0001	Significant					
Lack of Fit	2.474179	0.824726	3	4.701	0.0136	Significant					
Pure Error	3.157895	0.175439	18								
Residual	5.632073	0.268194	21								
Residual Analysis											
Attribute	Method		Test Stat	Critical	P-Value	Decision(α:5%)					
Goodness-of-Fit	Pearson Chi-Sq GOF		5.632	32.67	0.9997	Non-Significant Heterogeneity					
	Likelihood Ratio GOF		3.712	32.67	1.0000	Non-Significant Heterogeneity					
Variances	Mod Levene Equality of Variance		1	2.773	0.4457	Equal Variances					
Distribution	Shapiro-Wilk W Normality		0.557	0.9169	<0.0001	Non-normal Distribution					
	Anderson-Darling A2 Normality		3.569	2.492	<0.0001	Non-normal Distribution					
96h Survival Rate Summary											
			Calculated Variate(A/B)								
C-µg/L	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
0	Lab Control	4	1	1	1	0	0	0.0%	0.0%	20	20
56		4	1	1	1	0	0	0.0%	0.0%	20	20
100		4	0.95	0.8	1	0.05	0.1	10.53%	5.0%	19	20
210		4	0.6	0.6	0.6	0	0	0.0%	40.0%	12	20
620		4	0	0	0	0	0		100.0%	0	20
850		4	0	0	0	0	0		100.0%	0	20

000-010-187-1

CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Analytical Report

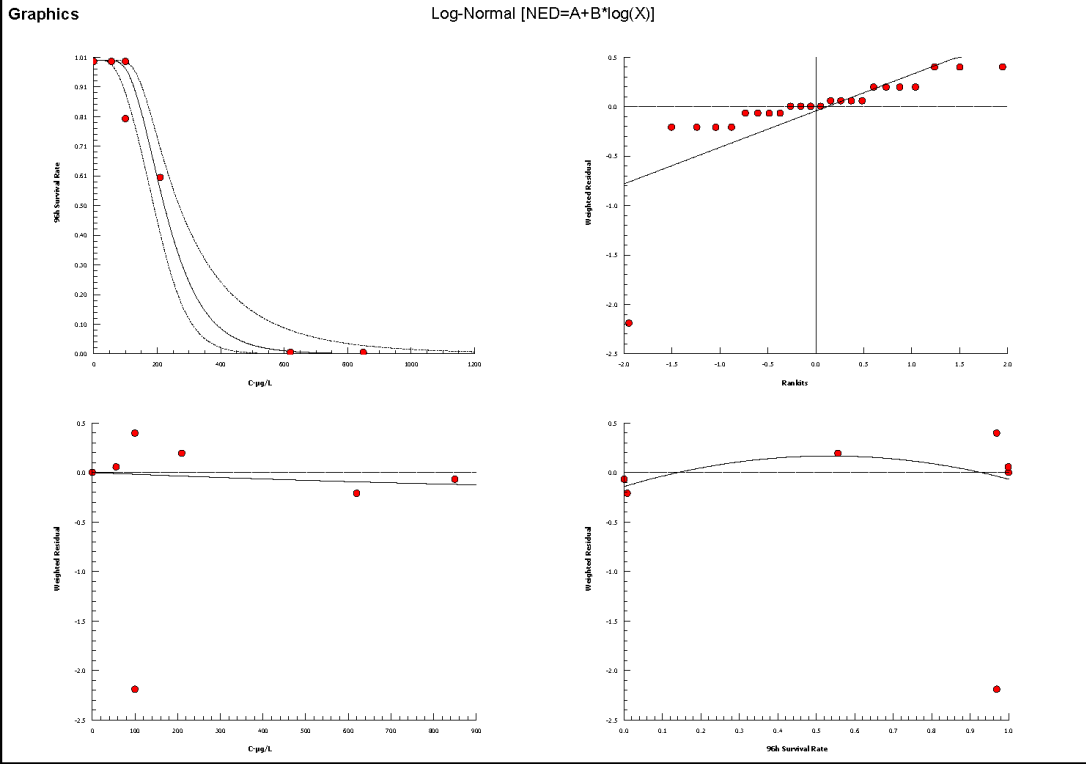
Report Date: 03 Jun-16 08:39 (p 2 of 2)
 Test Code: 3F986ECD | 10-6695-4445

Americamysis 96-h Acute Survival Test SPAWAR Systems Center

Analysis ID: 09-7413-8532 Endpoint: 96h Survival Rate CETIS Version: CETISv1.8.7
 Analyzed: 28 May-16 10:21 Analysis: Linear Regression (MLE) Official Results: Yes

96h Survival Rate Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Control	1	1	1	1
56		1	1	1	1
100		0.8	1	1	1
210		0.6	0.6	0.6	0.6
620		0	0	0	0
850		0	0	0	0

96h Survival Rate Binomials					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Control	5/5	5/5	5/5	5/5
56		5/5	5/5	5/5	5/5
100		4/5	5/5	5/5	5/5
210		3/5	3/5	3/5	3/5
620		0/5	0/5	0/5	0/5
850		0/5	0/5	0/5	0/5



000-010-187-1

CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Summary Report

Report Date: 02 Jun-16 16:56 (p 1 of 1)
 Test Code: 22F485A7 | 05-8645-0343

Americamysis 96-h Acute Survival Test							SPAWAR Systems Center				
Batch ID:	18-0018-1674	Test Type:	Survival (96h)				Analyst:	Marianne A Colvin			
Start Date:	29 Apr-16 09:00	Protocol:	EPA/821/R-02-012 (2002)				Diluent:	Laboratory Seawater			
Ending Date:	03 May-16 09:00	Species:	Americamysis bahia				Brine:	Not Applicable			
Duration:	96h	Source:	Aquatic Research Organisms, NH				Age:	5			
Sample ID:	01-5927-6650	Code:	97E5E6A				Client:	SPAWAR			
Sample Date:	29 Apr-16	Material:	Zinc sulfate				Project:	Pulsed Exposure			
Receive Date:	29 Apr-16	Source:	Reference Toxicant								
Sample Age:	9h	Station:									
Comparison Summary											
Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method				
00-9963-7171	96h Survival Rate	320	540	415.7	15.5%		Dunnett Multiple Comparison Test				
Point Estimate Summary											
Analysis ID	Endpoint	Level	µg/L	95% LCL	95% UCL	TU	Method				
05-7237-6669	96h Survival Rate	LC50	688.9	575.2	824.9		Trimmed Spearman-Kärber				
96h Survival Rate Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
6.4	Lab Control	4	1	1	1	1	1	0	0	0.0%	0.0%
180		4	0.9	0.7163	1	0.8	1	0.05774	0.1155	12.83%	10.0%
320		4	0.95	0.7909	1	0.8	1	0.05	0.1	10.53%	5.0%
540		4	0.7	0.5163	0.8837	0.6	0.8	0.05774	0.1155	16.5%	30.0%
1400		4	0	0	0	0	0	0	0		100.0%
2700		4	0	0	0	0	0	0	0		100.0%
96h Survival Rate Detail											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
6.4	Lab Control	1	1	1	1						
180		0.8	1	0.8	1						
320		1	1	1	0.8						
540		0.6	0.6	0.8	0.8						
1400		0	0	0	0						
2700		0	0	0	0						
96h Survival Rate Binomials											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
6.4	Lab Control	5/5	5/5	5/5	5/5						
180		4/5	5/5	4/5	5/5						
320		5/5	5/5	5/5	4/5						
540		3/5	3/5	4/5	4/5						
1400		0/5	0/5	0/5	0/5						
2700		0/5	0/5	0/5	0/5						

000-010-187-1

CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Analytical Report

Report Date: 02 Jun-16 16:56 (p 1 of 2)
Test Code: 22F485A7 | 05-8645-0343

Americamysis 96-h Acute Survival Test										SPAWAR Systems Center	
Analysis ID: 00-9963-7171		Endpoint: 96h Survival Rate					CETIS Version: CETISv1.8.7				
Analyzed: 28 May-16 10:25		Analysis: Parametric-Control vs Treatments					Official Results: Yes				
Batch ID: 18-0018-1674		Test Type: Survival (96h)					Analyst: Marienne A Colvin				
Start Date: 29 Apr-16 09:00		Protocol: EPA/821/R-02-012 (2002)					Diluent: Laboratory Seawater				
Ending Date: 03 May-16 09:00		Species: Americamysis bahia					Brine: Not Applicable				
Duration: 96h		Source: Aquatic Research Organisms, NH					Age: 5				
Sample ID: 01-5927-6650		Code: 97E5E6A					Client: SPAWAR				
Sample Date: 29 Apr-16		Material: Zinc sulfate					Project: Pulsed Exposure				
Receive Date: 29 Apr-16		Source: Reference Toxicant									
Sample Age: 9h		Station:									
Data Transform		Zeta	Alt Hyp	Trials	Seed	PMSD		NOEL	LOEL	TOEL	TU
Angular (Corrected)		NA	C > T	NA	NA	15.5%		320	540	415.7	
Dunnett Multiple Comparison Test											
Control	vs	C-µg/L	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)		
6.4		180	1.516	2.287	0.18	6	0.1712	CDF	Non-Significant Effect		
6.4		320	0.7578	2.287	0.18	6	0.4334	CDF	Non-Significant Effect		
6.4		540*	4.438	2.287	0.18	6	0.0011	CDF	Significant Effect		
ANOVA Table											
Source	Sum Squares		Mean Square		DF	F Stat	P-Value	Decision(α:5%)			
Between	0.2791536		0.0930512		3	7.539	0.0043	Significant Effect			
Error	0.1481115		0.01234262		12						
Total	0.4272651				15						
Distributional Tests											
Attribute	Test			Test Stat	Critical	P-Value	Decision(α:1%)				
Variances	Mod Levene Equality of Variance			3.401	5.953	0.0535	Equal Variances				
Variances	Levene Equality of Variance			13.46	5.953	0.0004	Unequal Variances				
Distribution	Shapiro-Wilk W Normality			0.8931	0.8408	0.0624	Normal Distribution				
96h Survival Rate Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
6.4	Lab Control	4	1	1	1	1	1	1	0	0.0%	0.0%
180		4	0.9	0.7163	1	0.9	0.8	1	0.05774	12.83%	10.0%
320		4	0.95	0.7909	1	1	0.8	1	0.05	10.53%	5.0%
540		4	0.7	0.5163	0.8837	0.7	0.6	0.8	0.05774	16.5%	30.0%
1400		4	0	0	0	0	0	0	0		100.0%
2700		4	0	0	0	0	0	0	0		100.0%
Angular (Corrected) Transformed Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
6.4	Lab Control	4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
180		4	1.226	1.007	1.445	1.226	1.107	1.345	0.06874	11.21%	8.85%
320		4	1.286	1.096	1.475	1.345	1.107	1.345	0.05953	9.26%	4.43%
540		4	0.9966	0.7935	1.2	0.9966	0.8861	1.107	0.06382	12.81%	25.92%
1400		4	0.2255	0.2255	0.2256	0.2255	0.2255	0.2255	0	0.0%	83.24%
2700		4	0.2255	0.2255	0.2256	0.2255	0.2255	0.2255	0	0.0%	83.24%

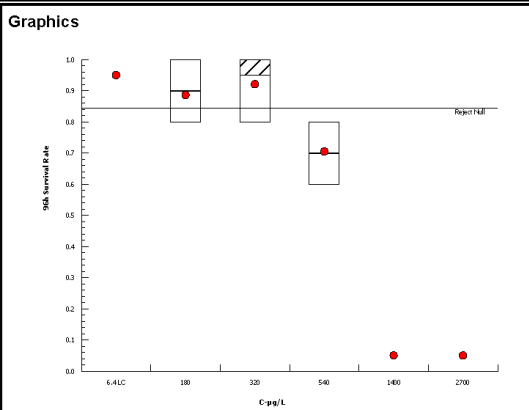
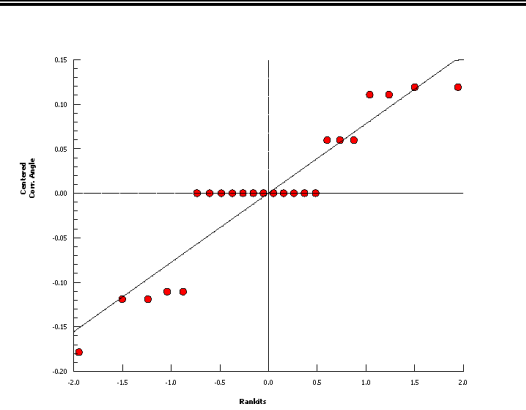
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CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Analytical Report

Report Date: 02 Jun-16 16:56 (p 2 of 2)
Test Code: 22F485A7 | 05-8645-0343

Americamysis 96-h Acute Survival Test				SPAWAR Systems Center	
Analysis ID: 00-9963-7171		Endpoint: 96h Survival Rate		CETIS Version: CETISv1.8.7	
Analyzed: 28 May-16 10:25		Analysis: Parametric-Control vs Treatments		Official Results: Yes	
96h Survival Rate Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
6.4	Lab Control	1	1	1	1
180		0.8	1	0.8	1
320		1	1	1	0.8
540		0.6	0.6	0.8	0.8
1400		0	0	0	0
2700		0	0	0	0
Angular (Corrected) Transformed Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
6.4	Lab Control	1.345	1.345	1.345	1.345
180		1.107	1.345	1.107	1.345
320		1.345	1.345	1.345	1.107
540		0.8861	0.8861	1.107	1.107
1400		0.2255	0.2255	0.2255	0.2255
2700		0.2255	0.2255	0.2255	0.2255
96h Survival Rate Binomials					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
6.4	Lab Control	5/5	5/5	5/5	5/5
180		4/5	5/5	4/5	5/5
320		5/5	5/5	5/5	4/5
540		3/5	3/5	4/5	4/5
1400		0/5	0/5	0/5	0/5
2700		0/5	0/5	0/5	0/5
Graphics					
 					

000-010-187-1

CETIS™ v1.8.7.16

Analyst: _____ QA: _____

CETIS Analytical Report

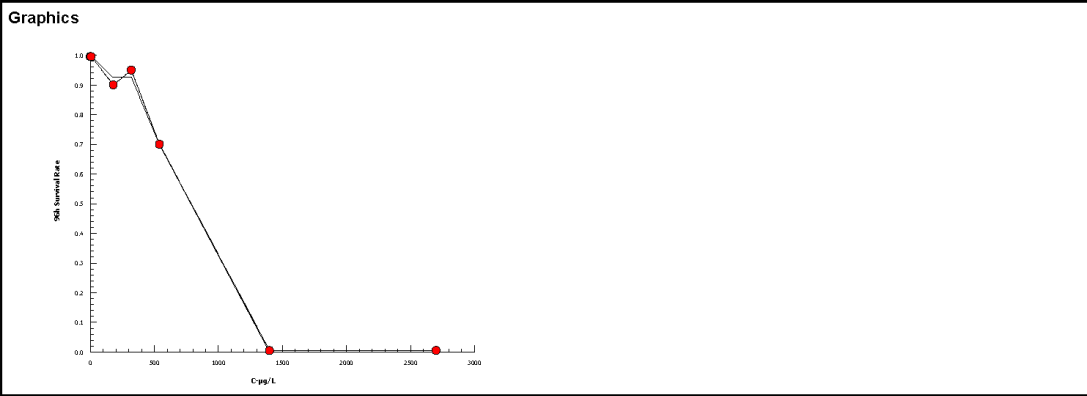
Report Date: 02 Jun-16 16:56 (p 1 of 2)
 Test Code: 22F485A7 | 05-8645-0343

Americamysis 96-h Acute Survival Test						SPAWAR Systems Center					
Analysis ID: 05-7237-6669		Endpoint: 96h Survival Rate				CETIS Version: CETISv1.8.7					
Analyzed: 28 May-16 10:27		Analysis: Trimmed Spearman-Kärber				Official Results: Yes					
Batch ID: 18-0018-1674		Test Type: Survival (96h)				Analyst: Marienne A Colvin					
Start Date: 29 Apr-16 09:00		Protocol: EPA/821/R-02-012 (2002)				Diluent: Laboratory Seawater					
Ending Date: 03 May-16 09:00		Species: Americamysis bahia				Brine: Not Applicable					
Duration: 96h		Source: Aquatic Research Organisms, NH				Age: 5					
Sample ID: 01-5927-6650		Code: 97E5E6A				Client: SPAWAR					
Sample Date: 29 Apr-16		Material: Zinc sulfate				Project: Pulsed Exposure					
Receive Date: 29 Apr-16		Source: Reference Toxicant									
Sample Age: 9h		Station:									
Trimmed Spearman-Kärber Estimates											
Threshold Option		Threshold	Trim	Mu	Sigma	LC50	95% LCL	95% UCL			
Control Threshold		0	7.50%	2.838	0.03915	688.9	575.2	824.9			
96h Survival Rate Summary											
		Calculated Variate(A/B)									
C-µg/L	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
6.4	Lab Control	4	1	1	1	0	0	0.0%	0.0%	20	20
180		4	0.9	0.8	1	0.05774	0.1155	12.83%	10.0%	18	20
320		4	0.95	0.8	1	0.05	0.1	10.53%	5.0%	19	20
540		4	0.7	0.6	0.8	0.05774	0.1155	16.5%	30.0%	14	20
1400		4	0	0	0	0	0		100.0%	0	20
2700		4	0	0	0	0	0		100.0%	0	20
96h Survival Rate Detail											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
6.4	Lab Control	1	1	1	1						
180		0.8	1	0.8	1						
320		1	1	1	0.8						
540		0.6	0.6	0.8	0.8						
1400		0	0	0	0						
2700		0	0	0	0						
96h Survival Rate Binomials											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
6.4	Lab Control	5/5	5/5	5/5	5/5						
180		4/5	5/5	4/5	5/5						
320		5/5	5/5	5/5	4/5						
540		3/5	3/5	4/5	4/5						
1400		0/5	0/5	0/5	0/5						
2700		0/5	0/5	0/5	0/5						

CETIS Analytical Report

Report Date: 02 Jun-16 16:56 (p 2 of 2)
Test Code: 22F485A7 | 05-8645-0343

Americamysis 96-h Acute Survival Test		SPAWAR Systems Center
Analysis ID: 05-7237-6669	Endpoint: 96h Survival Rate	CETIS Version: CETISv1.8.7
Analyzed: 28 May-16 10:27	Analysis: Trimmed Spearman-Kärber	Official Results: Yes



Marine Acute Bioassay
Static-Renewal Conditions

Water Quality Measurements
& Test Organism Survival

Project: MixMetals Cu + Zn Pesticide Test Test Species: A. balearica
Sample ID: 96 hr CW Reference Test Start Date/Time: 4/29/16 0900
Test No.: _____ End Date/Time: 5/2/16 0900

Tech Initials				
0	24	48	72	96
Counts: JM	JM	JM	JM	JM
Readings: JM	JM	JM	JM	JM
Dilutions made by: JM				

Sample ID (μg/L)	Rep	Number of Live Organisms					Salinity (ppt)					Temperature (°C)					Dissolved Oxygen (mg/L)					pH (units)				
		0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96
LC	A	5	5	5	5	5	34.5	34.4	34.3	34.3	34.9	19.0	19.0	19.1	19.0	19.3	7.5	7.6	7.7	7.7	7.3	7.99	8.01	8.02	8.01	8.01
	B	5	5	5	5	5																				
	C	5	5	5	5	5																				
	D	5	5	5	5	5																				
50	A	5	5	5	5	5	34.1	34.1	34.1	34.6	34.5	19.1	19.2	19.1	19.0	19.3	7.5	7.5	7.5	7.6	7.5	8.01	8.02	8.01	8.17	8.02
	B	5	5	5	5	5																				
	C	5	5	5	5	5																				
	D	5	5	5	5	5																				
100	A	5	5	5	5	4	34.1	34.2	34.2	34.5	34.6	19.0	19.0	19.1	19.0	19.2	7.7	7.8	7.6	7.9	7.5	8.01	7.97	8.02	8.03	8.03
	B	5	5	5	5	5																				
	C	5	5	5	5	5																				
	D	5	5	5	5	5																				
200	A	5	5	4	3	3	33.8	34.1	34.3	34.5	34.6	19.0	19.0	19.1	19.0	19.2	8.0	8.1	7.7	7.6	7.5	7.97	7.98	7.94	7.97	8.01
	B	5	4	4	4	3																				
	C	5	5	4	3	3																				
	D	5	5	4	4	3																				
400	A	5	2	1	0	-	33.9	34.2	34.7	34.9	34.8	19.1	19.1	19.1	19.0	19.3	7.9	7.8	7.8	7.7	7.5	7.89	7.90	7.97	7.96	8.01
	B	5	4	0	-	-																				
	C	5	2	1	1	0																				
	D	5	2	1	0	-																				
800	A	5	3	0	-	-	34.3	34.4	34.5	34.9	33.9	19.0	19.1	19.1	19.0	19.3	7.4	7.6	7.7	7.6	7.4	7.89	7.99	7.97	7.86	8.02
	B	5	2	1	1	0																				
	C	5	3	0	-	-																				
	D	5	2	0	-	-																				
	A																									
	B																									
	C																									
	D																									

Initial Counts
QC'd by: JM

Animal Source/Date Received: ARO 4/28/16 Age at Initiation: 8d

Comments: 1 = initial reading in fresh test solution, f = final reading in test chamber prior to renewal
Organisms fed prior to initiation, circle one (y) / n)
Tests aerated? Circle one (y / n) if yes, sample ID(s): Duration: _____
Aeration source: _____

QC Check: JM 6/1/2016

Final Review: all 6/2/16

Feeding Times				
0	24	48	72	96
AM: 0700	1100	1100	0830	0715
PM: 1900	1900	1900	1600	-

Marine Acute Bioassay
Static-Renewal Conditions

Water Quality Measurements
& Test Organism Survival

Project: Metal Metal Paced Test Cu+Zn Test Species: A. bailey
Sample ID: Zn Reference Test 96 hr Start Date/Time: 4/29/16 0900
Test No.: End Date/Time: 5/3/16 0900

Tech Initials				
0	24	48	72	96
Counts: JA	JA	JA	JA	JA
Readings: JA	JA	JA	JA	JA
Dilutions made by: PC				

Sample ID (μg/L)	Rep	Number of Live Organisms					Salinity (ppt)					Temperature (°C)					Dissolved Oxygen (mg/L)					pH (units)				
		0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96
LC	A	5	5	5	5	5	31.2	32.3	34.1	34.6	34.7	19.0	19.0	19.1	19.2	19.2	7.9	8.0	8.0	7.7	7.1	7.88	8.01	8.00	7.11	7.98
	B	5	5	5	5	5																				
	C	5	5	5	5	5																				
	D	5	5	5	5	5																				
125	A	5	5	5	5	4	31.2	34.1	33.9	34.7	34.9	19.1	19.1	19.1	19.2	19.3	7.8	8.1	7.4	7.6	7.1	7.88	7.97	7.76	7.49	7.97
	B	5	5	5	5	5																				
	C	5	5	5	4	4																				
	D	5	5	5	5	5																				
250	A	5	5	5	5	5	34.1	33.9	34.2	34.8	34.9	19.0	18.9	19.1	19.2	19.4	7.7	8.0	7.5	7.5	7.4	7.80	7.71	7.76	7.77	8.01
	B	5	5	5	5	5																				
	C	5	5	5	5	5																				
	D	5	5	5	5	4																				
500	A	5	5	5	4	3	34.9	34.1	33.7	34.8	34.7	19.1	19.0	19.1	19.2	19.4	7.9	8.1	7.6	7.7	7.3	7.71	7.89	7.96	7.81	8.02
	B	5	5	5	4	3																				
	C	5	5	4	4	4																				
	D	5	5	5	5	4																				
1000	A	5	4	2	2	0	34.1	34.1	34.7	34.9	34.8	19.1	19.1	19.1	19.2	19.5	7.7	8.0	7.4	7.6	7.3	7.80	7.91	7.77	7.91	7.99
	B	5	3	1	0	-																				
	C	5	4	2	0	-																				
	D	5	3	2	0	-																				
2000	A	5	3	1	0	-	33.9	34.5	34.8	34.8	34.7	19.0	19.0	19.1	19.2	19.6	7.9	8.1	7.6	7.4	7.3	7.89	8.01	7.87	7.15	7.98
	B	5	1	1	0	-																				
	C	5	3	2	0	-																				
	D	5	2	1	0	-																				
	A																									
	B																									
	C																									
	D																									

Initial Counts
QC'd by: JA

Animal Source/Date Received: ARO 4/28/16 Age at Initiation: 5d

Comments: 1 = initial reading in fresh test solution, f = final reading in test chamber prior to renewal
Organisms fed prior to initiation, circle one () n)
Tests aerated? Circle one (y (n)) If yes, sample ID(s): Duration:
Aeration source:

QC Check: JA 6/1/2016

Feeding Times				
0	24	48	72	96
AM: 0700	1100	1100	0830	0815
PM: 1900	1500	1400	1600	—

Final Review: ML 6/2/16

B.3. MIXED METAL EXPOSURES – ANALYTICAL CHEMISTRY REPORTS:



CERTIFICATE OF ANALYSIS

Client: U.S. Naval SPAWAR Systems Center Pacific 53475 Strothe Rd., Bldg. 111 Code 71760 San Diego CA, 92152	Report Date: 05/26/16 15:34
Attention: Molly Colvin	Received Date: 05/12/16 10:10
Phone: (619) 553-2788	Turn Around: Normal
Fax: -	Client Project: Mixed Copper and Zinc Pulsed Toxicity Test
Work Order(s): 6E12040	

NELAC #4047-002 ORELAP ELAP#1132 NEVADA #CA211 HAWAII LACSD #10143

The results in this report apply to the samples analyzed in accordance with the Chain of Custody document. Weck Laboratories, Inc. certifies that the test results meet all NELAC requirements unless noted in the case narrative. This analytical report is confidential and is only intended for the use of Weck Laboratories, Inc. and its client. This report contains the Chain of Custody document, which is an integral part of it, and can only be reproduced in full with the authorization of Weck Laboratories, Inc.

Dear Molly Colvin :

Enclosed are the results of analyses for samples received 05/12/16 10:10 with the Chain of Custody document. The samples were received in good condition, at 18.8 °C. All analysis met the method criteria except as noted below or in the report with data qualifiers.

Case Narrative:

Samples were received at higher temperature than required for DOC analysis.

Reviewed by:

Chris Samatmanakit
Project Manager



Page 1 of 37

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U.S. Naval SPAWAR Systems Center Pacific
53475 Strothe Rd., Bldg. 111 Code 71760
San Diego CA, 92152

Date Received: 05/12/16 10:10
Date Reported: 05/26/16 15:34

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Sampled by:	Lab ID	Matrix	Date Sampled
Static-LC-CU	Molly, Gunther Rosen, Jac	6E12040-01	Water	04/29/16 08:30
Static-CU-50	Molly, Gunther Rosen, Jac	6E12040-02	Water	04/29/16 08:30
Static-CU-100	Molly, Gunther Rosen, Jac	6E12040-03	Water	04/29/16 08:30
Static-CU-200	Molly, Gunther Rosen, Jac	6E12040-04	Water	04/29/16 08:30
Static-CU-400	Molly, Gunther Rosen, Jac	6E12040-05	Water	04/29/16 08:30
Static-CU-800	Molly, Gunther Rosen, Jac	6E12040-06	Water	04/29/16 08:30
Static-Zn-125	Molly, Gunther Rosen, Jac	6E12040-07	Water	04/29/16 08:30
Static-Zn-250	Molly, Gunther Rosen, Jac	6E12040-08	Water	04/29/16 08:30
Static-Zn-500	Molly, Gunther Rosen, Jac	6E12040-09	Water	04/29/16 08:30
Static-Zn-1000	Molly, Gunther Rosen, Jac	6E12040-10	Water	04/29/16 08:30
Static-Zn-2000	Molly, Gunther Rosen, Jac	6E12040-11	Water	04/29/16 08:30
96hr-TU-0.25	Molly, Gunther Rosen, Jac	6E12040-12	Water	04/29/16 08:30
96hr-TU-0.5	Molly, Gunther Rosen, Jac	6E12040-13	Water	04/29/16 08:30
96hr-TU-0.125	Molly, Gunther Rosen, Jac	6E12040-14	Water	04/29/16 08:30
96hr-TU-1	Molly, Gunther Rosen, Jac	6E12040-15	Water	04/29/16 08:30
96hr-TU-2	Molly, Gunther Rosen, Jac	6E12040-16	Water	04/29/16 08:30
3hr-TU-0.125	Molly, Gunther Rosen, Jac	6E12040-17	Water	04/29/16 08:30
3hr-TU-0.25	Molly, Gunther Rosen, Jac	6E12040-18	Water	04/29/16 08:30
3hr-TU-0.5	Molly, Gunther Rosen, Jac	6E12040-19	Water	04/29/16 08:30
3hr-TU-1	Molly, Gunther Rosen, Jac	6E12040-20	Water	04/29/16 08:30
3hr-TU-2	Molly, Gunther Rosen, Jac	6E12040-21	Water	04/29/16 08:30
6hr-TU-0.125	Molly, Gunther Rosen, Jac	6E12040-22	Water	04/29/16 08:30
6hr-TU-0.25	Molly, Gunther Rosen, Jac	6E12040-23	Water	04/29/16 08:30
6hr-TU-0.5	Molly, Gunther Rosen, Jac	6E12040-24	Water	04/29/16 08:30
6hr-TU-1	Molly, Gunther Rosen, Jac	6E12040-25	Water	04/29/16 08:30
6hr-TU-2	Molly, Gunther Rosen, Jac	6E12040-26	Water	04/29/16 08:30
12hr-TU-0.125	Molly, Gunther Rosen, Jac	6E12040-27	Water	04/29/16 08:30
12hr-TU-0.25	Molly, Gunther Rosen, Jac	6E12040-28	Water	04/29/16 08:30
12hr-TU-0.5	Molly, Gunther Rosen, Jac	6E12040-29	Water	04/29/16 08:30
12hr-TU-1	Molly, Gunther Rosen, Jac	6E12040-30	Water	04/29/16 08:30
12hr-TU-2	Molly, Gunther Rosen, Jac	6E12040-31	Water	04/29/16 08:30

ANALYSES

Conventional Chemistry/Physical Parameters by APHA/EPA/ASTM Methods

Metals - Low Level by 1600 Series Methods



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Date Received: 05/12/16 10:10
Date Reported: 05/26/16 15:34

6E12040-01 Static-LC-CU							
Sampled: 04/29/16 08:30		Sampled By: Molly, Gunther Rosen, Jacob Munson				Matrix: Water	
Conventional Chemistry/Physical Parameters by APHA/EPA/ASTM Methods							
Method: SM 5310B		Batch: W6E1048	Prepared: 05/18/16 13:34			Analyst: jlp	
Analyte		Result	MRL	Units	Dil	Analyzed	Qualifier
Dissolved Organic Carbon		1.0	0.10	mg/l	1	05/18/16 14:56	
Metals - Low Level by 1600 Series Methods							
Method: EPA 1640		Batch: W6E0823	Prepared: 05/16/16 09:13			Analyst: gza	
Analyte		Result	MRL	Units	Dil	Analyzed	Qualifier
Copper, Total		1.6	0.010	ug/l	1	05/18/16 01:46	
Zinc, Total		6.4	0.20	ug/l	1	05/18/16 01:46	



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Date Received: 05/12/16 10:10
Date Reported: 05/26/16 15:34

6E12040-02		Static-CU-50			
Sampled: 04/29/16 08:30		Sampled By: Molly, Gunther Rosen, Jacob Munson			Matrix: Water
Metals - Low Level by 1600 Series Methods					
Method: EPA 1640		Batch: W6E0823		Prepared: 05/16/16 09:13	
					Analyst: gza
Analyte	Result	MRL	Units	Dil	Analyzed
Copper, Total	56	0.50	ug/l	50	05/18/16 02:00
					Qualifier



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Date Received: 05/12/16 10:10
Date Reported: 05/26/16 15:34

6E12040-03		Static-CU-100	
Sampled: 04/29/16 08:30	Sampled By: Molly, Gunther Rosen, Jacob Munson		Matrix: Water
Metals - Low Level by 1600 Series Methods			
Method: EPA 1640	Batch: W6E0823	Prepared: 05/16/16 09:13	Analyst: gza
Analyte	Result	MRL	Units
Copper, Total	100	1.0	ug/l
			Dil
			Analyzed
			100 05/18/16 02:14
			Qualifier



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Date Received: 05/12/16 10:10
Date Reported: 05/26/16 15:34

6E12040-04		Static-CU-200			
Sampled: 04/29/16 08:30		Sampled By: Molly, Gunther Rosen, Jacob Munson			Matrix: Water
Metals - Low Level by 1600 Series Methods					
Method: EPA 1640		Batch: W6E0823		Prepared: 05/16/16 09:13	
		Analyst: gza			
Analyte	Result	MRL	Units	Dil	Analyzed
Copper, Total	210	1.0	ug/l	100	05/18/16 02:27



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Date Received: 05/12/16 10:10
Date Reported: 05/26/16 15:34

6E12040-05		Static-CU-400			
Sampled: 04/29/16 08:30		Sampled By: Molly, Gunther Rosen, Jacob Munson			Matrix: Water
Metals - Low Level by 1600 Series Methods					
Method: EPA 1640		Batch: W6E0823		Prepared: 05/16/16 09:13	
				Analyst: gza	
Analyte	Result	MRL	Units	Dil	Analyzed
Copper, Total	620	10	ug/l	1000	05/18/16 02:41



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Date Received: 05/12/16 10:10

Date Reported: 05/26/16 15:34

6E12040-06		Static-CU-800			
Sampled: 04/29/16 08:30		Sampled By: Molly, Gunther Rosen, Jacob Munson			Matrix: Water
Metals - Low Level by 1600 Series Methods					
Method: EPA 1640		Batch: W6E0823		Prepared: 05/16/16 09:13	
				Analyst: gza	
Analyte	Result	MRL	Units	Dil	Analyzed
Copper, Total	850	10	ug/l	1000	05/18/16 02:55



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Date Received: 05/12/16 10:10
Date Reported: 05/26/16 15:34

6E12040-07		Static-Zn-125			
Sampled: 04/29/16 08:30		Sampled By: Molly, Gunther Rosen, Jacob Munson			Matrix: Water
Metals - Low Level by 1600 Series Methods					
Method: EPA 1640		Batch: W6E0896		Prepared: 05/19/16 09:10	
Analyst: gza					
Analyte	Result	MRL	Units	Dil	Analyzed
Zinc, Total	180	20	ug/l	100	05/19/16 21:58
Qualifier					



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Date Received: 05/12/16 10:10
Date Reported: 05/26/16 15:34

6E12040-08		Static-Zn-250			
Sampled: 04/29/16 08:30		Sampled By: Molly, Gunther Rosen, Jacob Munson			Matrix: Water
Metals - Low Level by 1600 Series Methods					
Method: EPA 1640		Batch: W6E0896		Prepared: 05/19/16 09:10	
		Analyst: gza			
Analyte	Result	MRL	Units	Dil	Analyzed
Zinc, Total	320	20	ug/l	100	05/19/16 22:11
		Qualifier			



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Date Received: 05/12/16 10:10
Date Reported: 05/26/16 15:34

6E12040-09		Static-Zn-500			
Sampled: 04/29/16 08:30		Sampled By: Molly, Gunther Rosen, Jacob Munson			Matrix: Water
Metals - Low Level by 1600 Series Methods					
Method: EPA 1640		Batch: W6E0896		Prepared: 05/19/16 09:10	
Analyst: gza					
Analyte	Result	MRL	Units	Dil	Analyzed
Zinc, Total	540	20	ug/l	100	05/19/16 22:25



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Date Received: 05/12/16 10:10

Date Reported: 05/26/16 15:34

6E12040-10		Static-Zn-1000			
Sampled: 04/29/16 08:30		Sampled By: Molly, Gunther Rosen, Jacob Munson			Matrix: Water
Metals - Low Level by 1600 Series Methods					
Method: EPA 1640		Batch: W6E0896		Prepared: 05/19/16 09:10	
		Analyst: gza			
Analyte	Result	MRL	Units	Dil	Analyzed
Zinc, Total	1400	20	ug/l	100	05/19/16 22:39



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Date Received: 05/12/16 10:10

Date Reported: 05/26/16 15:34

6E12040-11		Static-Zn-2000			
Sampled: 04/29/16 08:30		Sampled By: Molly, Gunther Rosen, Jacob Munson			Matrix: Water
Metals - Low Level by 1600 Series Methods					
Method: EPA 1640		Batch: W6E0896		Prepared: 05/19/16 09:10	
Analyst: gza					
Analyte	Result	MRL	Units	Dil	Analyzed
Zinc, Total	2700	200	ug/l	1000	05/19/16 23:34



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Date Received: 05/12/16 10:10
Date Reported: 05/26/16 15:34

6E12040-12		96hr-TU-0.25				
Sampled: 04/29/16 08:30		Sampled By: Molly, Gunther Rosen, Jacob Munson			Matrix: Water	
Metals - Low Level by 1600 Series Methods						
Method: EPA 1640		Batch: W6E0896		Prepared: 05/19/16 09:10		
		Analyst: gza				
Analyte	Result	MRL	Units	Dil	Analyzed	Qualifier
Copper, Total	34	1.0	ug/l	100	05/19/16 23:47	
Zinc, Total	150	20	ug/l	100	05/19/16 23:47	



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Date Received: 05/12/16 10:10
Date Reported: 05/26/16 15:34

6E12040-13		96hr-TU-0.5				
Sampled: 04/29/16 08:30		Sampled By: Molly, Gunther Rosen, Jacob Munson				Matrix: Water
Metals - Low Level by 1600 Series Methods						
Method: EPA 1640		Batch: W6E0896		Prepared: 05/19/16 09:10		Analyst: gza
Analyte	Result	MRL	Units	Dil	Analyzed	Qualifier
Copper, Total	71	1.0	ug/l	100	05/20/16 00:01	
Zinc, Total	320	20	ug/l	100	05/20/16 00:01	



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Date Received: 05/12/16 10:10
Date Reported: 05/26/16 15:34

6E12040-14		96hr-TU-0.125			
Sampled: 04/29/16 08:30	Sampled By: Molly, Gunther Rosen, Jacob Munson				Matrix: Water
Metals - Low Level by 1600 Series Methods					
Method: EPA 1640	Batch: W6E0896	Prepared: 05/19/16 09:10			Analyst: gza
Analyte	Result	MRL	Units	Dil	Analyzed
Copper, Total	21	1.0	ug/l	100	05/20/16 00:15
Zinc, Total	81	20	ug/l	100	05/20/16 00:15



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Date Received: 05/12/16 10:10
Date Reported: 05/26/16 15:34

6E12040-15		96hr-TU-1			
Sampled: 04/29/16 08:30		Sampled By: Molly, Gunther Rosen, Jacob Munson			Matrix: Water
Metals - Low Level by 1600 Series Methods					
Method: EPA 1640		Batch: W6E0896		Prepared: 05/19/16 09:10	
				Analyst: gza	
Analyte	Result	MRL	Units	Dil	Analyzed
Copper, Total	140	1.0	ug/l	100	05/20/16 00:29
Zinc, Total	860	20	ug/l	100	05/20/16 00:29



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Date Reported: 05/26/16 15:34

6E12040-16		96hr-TU-2				
Sampled: 04/29/16 08:30		Sampled By: Molly, Gunther Rosen, Jacob Munson				Matrix: Water
Metals - Low Level by 1600 Series Methods						
Method: EPA 1640		Batch: W6E0896		Prepared: 05/19/16 09:10		Analyst: gza
Analyte	Result	MRL	Units	Dil	Analyzed	Qualifier
Copper, Total	280	1.0	ug/l	100	05/20/16 00:42	
Zinc, Total	1600	20	ug/l	100	05/20/16 00:42	



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6E12040-17		3hr-TU-0.125			
Sampled: 04/29/16 08:30		Sampled By: Molly, Gunther Rosen, Jacob Munson			Matrix: Water
Metals - Low Level by 1600 Series Methods					
Method: EPA 1640		Batch: W6E0896		Prepared: 05/19/16 09:10	
		Analyst: gza			
Analyte	Result	MRL	Units	Dil	Analyzed
Copper, Total	190	1.0	ug/l	100	05/20/16 00:56
Zinc, Total	1800	20	ug/l	100	05/20/16 00:56



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6E12040-18		3hr-TU-0.25				
Sampled: 04/29/16 08:30	Sampled By: Molly, Gunther Rosen, Jacob Munson				Matrix: Water	
Metals - Low Level by 1600 Series Methods						
Method: EPA 1640	Batch: W6E0896	Prepared: 05/19/16 09:10			Analyst: gza	
Analyte	Result	MRL	Units	Dil	Analyzed	Qualifier
Copper, Total	350	10	ug/l	1000	05/20/16 01:10	
Zinc, Total	3900	200	ug/l	1000	05/20/16 01:10	



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6E12040-19		3hr-TU-0.5					
Sampled: 04/29/16 08:30		Sampled By: Molly, Gunther Rosen, Jacob Munson				Matrix: Water	
Metals - Low Level by 1600 Series Methods							
Method: EPA 1640		Batch: W6E0896		Prepared: 05/19/16 09:10		Analyst: gza	
Analyte	Result	MRL	Units	Dil	Analyzed		
Copper, Total	880	10	ug/l	1000	05/20/16 01:23		
Zinc, Total	7400	200	ug/l	1000	05/20/16 01:23		



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6E12040-20		3hr-TU-1				
Sampled: 04/29/16 08:30		Sampled By: Molly, Gunther Rosen, Jacob Munson				Matrix: Water
Metals - Low Level by 1600 Series Methods						
Method: EPA 1640		Batch: W6E0896		Prepared: 05/19/16 09:10		Analyst: gza
Analyte	Result	MRL	Units	Dil	Analyzed	Qualifier
Copper, Total	1500	10	ug/l	1000	05/20/16 01:37	
Zinc, Total	15000	200	ug/l	1000	05/20/16 01:37	



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6E12040-21		3hr-TU-2				
Sampled: 04/29/16 08:30		Sampled By: Molly, Gunther Rosen, Jacob Munson				Matrix: Water
Metals - Low Level by 1600 Series Methods						
Method: EPA 1640		Batch: W6E0896		Prepared: 05/19/16 09:10		Analyst: gza
Analyte	Result	MRL	Units	Dil	Analyzed	Qualifier
Copper, Total	3100	20	ug/l	2000	05/20/16 02:32	
Zinc, Total	30000	400	ug/l	2000	05/20/16 02:32	

Page 23 of 37

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Date Reported: 05/26/16 15:34

6E12040-22		6hr-TU-0.125			
Sampled: 04/29/16 08:30		Sampled By: Molly, Gunther Rosen, Jacob Munson			Matrix: Water
Metals - Low Level by 1600 Series Methods					
Method: EPA 1640		Batch: W6E0896		Prepared: 05/19/16 09:10	
		Analyst: gza			
Analyte	Result	MRL	Units	Dil	Analyzed
Copper, Total	99	1.0	ug/l	100	05/20/16 02:46
Zinc, Total	850	20	ug/l	100	05/20/16 02:46

Page 24 of 37

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6E12040-23		6hr-TU-0.25			
Sampled: 04/29/16 08:30		Sampled By: Molly, Gunther Rosen, Jacob Munson			Matrix: Water
Metals - Low Level by 1600 Series Methods					
Method: EPA 1640		Batch: W6E0896	Prepared: 05/19/16 09:10		Analyst: gza
Analyte	Result	MRL	Units	Dil	Analyzed
Copper, Total	200	1.0	ug/l	100	05/20/16 02:59
Zinc, Total	1500	20	ug/l	100	05/20/16 02:59



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Date Reported: 05/26/16 15:34

6E12040-24		6hr-TU-0.5				
Sampled: 04/29/16 08:30	Sampled By: Molly, Gunther Rosen, Jacob Munson				Matrix: Water	
Metals - Low Level by 1600 Series Methods						
Method: EPA 1640	Batch: W6E0896	Prepared: 05/19/16 09:10			Analyst: gza	
Analyte	Result	MRL	Units	Dil	Analyzed	
Copper, Total	440	10	ug/l	1000	05/20/16 03:13	
Zinc, Total	2500	200	ug/l	1000	05/20/16 03:13	

Page 26 of 37

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Date Reported: 05/26/16 15:34

6E12040-25		6hr-TU-1				
Sampled: 04/29/16 08:30	Sampled By: Molly, Gunther Rosen, Jacob Munson				Matrix: Water	
Metals - Low Level by 1600 Series Methods						
Method: EPA 1640		Batch: W6E0896		Prepared: 05/19/16 09:10		Analyst: gza
Analyte	Result	MRL	Units	Dil	Analyzed	Qualifier
Copper, Total	770	10	ug/l	1000	05/20/16 03:27	
Zinc, Total	5200	200	ug/l	1000	05/20/16 03:27	



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Date Reported: 05/26/16 15:34

6E12040-26		6hr-TU-2				
Sampled: 04/29/16 08:30		Sampled By: Molly, Gunther Rosen, Jacob Munson				Matrix: Water
Metals - Low Level by 1600 Series Methods						
Method: EPA 1640		Batch: W6E0896		Prepared: 05/19/16 09:10		Analyst: gza
Analyte	Result	MRL	Units	Dil	Analyzed	Qualifier
Copper, Total	1600	10	ug/l	1000	05/20/16 03:40	
Zinc, Total	11000	200	ug/l	1000	05/20/16 03:40	

Page 28 of 37

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Date Reported: 05/26/16 15:34

6E12040-27		12hr-TU-0.125			
Sampled: 04/29/16 08:30	Sampled By: Molly, Gunther Rosen, Jacob Munson				Matrix: Water
Metals - Low Level by 1600 Series Methods					
Method: EPA 1640	Batch: W6E1121	Prepared: 05/19/16 16:12			Analyst: gza
Analyte	Result	MRL	Units	Dil	Analyzed
Copper, Total	34	1.0	ug/l	100	05/23/16 21:34
Zinc, Total	360	20	ug/l	100	05/23/16 21:34

Page 29 of 37

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Date Reported: 05/26/16 15:34

6E12040-28		12hr-TU-0.25			
Sampled: 04/29/16 08:30		Sampled By: Molly, Gunther Rosen, Jacob Munson			Matrix: Water
Metals - Low Level by 1600 Series Methods					
Method: EPA 1640		Batch: W6E1121		Prepared: 05/19/16 16:12	
		Analyst: gza			
Analyte	Result	MRL	Units	Dil	Analyzed
Copper, Total	72	1.0	ug/l	100	05/23/16 21:48
Zinc, Total		20	ug/l	100	05/23/16 21:48



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Date Reported: 05/26/16 15:34

6E12040-29		12hr-TU-0.5				
Sampled: 04/29/16 08:30		Sampled By: Molly, Gunther Rosen, Jacob Munson				Matrix: Water
Metals - Low Level by 1600 Series Methods						
Method: EPA 1640		Batch: W6E1121		Prepared: 05/19/16 16:12		Analyst: gza
Analyte	Result	MRL	Units	Dil	Analyzed	Qualifier
Copper, Total	120	1.0	ug/l	100	05/23/16 22:01	
Zinc, Total	1500	20	ug/l	100	05/23/16 22:01	



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Date Reported: 05/26/16 15:34

6E12040-30		12hr-TU-1			
Sampled: 04/29/16 08:30	Sampled By: Molly, Gunther Rosen, Jacob Munson				Matrix: Water
Metals - Low Level by 1600 Series Methods					
Method: EPA 1640	Batch: W6E1121	Prepared: 05/19/16 16:12			Analyst: gza
Analyte	Result	MRL	Units	Dil	Analyzed
Copper, Total	340	10	ug/l	1000	05/23/16 22:56
Zinc, Total	3100	200	ug/l	1000	05/23/16 22:56



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Date Reported: 05/26/16 15:34

6E12040-31		12hr-TU-2				
Sampled: 04/29/16 08:30		Sampled By: Molly, Gunther Rosen, Jacob Munson			Matrix: Water	
Metals - Low Level by 1600 Series Methods						
Method: EPA 1640		Batch: W6E1121		Prepared: 05/19/16 16:12		
		Analyst: gza				
Analyte	Result	MRL	Units	Dil	Analyzed	Qualifier
Copper, Total	570	10	ug/l	1000	05/23/16 23:10	
Zinc, Total	5900	200	ug/l	1000	05/23/16 23:10	



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Date Reported: 05/26/16 15:34

QUALITY CONTROL SECTION

Page 34 of 37

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Conventional Chemistry/Physical Parameters by APHA/EPA/ASTM Methods - Quality Control

Batch W6E1048 - SM 5310B

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	% REC Limits	RPD	RPD Limit	Data Qualifiers
Blank (W6E1048-BLK1)				Analyzed: 05/18/16 14:56						
Dissolved Organic Carbon	ND	0.10	mg/l							
LCS (W6E1048-BS1)				Analyzed: 05/18/16 14:56						
Dissolved Organic Carbon	1.07	0.10	mg/l	1.00		107	85-115			
Matrix Spike (W6E1048-MS1)				Source: 6E12040-01 Analyzed: 05/18/16 14:56						
Dissolved Organic Carbon	5.94	0.10	mg/l	5.00	1.04	98	74-120			
Matrix Spike Dup (W6E1048-MSD1)				Source: 6E12040-01 Analyzed: 05/18/16 14:56						
Dissolved Organic Carbon	5.62	0.10	mg/l	5.00	1.04	92	74-120	6	20	

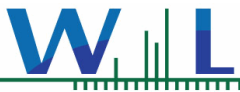
Metals - Low Level by 1600 Series Methods - Quality Control

Batch W6E0823 - EPA 1640

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	% REC Limits	RPD	RPD Limit	Data Qualifiers
Blank (W6E0823-BLK1)				Analyzed: 05/17/16 19:50						
Copper, Total	ND	0.010	ug/l							
Zinc, Total	ND	0.20	ug/l							
LCS (W6E0823-BS1)				Analyzed: 05/17/16 20:03						
Copper, Total	1.93	0.010	ug/l	2.00		97	73-122			
Zinc, Total	10.0	0.20	ug/l	10.0		100	75-127			
Matrix Spike (W6E0823-MS1)				Source: 6E10043-01 Analyzed: 05/17/16 20:17						
Copper, Total	5.85	0.010	ug/l	2.00	4.15	85	60-138			
Zinc, Total	29.0	0.20	ug/l	10.0	20.2	89	68-132			
Matrix Spike (W6E0823-MS2)				Source: 6E12039-01 Analyzed: 05/17/16 20:44						
Copper, Total	3.39	0.010	ug/l	2.00	1.43	98	60-138			
Zinc, Total	16.4	0.20	ug/l	10.0	6.09	103	68-132			
Matrix Spike Dup (W6E0823-MSD1)				Source: 6E10043-01 Analyzed: 05/17/16 20:31						
Copper, Total	5.96	0.010	ug/l	2.00	4.15	90	60-138	2	30	
Zinc, Total	29.5	0.20	ug/l	10.0	20.2	94	68-132	2	30	
Matrix Spike Dup (W6E0823-MSD2)				Source: 6E12039-01 Analyzed: 05/17/16 20:58						
Copper, Total	3.40	0.010	ug/l	2.00	1.43	99	60-138	0.5	30	
Zinc, Total	16.4	0.20	ug/l	10.0	6.09	103	68-132	0.09	30	

Batch W6E0896 - EPA 1640

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	% REC Limits	RPD	RPD Limit	Data Qualifiers
Blank (W6E0896-BLK1)				Analyzed: 05/19/16 20:36						
Copper, Total	ND	0.010	ug/l							
Zinc, Total	ND	0.20	ug/l							
LCS (W6E0896-BS1)				Analyzed: 05/19/16 20:49						
Copper, Total	1.86	0.010	ug/l	2.00		93	73-122			
Zinc, Total	9.40	0.20	ug/l	10.0		94	75-127			



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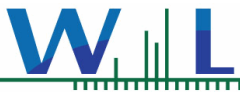
Metals - Low Level by 1600 Series Methods - Quality Control

Batch W6E0896 - EPA 1640

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	% REC Limits	RPD	RPD Limit	Data Qualifiers
Matrix Spike (W6E0896-MS1)				Source: 6E12040-07		Analyzed: 05/19/16 21:03				
Copper, Total	4.36	0.050	ug/l	2.00	4.28	4	60-138			MS-02
Zinc, Total	175	1.0	ug/l	10.0	178	NR	68-132			MS-02
Matrix Spike (W6E0896-MS2)				Source: 6E12040-12		Analyzed: 05/19/16 21:30				
Copper, Total	34.4	0.050	ug/l	2.00	33.5	44	60-138			MS-02
Zinc, Total	181	1.0	ug/l	10.0	153	277	68-132			MS-02
Matrix Spike Dup (W6E0896-MSD1)				Source: 6E12040-07		Analyzed: 05/19/16 21:17				
Copper, Total	4.39	0.050	ug/l	2.00	4.28	5	60-138	0.6	30	MS-02
Zinc, Total	176	1.0	ug/l	10.0	178	NR	68-132	0.5	30	MS-02
Matrix Spike Dup (W6E0896-MSD2)				Source: 6E12040-12		Analyzed: 05/19/16 21:44				
Copper, Total	34.8	0.050	ug/l	2.00	33.5	63	60-138	1	30	
Zinc, Total	182	1.0	ug/l	10.0	153	290	68-132	0.8	30	MS-02

Batch W6E1121 - EPA 1640

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	% REC Limits	RPD	RPD Limit	Data Qualifiers
Blank (W6E1121-BLK1)				Analyzed: 05/23/16 20:39						
Copper, Total	ND	0.010	ug/l							
Zinc, Total	ND	0.20	ug/l							
LCS (W6E1121-BS1)				Analyzed: 05/23/16 20:53						
Copper, Total	1.91	0.010	ug/l	2.00		95	73-122			
Zinc, Total	9.98	0.20	ug/l	10.0		100	75-127			
Matrix Spike (W6E1121-MS1)				Source: 6E12065-01		Analyzed: 05/23/16 21:06				
Copper, Total	4.38	0.010	ug/l	2.00	2.56	91	60-138			
Zinc, Total	143	0.20	ug/l	10.0	138	58	68-132			MS-02
Matrix Spike Dup (W6E1121-MSD1)				Source: 6E12065-01		Analyzed: 05/23/16 21:20				
Copper, Total	4.41	0.010	ug/l	2.00	2.56	93	60-138	0.7	30	
Zinc, Total	147	0.20	ug/l	10.0	138	90	68-132	2	30	



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Notes and Definitions

MS-02	The RPD and/or percent recovery for this QC spike sample cannot be accurately calculated due to the high concentration of analyte inherent in the sample.
ND	NOT DETECTED at or above the Method Reporting Limit (MRL). If Method Detection Limit (MDL) is reported, then not detected at or above the MDL.
NR	Not Reportable
Dil	Dilution
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference
% Rec	Percent Recovery
Sub	Subcontracted analysis, original report available upon request
MDL	Method Detection Limit
MDA	Minimum Detectable Activity
MRL	Method Reporting Limit

Any remaining sample(s) will be disposed of one month from the final report date unless other arrangements are made in advance.

An Absence of Total Coliform meets the drinking water standards as established by the California Department of Health Services.

The Reporting Limit (RL) is referenced as the Laboratory's Practical Quantitation Limit (PQL) or the Detection Limit for Reporting Purposes (DLR).

All samples collected by Weck Laboratories have been sampled in accordance to laboratory SOP Number MIS002.

Chain of Custody Record

6E12040

Date: 5/14/2016
 Page: 1 of 2

Project Title/Project Number: Mixed Copper and Zinc Pulsed Toxicity Test										Project Leader: Molly Colvin	
Remarks/Air Bill:										Contact Tel: 619 553-2788	
Sampler(s): Molly Colvin, Gunther Rosen, Jacob Munson										Email: mcolvin@spawar.mil	
Tel: 619-553-2788 Fax:										Requested Analyses	
Special Instructions:											
Sample ID	Date	Time	Matrix	Container Type	# of Containers	Total Wet Weight (g)	Disolved	Disolved	DOC	Nominal wgt	Nominal wgt
Static - LC - Cu	4/29/16	0830	See water	HDPE	1		X	X	X	0	0
Static - Cu - 50	4/29/16	0830	See water	HDPE	1		X	X		50	0
Static - Cu - 100	4/29/16	0830	See water	HDPE	1		X	X		100	0
Static - Cu - 200	4/29/16	0830	See water	HDPE	1		X	X		200	0
Static - Cu - 400	4/29/16	0830	See water	HDPE	1		X	X		400	0
Static - Cu - 800	4/29/16	0830	See water	HDPE	1		X	X		800	0
Static - Zn - 125	4/29/16	0830	See water	HDPE	1		X	X		125	0
Static - Zn - 250	4/29/16	0830	See water	HDPE	1		X	X		250	0
Static - Zn - 500	4/29/16	0830	See water	HDPE	1		X	X		500	0
Static - Zn - 1000	4/29/16	0830	See water	HDPE	1		X	X		1000	0
Static - Zn - 2000	4/29/16	0830	See water	HDPE	1		X	X		2000	0
96 hr - TU - 0.25	4/29/16	0830	See water	HDPE	1		X	X		34	127.5
96 hr - TU - 0.5	4/29/16	0830	See water	HDPE	1		X	X		68	255.1
96 hr - TU - 1.25	4/29/16	0830	See water	HDPE	1		X	X		17	63.8
96 hr - TU - 1	4/29/16	0830	See water	HDPE	1		X	X		135	510.1
96 hr - TU - 2	4/29/16	0830	See water	HDPE	1		X	X		270	1021.2
3 hr - TU - 0.125	4/29/16	0830	See water	HDPE	1		X	X		184	1905
3 hr - TU - 0.25	4/29/16	0830	See water	HDPE	1		X	X		369	2610
3 hr - TU - 0.5	4/29/16	0830	See water	HDPE	1		X	X		737	5220
3 hr - TU - 1	4/29/16	0830	See water	HDPE	1		X	X		1475	10440
3 hr - TU - 2	4/29/16	0830	See water	HDPE	1		X	X		2950	20880
Relinquished by: (Signature) SSC										Received by: (Signature) Felix	
Relinquished by: (Signature) Felix										Received by: (Signature) Felix	
Date: 5/10/2016										Time: 1000	
Date: 5.12.16										Time: 1010	



ENVIRONMENTAL SCIENCES AND
APPLIED SYSTEMS BRANCH, CODE 71750
53605 HULL STREET
SAN DIEGO, CA 92152-5000

Systems Center
San Diego

Chain of Custody Record

6E12040

Date: 5/4/2010

Page: 2 of 2

Project Title/Project Number: Mixed Copper and Zinc Pulsed Toxicity Test		Project Leader: Molly Colvin								
Remarks/Air Bill:		Contact: 619 553-2788								
Sampler(s): (Signature) Molly Colvin, Gantner Rosen, Jacob Munson		Contact Info								
Tel: 619 553-2788 Fax:		Email: mcolvin@spawar.navy.mil								
Special Instructions:		Requested Analyses								
Field Sample Identification	Date	Time	Matrix	Type	Collection Temp (C)	Arrival Temp (C)	Dissolved	Filtered	Concentration	Concentration
6hr-TU-0.125	4/29/16	0830	Seawater	ADPE			X			69 1483
6hr-TU-0.25	4/29/16	0830	Seawater	ADPE			X			149 1483
6hr-TU-0.5	4/29/16	0830	Seawater	ADPE			X			318 1451
6hr-TU-1	4/29/16	0830	Seawater	ADPE			X			715 394
6hr-TU-2	4/29/16	0830	Seawater	ADPE			X			592 7820
12hr-TU-0.125	4/29/16	0830	Seawater	ADPE			X			30 257
12hr-TU-0.25	4/29/16	0830	Seawater	ADPE			X			60 515
12hr-TU-0.5	4/29/16	0830	Seawater	ADPE			X			20 1030
12hr-TU-1	4/29/16	0830	Seawater	ADPE			X			240 206
12hr-TU-2	4/29/16	0830	Seawater	ADPE			X			479 4128
Relinquished by: (Signature) [Signature]		Received by: (Signature) [Signature]		Date: 5/10/2010		Time: 1000				
Relinquished by: (Signature) [Signature]		Received by: (Signature) [Signature]		Date: 5/12/16		Time: 1810				

APPENDIX C
TEST DATA AND STATISTICAL SUMMARIES
STORMWATER EXPOSURES

C.1 OVERVIEW

Items included are included in Appendix C:

1. Stormwater Exposures – Purple Urchin C-15
2. Stormwater Exposures – Mysid Shrimp C-15
3. Stormwater Exposures – Analytical Chemistry Reports C-15
4. Stormwater Exposures – Reference Toxicant Test Results C-15
5. Stormwater Exposures – Sample Information and Chain of Custody C-15

C.1. COPPER EXPOSURES – PURPLE URCHIN:

TST Summary Sheet

Lab Name	SSC - Pacific	Client Name	SSC - Pacific
Test ID	SSC-2016-Outfall 73_12hr	Test Species	<i>S. purpuratus (echinoderm)</i>
Test Date	3.25.2016	Test Type	Chronic
Test Duration	4 day	Endpoint	Larval Development
Critical Conc.	64		

Statistic	Control	Critical Concentration
Percent Mean of Raw Data	0.99	0.94
Mean used in Calculation (transformed)	1.49	1.32
Variance used in Calculation (transformed)	0.002	0.003
Standard Deviation of Transformed Data	0.044	0.055
CV of Transformed Data	0.030	0.042
n	4	4

Mean % Effect at Critical Conc.

5.54

Calculated t-value	Degrees of Freedom	Table t-value	Percent Difference
6.4828	4	2.1318	

Results

Pass Sample is Non-toxic

Raw Data

Control Data		Critical Concentration Data	
No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)	No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)
100	99	100	91
100	98	100	93
100	100	100	94
100	100	100	97

TST Summary Sheet

Lab Name	SSC - Pacific	Client Name	SSC - Pacific
Test ID	SSC-2016-Outfall 73_96hr	Test Species	<i>S. purpuratus (echinoderm)</i>
Test Date	3.25.2016	Test Type	Chronic
Test Duration	4 day	Endpoint	Larval Development
Critical Conc.	64		

Statistic	Control	Critical Concentration
Percent Mean of Raw Data	0.99	0.00
Mean used in Calculation (transformed)	1.49	0.05
Variance used in Calculation (transformed)	0.002	0.000
Standard Deviation of Transformed Data	0.044	0.000
CV of Transformed Data	0.030	0.000
n	4	4

Mean % Effect at Critical Conc.

100.00

Calculated t-value	Degrees of Freedom	Table t-value	Percent Difference
-63.9040	3	2.3534	

Results

Fail Sample is Toxic

Raw Data

Control Data		Critical Concentration Data	
No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)	No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)
100	99	100	0
100	98	100	0
100	100	100	0
100	100	100	0

TST Summary Sheet

Lab Name	SSC - Pacific	Client Name	SSC - Pacific
Test ID	SSC-2016-Pier 10 Influent_12hr	Test Species	<i>S. purpuratus (echinoderm)</i>
Test Date	3/25/2016	Test Type	Chronic
Test Duration	4 day	Endpoint	Larval Development
Critical Conc.	64		

Statistic	Control	Critical Concentration
Percent Mean of Raw Data	0.99	0.97
Mean used in Calculation (transformed)	1.49	1.39
Variance used in Calculation (transformed)	0.002	0.002
Standard Deviation of Transformed Data	0.044	0.050
CV of Transformed Data	0.030	0.036
n	4	4

Mean % Effect at Critical Conc.

2.52

Calculated t-value	Degrees of Freedom	Table t-value	Percent Difference
9.3663	5	2.0150	

Results

Pass Sample is Non-toxic

Raw Data

Control Data		Critical Concentration Data	
No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)	No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)
100	99	100	98
100	98	100	94
100	100	100	97
100	100	100	98

TST Summary Sheet

Lab Name	SSC - Pacific	Client Name	SSC - Pacific
Test ID	SSC-2016-Pier 10 Influent_96hr	Test Species	<i>S. purpuratus (echinoderm)</i>
Test Date	3/25/2016	Test Type	Chronic
Test Duration	4 day	Endpoint	Larval Development
Critical Conc.	64		

Statistic	Control	Critical Concentration
Percent Mean of Raw Data	0.99	0.09
Mean used in Calculation (transformed)	1.49	0.30
Variance used in Calculation (transformed)	0.002	0.013
Standard Deviation of Transformed Data	0.044	0.112
CV of Transformed Data	0.030	0.380
n	4	4

Mean % Effect at Critical Conc.

90.68

Calculated t-value	Degrees of Freedom	Table t-value	Percent Difference
-13.9810	3	2.3534	

Results

Fail Sample is Toxic

Raw Data

Control Data		Critical Concentration Data	
No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)	No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)
100	99	100	15
100	98	100	14
100	100	100	3
100	100	100	5

TST Summary Sheet

Lab Name	SSC - Pacific	Client Name	SSC - Pacific
Test ID	SSC-2016-Pier 10 Effluent_12hr	Test Species	<i>S. purpuratus (echinoderm)</i>
Test Date	3/25/2016	Test Type	Chronic
Test Duration	4 day	Endpoint	Larval Development
Critical Conc.	64		

Statistic	Control	Critical Concentration
Percent Mean of Raw Data	0.99	0.97
Mean used in Calculation (transformed)	1.49	1.42
Variance used in Calculation (transformed)	0.002	0.008
Standard Deviation of Transformed Data	0.044	0.089
CV of Transformed Data	0.030	0.063
n	4	4

Mean % Effect at Critical Conc.

2.02

Calculated t-value	Degrees of Freedom	Table t-value	Percent Difference
6.4225	3	2.3534	

Results

Pass Sample is Non-toxic

Raw Data

Control Data		Critical Concentration Data	
No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)	No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)
100	99	100	98
100	98	100	93
100	100	100	100
100	100	100	98

TST Summary Sheet

Lab Name	SSC - Pacific	Client Name	SSC - Pacific
Test ID	SSC-2016-Pier 10 Effluent_96hr	Test Species	<i>S. purpuratus (echinoderm)</i>
Test Date	3/25/2016	Test Type	Chronic
Test Duration	4 day	Endpoint	Larval Development
Critical Conc.	64		

Statistic	Control	Critical Concentration
Percent Mean of Raw Data	0.99	0.11
Mean used in Calculation (transformed)	1.49	0.33
Variance used in Calculation (transformed)	0.002	0.003
Standard Deviation of Transformed Data	0.044	0.059
CV of Transformed Data	0.030	0.180
n	4	4

Mean % Effect at Critical Conc.

89.42

Calculated t-value	Degrees of Freedom	Table t-value	Percent Difference
-23.2693	4	2.1318	

Results

Fail Sample is Toxic

Raw Data

Control Data		Critical Concentration Data	
No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)	No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)
100	99	100	8
100	98	100	10
100	100	100	16
100	100	100	8

TST Summary Sheet

Lab Name	SSC - Pacific	Client Name	SSC - Pacific
Test ID	SSC-2016-Pier 13 Base_12hr	Test Species	<i>S. purpuratus (echinoderm)</i>
Test Date	3/25/2016	Test Type	Chronic
Test Duration	4 day	Endpoint	Larval Development
Critical Conc.	64		

Statistic	Control	Critical Concentration
Percent Mean of Raw Data	0.99	0.96
Mean used in Calculation (transformed)	1.49	1.39
Variance used in Calculation (transformed)	0.002	0.006
Standard Deviation of Transformed Data	0.044	0.077
CV of Transformed Data	0.030	0.056
n	4	4

Mean % Effect at Critical Conc.

3.02

Calculated t-value	Degrees of Freedom	Table t-value	Percent Difference
6.5107	4	2.1318	

Results

Pass Sample is Non-toxic

Raw Data

Control Data		Critical Concentration Data	
No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)	No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)
100	99	100	99
100	98	100	92
100	100	100	97
100	100	100	97

TST Summary Sheet

Lab Name	SSC - Pacific	Client Name	SSC - Pacific
Test ID	SSC-2016-Pier 13 Base_96hr	Test Species	<i>S. purpuratus (echinoderm)</i>
Test Date	3/25/2016	Test Type	Chronic
Test Duration	4 day	Endpoint	Larval Development
Critical Conc.	64		

Statistic	Control	Critical Concentration
Percent Mean of Raw Data	0.99	0.91
Mean used in Calculation (transformed)	1.49	1.26
Variance used in Calculation (transformed)	0.002	0.003
Standard Deviation of Transformed Data	0.044	0.052
CV of Transformed Data	0.030	0.041
n	4	4

Mean % Effect at Critical Conc.

8.56

Calculated t-value	Degrees of Freedom	Table t-value	Percent Difference
4.9040	5	2.0150	

Results

Pass Sample is Non-toxic

Raw Data

Control Data		Critical Concentration Data	
No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)	No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)
100	99	100	90
100	98	100	87
100	100	100	94
100	100	100	92

TST Summary Sheet

Lab Name	SSC - Pacific	Client Name	SSC - Pacific
Test ID	SSC-2016-Pier 13 Mid_12hr_Outlier R	Test Species	<i>S. purpuratus (echinoderm)</i>
Test Date	3/25/2016	Test Type	Chronic
Test Duration	4 day	Endpoint	Larval Development
Critical Conc.	64		

Statistic	Control	Critical Concentration
Percent Mean of Raw Data	0.99	0.94
Mean used in Calculation (transformed)	1.49	1.33
Variance used in Calculation (transformed)	0.002	0.001
Standard Deviation of Transformed Data	0.044	0.038
CV of Transformed Data	0.030	0.029
n	4	3

Mean % Effect at Critical Conc.

5.29

Calculated t-value	Degrees of Freedom	Table t-value	Percent Difference
7.6258	4	2.1318	

Results

Pass Sample is Non-toxic

Raw Data

Control Data		Critical Concentration Data	
No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)	No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)
100	99	100	93
100	98	100	93
100	100	100	96
100	100		

TST Summary Sheet

Lab Name	SSC - Pacific	Client Name	SSC - Pacific
Test ID	SSC-2016-Pier 13 Mid_96hr	Test Species	<i>S. purpuratus (echinoderm)</i>
Test Date	3/25/2016	Test Type	Chronic
Test Duration	4 day	Endpoint	Larval Development
Critical Conc.	64		

Statistic	Control	Critical Concentration
Percent Mean of Raw Data	0.99	0.00
Mean used in Calculation (transformed)	1.49	0.05
Variance used in Calculation (transformed)	0.002	0.000
Standard Deviation of Transformed Data	0.044	0.000
CV of Transformed Data	0.030	0.000
n	4	4

Mean % Effect at Critical Conc.

100.00

Calculated t-value	Degrees of Freedom	Table t-value	Percent Difference
-63.9040	3	2.3534	

Results

Fail Sample is Toxic

Raw Data

Control Data		Critical Concentration Data	
No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)	No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)
100	99	100	0
100	98	100	0
100	100	100	0
100	100	100	0

TST Summary Sheet

Lab Name	SSC - Pacific	Client Name	SSC - Pacific
Test ID	SSC-2016-Pier 13 End_12hr	Test Species	<i>S. purpuratus (echinoderm)</i>
Test Date	3/25/2016	Test Type	Chronic
Test Duration	4 day	Endpoint	Larval Development
Critical Conc.	64		

Statistic	Control	Critical Concentration
Percent Mean of Raw Data	0.99	0.95
Mean used in Calculation (transformed)	1.49	1.35
Variance used in Calculation (transformed)	0.002	0.004
Standard Deviation of Transformed Data	0.044	0.061
CV of Transformed Data	0.030	0.045
n	4	4

Mean % Effect at Critical Conc.

4.53

Calculated t-value	Degrees of Freedom	Table t-value	Percent Difference
6.6463	4	2.1318	

Results

Pass Sample is Non-toxic

Raw Data

Control Data		Critical Concentration Data	
No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)	No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)
100	99	100	92
100	98	100	94
100	100	100	95
100	100	100	98

TST Summary Sheet

Lab Name	SSC - Pacific	Client Name	SSC - Pacific
Test ID	SSC-2016-Pier 13 End_96hr	Test Species	<i>S. purpuratus (echinoderm)</i>
Test Date	3/25/2016	Test Type	Chronic
Test Duration	4 day	Endpoint	Larval Development
Critical Conc.	64		

Statistic	Control	Critical Concentration
Percent Mean of Raw Data	0.99	0.00
Mean used in Calculation (transformed)	1.49	0.05
Variance used in Calculation (transformed)	0.002	0.000
Standard Deviation of Transformed Data	0.044	0.000
CV of Transformed Data	0.030	0.000
n	4	4

Mean % Effect at Critical Conc.

100.00

Calculated t-value	Degrees of Freedom	Table t-value	Percent Difference
-63.9040	3	2.3534	

Results

Fail Sample is Toxic

Raw Data

Control Data		Critical Concentration Data	
No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)	No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)
100	99	100	0
100	98	100	0
100	100	100	0
100	100	100	0

Embryo Larval Bioassay

96-Hour Development

Project: NBSD Storm H₂O - pulsedTest Species: S. purpuratusSample ID: 3hr Exposure - Binned SamplesStart Date: 3/8/2016 1000Test No.: End Date: 3/12/2016 1030

Random #	Number Counted	Number Normal	Technician Initials
36	100	0	MC
37	100	100	MC
38	100	87	MC
39	100	74	MC
40	100	0	MC
41	100	0	MC
42	100	72	MC
43	100	10	MC
44	100	23	MC
45	100	99	MC
46	100	100	MC
47	100	98	MC
48	MC 100 79	76	MC
49	100	100	MC
50	100	54	MC
51	100	24	MC
52	100	0	MC
53	100	90	MC
54	100	99	MC
55	100	100	MC
56	100	100	MC
57	100	91	MC
58	100	95	MC
59	100	0	MC
60	100	0	MC
61	100	95	MC
62	100	100	MC
63	100	100	MC
64	100	90	MC
65	100	100	MC
66	100	97	MC
67	100	74	MC

QC Check: JMG 3/12/2016Final Review: lll 6/2/16

SPAWAR Systems Center Pacific Bioassay Lab, 53475 Strothe Rd, Bldg 111 Rm 116, San Diego, CA 92152

96-Hour Development

Project: NBSD Storm H₂O - pulsed Test Species: S. purpuratus
Sample ID: 1hr Exposure - Brined Samples Start Date: 3/8/2016 1000
Test No.: ✓ End Date: 3/12/2016 1030

[illegible]

Final Review: lll 6/2/16

C-15

96-Hour Development

Test Species: *S. purpuratus*

Start Date: 3/8/2016 1000

End Date: 3/12/2016 1020

Final Review: all 6/2/16

C-16

96-Hour Development

Project: NBSD StormH₂O - Pulsed Test Species: S. purpuratus
Sample ID: 96hr/Static Exposure - Brined Samples Start Date: 3/8/2016 1000
Test No.: _____ End Date: 3/12/2016 1030

[illegible]

Final Review: 11/6/2/14

C-17

SPAWAR Pulsed Exposure Definitive Study
Echinoderm Development Tests
Test Initiation Date: 3/8/2016
3-hour exposure

Copper Concentration (µg/L)	Rand#
Lab Control	49
	62
	55
	37
Brine Control	45
	47
	46
	56
Storm water sample #1	44
	48
	52
	41
Storm water sample #2	53
	51
	63
	59
Storm water sample #3	42
	43
	40
	36
Storm water sample #4	66
	61
	65
	60
Storm water sample #5	67
	39
	58
	57
Storm water sample #6	64
	38
	50
	54

QC Check: lll

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**SPAWAR Pulsed Exposure Definitive Study
Echinoderm Development Tests
Test Initiation Date: 3/8/2016
6-hour exposure**

Copper Concentration (µg/L)	Rand#
Storm water sample #1	69
	82
	77
	70
Storm water sample #2	90
	76
	81
	68
Storm water sample #3	72
	71
	86
	88
Storm water sample #4	73
	91
	85
	87
Storm water sample #5	78
	80
	89
	83
Storm water sample #6	74
	75
	84
	79

QC Check: lll

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SPAWAR Pulsed Exposure Definitive Study
Echinoderm Development Tests
Test Initiation Date: 3/8/2016
12-hour exposure

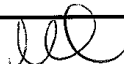
Copper Concentration (µg/L)	Rand#
Storm water sample #1	93
	106
	95
	103
Storm water sample #2	100
	92
	111
	110
Storm water sample #3	98
	96
	113
	99
Storm water sample #4	97
	109
	105
	94
Storm water sample #5	104
	108
	107
	112
Storm water sample #6	101
	115
	114
	102

QC Check: lll

SPAWAR Systems Center Pacific Bioassay Lab, 53475 Strothe Rd, Bldg 111 Rm 116, San Diego, CA 92152

SPAWAR Pulsed Exposure Definitive Study
Echinoderm Development Tests
Test Initiation Date: 3/8/2016
Static

Copper Concentration (µg/L)	Rand#
Storm water sample #1	124
	129
	118
	132
Storm water sample #2	120
	139
	116
	126
Storm water sample #3	125
	137
	127
	138
Storm water sample #4	122
	135
	134
	131
Storm water sample #5	133
	123
	117
Storm water sample #6	121
	136
	128
	119
	130

QC Check: 

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Marine Chronic Bioassay

Water Quality Measurements

Project: NBSID Storm H₂O - Pulsed
 Sample ID: Drilled Samples
 Test No.: _____

Test Species: S. purpuratus
 Start Date/Time: 3/8/2016 1000
 End Date/Time: 3/17/2016 1030

Concentration %	Salinity (ppt)					Temperature (°C)					Dissolved Oxygen (mg/L)					pH (pH units)				
	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96
Lab Control	33.2					15.1					8.9					7.97				
Blue Control	33.7					15.2					8.8					8.13				
1 - OF73	34.2					14.3					9.0					8.15				
2 - Pier 10 Eff	34.3					14.1					8.8					8.17				
3 - Pier 10 In	34.4					14.2					8.5					8.16				
4 - Pier 13 Base	34.7					14.2					8.7					8.20				
5 - Pier 13 Mid	34.7					14.8					8.4					8.13				
6 - Pier 13 End	34.8					14.9					8.8					8.08				

Technician Initials: 0 24 48 72 96
 WQ Readings: ML
 Dilutions made by: ML

Animal Source/Date Received: Field collected 1/28/16

Comments: Not enough volume for water quality readings

QC Check: IMD 6/17/16 Final Review: ML 6/21/16

Embryo-Larval Development Test – SPAWNING CHECKLIST & CALCULATIONS

Batch ID: 012816 SD Spawn/Test Date: 3/8/16 Test Species S. purpuratus
Analyst: JMD

Task	Time
Spawning Inducement Initiated	0600
Spawning Begins	0605
Females/Males Isolated in Incubator	4/2
Fertilization Initiated	0620
Fertilization Terminated/eggs rinsed	0645
Embryo Counts	0715
Embryo addition to vials	1000

Embryo Counts:

Embryo Stock #1: 42, 41, 40 Mean = 41 / 20 uL * 1000 uL/mL = 2050 cells/mL
Embryo Stock #2: 29, 36, 32 Mean = 32 / 20 uL * 1000 uL/mL = 1616 cells/mL
Embryo Stock #3: 23, 24, 20 Mean = 22 / 20 uL * 1000 uL/mL = 1100 cells/mL

Adjust selected embryo stock to 2000 embryos/ml. Confirm density:

Selected Stock : 42, 41, 40 Mean = 41 / 20 uL * 1000 uL/mL = 2050 cells/mL

Add 100 µl of 2000 embryo/ml stock to obtain 20 embryos/ml in test vials.

Notes:

Embryo Stock #1 790% fertilization
Embryo Stock #2 90% fertilization
Embryo Stock #3 < 90% fertilization

Stock #2 selected. 200 µl added - 1000
@ 2 cell stage @ initiation

C.2. COPPER EXPOSURES – MYSID SHRIMP:

TST Summary Sheet

Lab Name	SSC - Pacific	Client Name	SSC - Pacific
Test ID	SSC-2016-Outfall 73_3hr	Test Species	<i>A. bahia (mysid shrimp)</i>
Test Date	3/25/2016	Test Type	Acute
Test Duration	4 day	Endpoint	Survival
Critical Conc.	100		

Statistic	Control	Critical Concentration
Percent Mean of Raw Data	0.95	0.95
Mean used in Calculation (transformed)	1.29	1.29
Variance used in Calculation (transformed)	0.014	0.014
Standard Deviation of Transformed Data	0.119	0.119
CV of Transformed Data	0.093	0.093
n	4	4

Mean % Effect at Critical Conc.

0.00

Calculated t-value	Degrees of Freedom	Table t-value	Percent Difference
3.3729	5	1.4759	

Results

Pass Sample is Non-toxic

Raw Data

Control Data		Critical Concentration Data	
No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)	No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)
5	5	5	5
5	4	5	4
5	5	5	5
5	5	5	5

TST Summary Sheet

Lab Name	SSC - Pacific	Client Name	SSC - Pacific
Test ID	SSC-2016-Outfall 73_6hr	Test Species	<i>A. bahia (mysid shrimp)</i>
Test Date	3/25/2016	Test Type	Acute
Test Duration	4 day	Endpoint	Survival
Critical Conc.	100		

Statistic	Control	Critical Concentration
Percent Mean of Raw Data	0.95	0.95
Mean used in Calculation (transformed)	1.29	1.29
Variance used in Calculation (transformed)	0.014	0.014
Standard Deviation of Transformed Data	0.119	0.119
CV of Transformed Data	0.093	0.093
n	4	4

Mean % Effect at Critical Conc.

0.00

Calculated t-value	Degrees of Freedom	Table t-value	Percent Difference
3.3729	5	1.4759	

Results

Pass Sample is Non-toxic

Raw Data

Control Data		Critical Concentration Data	
No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)	No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)
5	5	5	5
5	4	5	5
5	5	5	4
5	5	5	5

TST Summary Sheet

Lab Name	SSC - Pacific	Client Name	SSC - Pacific
Test ID	SSC-2016-Outfall 73_12hr	Test Species	<i>A. bahia (mysid shrimp)</i>
Test Date	3/25/2016	Test Type	Acute
Test Duration	4 day	Endpoint	Survival
Critical Conc.	100		

Statistic	Control	Critical Concentration
Percent Mean of Raw Data	0.95	1.00
Mean used in Calculation (transformed)	1.29	1.35
Variance used in Calculation (transformed)	0.014	0.000
Standard Deviation of Transformed Data	0.119	0.000
CV of Transformed Data	0.093	0.000
n	4	4

Mean % Effect at Critical Conc.

-5.26

Calculated t-value	Degrees of Freedom	Table t-value	Percent Difference
6.6493	3	1.6377	

Results

Pass Sample is Non-toxic

Raw Data

Control Data		Critical Concentration Data	
No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)	No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)
5	5	5	5
5	4	5	5
5	5	5	5
5	5	5	5

TST Summary Sheet

Lab Name	SSC - Pacific	Client Name	SSC - Pacific
Test ID	SSC-2016-Outfall 73_96hr	Test Species	<i>A. bahia (mysid shrimp)</i>
Test Date	3/25/2016	Test Type	Acute
Test Duration	4 day	Endpoint	Survival
Critical Conc.	100		

Statistic	Control	Critical Concentration
Percent Mean of Raw Data	0.95	0.90
Mean used in Calculation (transformed)	1.29	1.23
Variance used in Calculation (transformed)	0.014	0.019
Standard Deviation of Transformed Data	0.119	0.137
CV of Transformed Data	0.093	0.112
n	4	4

Mean % Effect at Critical Conc.

5.26

Calculated t-value	Degrees of Freedom	Table t-value	Percent Difference
2.3630	5	1.4759	

Results

Pass Sample is Non-toxic

Raw Data

Control Data		Critical Concentration Data	
No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)	No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)
5	5	5	4
5	4	5	5
5	5	5	4
5	5	5	5

TST Summary Sheet

Lab Name	SSC - Pacific	Client Name	SSC - Pacific
Test ID	SSC-2016-Pier 10 Influent_3hr	Test Species	<i>A. bahia (mysid shrimp)</i>
Test Date	3/25/2016	Test Type	Acute
Test Duration	4 day	Endpoint	Survival
Critical Conc.	100		

Statistic	Control	Critical Concentration
Percent Mean of Raw Data	0.95	0.90
Mean used in Calculation (transformed)	1.29	1.23
Variance used in Calculation (transformed)	0.014	0.019
Standard Deviation of Transformed Data	0.119	0.137
CV of Transformed Data	0.093	0.112
n	4	4

Mean % Effect at Critical Conc.

5.26

Calculated t-value	Degrees of Freedom	Table t-value	Percent Difference
2.3630	5	1.4759	

Results

Pass Sample is Non-toxic

Raw Data

Control Data		Critical Concentration Data	
No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)	No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)
5	5	5	5
5	4	5	4
5	5	5	5
5	5	5	4

TST Summary Sheet

Lab Name	SSC - Pacific	Client Name	SSC - Pacific
Test ID	SSC-2016-Pier 10 Influent_6hr	Test Species	<i>A. bahia (mysid shrimp)</i>
Test Date	3/25/2016	Test Type	Acute
Test Duration	4 day	Endpoint	Survival
Critical Conc.	100		

Statistic	Control	Critical Concentration
Percent Mean of Raw Data	0.95	1.00
Mean used in Calculation (transformed)	1.29	1.35
Variance used in Calculation (transformed)	0.014	0.000
Standard Deviation of Transformed Data	0.119	0.000
CV of Transformed Data	0.093	0.000
n	4	4

Mean % Effect at Critical Conc.

-5.26

Calculated t-value	Degrees of Freedom	Table t-value	Percent Difference
6.6493	3	1.6377	

Results

Pass Sample is Non-toxic

Raw Data

Control Data		Critical Concentration Data	
No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)	No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)
5	5	5	5
5	4	5	5
5	5	5	5
5	5	5	5

TST Summary Sheet

Lab Name	SSC - Pacific	Client Name	SSC - Pacific
Test ID	SSC-2016-Pier 10 Influent_12hr	Test Species	<i>A. bahia (mysid shrimp)</i>
Test Date	3/25/2016	Test Type	Acute
Test Duration	4 day	Endpoint	Survival
Critical Conc.	100		

Statistic	Control	Critical Concentration
Percent Mean of Raw Data	0.95	0.90
Mean used in Calculation (transformed)	1.29	1.23
Variance used in Calculation (transformed)	0.014	0.019
Standard Deviation of Transformed Data	0.119	0.137
CV of Transformed Data	0.093	0.112
n	4	4

Mean % Effect at Critical Conc.

5.26

Calculated t-value	Degrees of Freedom	Table t-value	Percent Difference
2.3630	5	1.4759	

Results

Pass Sample is Non-toxic

Raw Data

Control Data		Critical Concentration Data	
No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)	No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)
5	5	5	5
5	4	5	4
5	5	5	5
5	5	5	4

TST Summary Sheet

Lab Name	SSC - Pacific	Client Name	SSC - Pacific
Test ID	SSC-2016-Pier 10 Influent_96hr	Test Species	<i>A. bahia (mysid shrimp)</i>
Test Date	3/25/2016	Test Type	Acute
Test Duration	4 day	Endpoint	Survival
Critical Conc.	100		

Statistic	Control	Critical Concentration
Percent Mean of Raw Data	0.95	0.90
Mean used in Calculation (transformed)	1.29	1.23
Variance used in Calculation (transformed)	0.014	0.019
Standard Deviation of Transformed Data	0.119	0.137
CV of Transformed Data	0.093	0.112
n	4	4

Mean % Effect at Critical Conc.

5.26

Calculated t-value	Degrees of Freedom	Table t-value	Percent Difference
2.3630	5	1.4759	

Results

Pass Sample is Non-toxic

Raw Data

Control Data		Critical Concentration Data	
No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)	No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)
5	5	5	5
5	4	5	4
5	5	5	4
5	5	5	5

TST Summary Sheet

Lab Name	SSC - Pacific	Client Name	SSC - Pacific
Test ID	SSC-2016-Pier 10 Effluent_3hr	Test Species	<i>A. bahia (mysid shrimp)</i>
Test Date	3/25/2016	Test Type	Acute
Test Duration	4 day	Endpoint	Survival
Critical Conc.	100		

Statistic	Control	Critical Concentration
Percent Mean of Raw Data	0.95	1.00
Mean used in Calculation (transformed)	1.29	1.35
Variance used in Calculation (transformed)	0.014	0.000
Standard Deviation of Transformed Data	0.119	0.000
CV of Transformed Data	0.093	0.000
n	4	4

Mean % Effect at Critical Conc.

-5.26

Calculated t-value	Degrees of Freedom	Table t-value	Percent Difference
6.6493	3	1.6377	

Results

Pass Sample is Non-toxic

Raw Data

Control Data		Critical Concentration Data	
No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)	No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)
5	5	5	5
5	4	5	5
5	5	5	5
5	5	5	5

TST Summary Sheet

Lab Name	SSC - Pacific	Client Name	SSC - Pacific
Test ID	SSC-2016-Pier 10 Effluent_6hr	Test Species	<i>A. bahia (mysid shrimp)</i>
Test Date	3/25/2016	Test Type	Acute
Test Duration	4 day	Endpoint	Survival
Critical Conc.	100		

Statistic	Control	Critical Concentration
Percent Mean of Raw Data	0.95	0.95
Mean used in Calculation (transformed)	1.29	1.29
Variance used in Calculation (transformed)	0.014	0.014
Standard Deviation of Transformed Data	0.119	0.119
CV of Transformed Data	0.093	0.093
n	4	4

Mean % Effect at Critical Conc.

0.00

Calculated t-value	Degrees of Freedom	Table t-value	Percent Difference
3.3729	5	1.4759	

Results

Pass Sample is Non-toxic

Raw Data

Control Data		Critical Concentration Data	
No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)	No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)
5	5	5	5
5	4	5	4
5	5	5	5
5	5	5	5

TST Summary Sheet

Lab Name	SSC - Pacific	Client Name	SSC - Pacific
Test ID	SSC-2016-Pier 10 Effluent_12hr	Test Species	<i>A. bahia (mysid shrimp)</i>
Test Date	3/25/2016	Test Type	Acute
Test Duration	4 day	Endpoint	Survival
Critical Conc.	100		

Statistic	Control	Critical Concentration
Percent Mean of Raw Data	0.95	0.90
Mean used in Calculation (transformed)	1.29	1.23
Variance used in Calculation (transformed)	0.014	0.019
Standard Deviation of Transformed Data	0.119	0.137
CV of Transformed Data	0.093	0.112
n	4	4

Mean % Effect at Critical Conc.

5.26

Calculated t-value	Degrees of Freedom	Table t-value	Percent Difference
2.3630	5	1.4759	

Results

Pass Sample is Non-toxic

Raw Data

Control Data		Critical Concentration Data	
No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)	No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)
5	5	5	4
5	4	5	5
5	5	5	4
5	5	5	5

TST Summary Sheet

Lab Name	SSC - Pacific	Client Name	SSC - Pacific
Test ID	SSC-2016-Pier 10 Effluent_96hr	Test Species	<i>A. bahia (mysid shrimp)</i>
Test Date	3/25/2016	Test Type	Acute
Test Duration	4 day	Endpoint	Survival
Critical Conc.	100		

Statistic	Control	Critical Concentration
Percent Mean of Raw Data	0.95	0.95
Mean used in Calculation (transformed)	1.29	1.29
Variance used in Calculation (transformed)	0.014	0.014
Standard Deviation of Transformed Data	0.119	0.119
CV of Transformed Data	0.093	0.093
n	4	4

Mean % Effect at Critical Conc.

0.00

Calculated t-value	Degrees of Freedom	Table t-value	Percent Difference
3.3729	5	1.4759	

Results

Pass Sample is Non-toxic

Raw Data

Control Data		Critical Concentration Data	
No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)	No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)
5	5	5	4
5	4	5	5
5	5	5	5
5	5	5	5

TST Summary Sheet

Lab Name	SSC - Pacific	Client Name	SSC - Pacific
Test ID	SSC-2016-Pier 13 Base_3hr	Test Species	<i>A. bahia (mysid shrimp)</i>
Test Date	3/25/2016	Test Type	Acute
Test Duration	4 day	Endpoint	Survival
Critical Conc.	100		

Statistic	Control	Critical Concentration
Percent Mean of Raw Data	0.95	0.95
Mean used in Calculation (transformed)	1.29	1.29
Variance used in Calculation (transformed)	0.014	0.014
Standard Deviation of Transformed Data	0.119	0.119
CV of Transformed Data	0.093	0.093
n	4	4

Mean % Effect at Critical Conc.

0.00

Calculated t-value	Degrees of Freedom	Table t-value	Percent Difference
3.3729	5	1.4759	

Results

Pass Sample is Non-toxic

Raw Data

Control Data		Critical Concentration Data	
No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)	No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)
5	5	5	5
5	4	5	4
5	5	5	5
5	5	5	5

TST Summary Sheet

Lab Name	SSC - Pacific	Client Name	SSC - Pacific
Test ID	SSC-2016-Pier 13 Base_6hr	Test Species	<i>A. bahia (mysid shrimp)</i>
Test Date	3/25/2016	Test Type	Acute
Test Duration	4 day	Endpoint	Survival
Critical Conc.	100		

Statistic	Control	Critical Concentration
Percent Mean of Raw Data	0.95	1.00
Mean used in Calculation (transformed)	1.29	1.35
Variance used in Calculation (transformed)	0.014	0.000
Standard Deviation of Transformed Data	0.119	0.000
CV of Transformed Data	0.093	0.000
n	4	4

Mean % Effect at Critical Conc.

-5.26

Calculated t-value	Degrees of Freedom	Table t-value	Percent Difference
6.6493	3	1.6377	

Results

Pass Sample is Non-toxic

Raw Data

Control Data		Critical Concentration Data	
No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)	No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)
5	5	5	5
5	4	5	5
5	5	5	5
5	5	5	5

TST Summary Sheet

Lab Name	SSC - Pacific	Client Name	SSC - Pacific
Test ID	SSC-2016-Pier 13 Base_12hr	Test Species	<i>A. bahia (mysid shrimp)</i>
Test Date	3/25/2016	Test Type	Acute
Test Duration	4 day	Endpoint	Survival
Critical Conc.	100		

Statistic	Control	Critical Concentration
Percent Mean of Raw Data	0.95	1.00
Mean used in Calculation (transformed)	1.29	1.35
Variance used in Calculation (transformed)	0.014	0.000
Standard Deviation of Transformed Data	0.119	0.000
CV of Transformed Data	0.093	0.000
n	4	4

Mean % Effect at Critical Conc.

-5.26

Calculated t-value	Degrees of Freedom	Table t-value	Percent Difference
6.6493	3	1.6377	

Results

Pass Sample is Non-toxic

Raw Data

Control Data		Critical Concentration Data	
No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)	No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)
5	5	5	5
5	4	5	5
5	5	5	5
5	5	5	5

TST Summary Sheet

Lab Name	SSC - Pacific	Client Name	SSC - Pacific
Test ID	SSC-2016-Pier 13 Base_96hr	Test Species	<i>A. bahia (mysid shrimp)</i>
Test Date	3/25/2016	Test Type	Acute
Test Duration	4 day	Endpoint	Survival
Critical Conc.	100		

Statistic	Control	Critical Concentration
Percent Mean of Raw Data	0.95	1.00
Mean used in Calculation (transformed)	1.29	1.35
Variance used in Calculation (transformed)	0.014	0.000
Standard Deviation of Transformed Data	0.119	0.000
CV of Transformed Data	0.093	0.000
n	4	4

Mean % Effect at Critical Conc.

-5.26

Calculated t-value	Degrees of Freedom	Table t-value	Percent Difference
6.6493	3	1.6377	

Results

Pass Sample is Non-toxic

Raw Data

Control Data		Critical Concentration Data	
No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)	No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)
5	5	5	5
5	4	5	5
5	5	5	5
5	5	5	5

TST Summary Sheet

Lab Name	SSC - Pacific	Client Name	SSC - Pacific
Test ID	SSC-2016-Pier 13 Mid_3hr	Test Species	<i>A. bahia (mysid shrimp)</i>
Test Date	3/25/2016	Test Type	Acute
Test Duration	4 day	Endpoint	Survival
Critical Conc.	100		

Statistic	Control	Critical Concentration
Percent Mean of Raw Data	0.95	0.95
Mean used in Calculation (transformed)	1.29	1.29
Variance used in Calculation (transformed)	0.014	0.014
Standard Deviation of Transformed Data	0.119	0.119
CV of Transformed Data	0.093	0.093
n	4	4

Mean % Effect at Critical Conc.

0.00

Calculated t-value	Degrees of Freedom	Table t-value	Percent Difference
3.3729	5	1.4759	

Results

Pass Sample is Non-toxic

Raw Data

Control Data		Critical Concentration Data	
No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)	No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)
5	5	5	4
5	4	5	5
5	5	5	5
5	5	5	5

TST Summary Sheet

Lab Name	SSC - Pacific	Client Name	SSC - Pacific
Test ID	SSC-2016-Pier 13 Mid_6hr	Test Species	<i>A. bahia (mysid shrimp)</i>
Test Date	3/25/2016	Test Type	Acute
Test Duration	4 day	Endpoint	Survival
Critical Conc.	100		

Statistic	Control	Critical Concentration
Percent Mean of Raw Data	0.95	0.90
Mean used in Calculation (transformed)	1.29	1.23
Variance used in Calculation (transformed)	0.014	0.019
Standard Deviation of Transformed Data	0.119	0.137
CV of Transformed Data	0.093	0.112
n	4	4

Mean % Effect at Critical Conc.

5.26

Calculated t-value	Degrees of Freedom	Table t-value	Percent Difference
2.3630	5	1.4759	

Results

Pass Sample is Non-toxic

Raw Data

Control Data		Critical Concentration Data	
No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)	No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)
5	5	5	5
5	4	5	4
5	5	5	5
5	5	5	4

TST Summary Sheet

Lab Name	SSC - Pacific	Client Name	SSC - Pacific
Test ID	SSC-2016-Pier 13 Mid_12hr	Test Species	<i>A. bahia (mysid shrimp)</i>
Test Date	3/25/2016	Test Type	Acute
Test Duration	4 day	Endpoint	Survival
Critical Conc.	100		

Statistic	Control	Critical Concentration
Percent Mean of Raw Data	0.95	0.75
Mean used in Calculation (transformed)	1.29	1.05
Variance used in Calculation (transformed)	0.014	0.012
Standard Deviation of Transformed Data	0.119	0.111
CV of Transformed Data	0.093	0.105
n	4	4

Mean % Effect at Critical Conc.

21.05

Calculated t-value	Degrees of Freedom	Table t-value	Percent Difference
0.3191	5	1.4759	

Results

Fail Sample is Toxic

Raw Data

Control Data		Critical Concentration Data	
No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)	No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)
5	5	5	4
5	4	5	4
5	5	5	4
5	5	5	3

TST Summary Sheet

Lab Name	SSC - Pacific	Client Name	SSC - Pacific
Test ID	SSC-2016-Pier 13 Mid_96hr	Test Species	<i>A. bahia (mysid shrimp)</i>
Test Date	3/25/2016	Test Type	Acute
Test Duration	4 day	Endpoint	Survival
Critical Conc.	100		

Statistic	Control	Critical Concentration
Percent Mean of Raw Data	0.95	0.75
Mean used in Calculation (transformed)	1.29	1.05
Variance used in Calculation (transformed)	0.014	0.012
Standard Deviation of Transformed Data	0.119	0.111
CV of Transformed Data	0.093	0.105
n	4	4

Mean % Effect at Critical Conc.

21.05

Calculated t-value	Degrees of Freedom	Table t-value	Percent Difference
0.3191	5	1.4759	

Results

Fail Sample is Toxic

Raw Data

Control Data		Critical Concentration Data	
No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)	No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)
5	5	5	4
5	4	5	4
5	5	5	3
5	5	5	4

TST Summary Sheet

Lab Name	SSC - Pacific	Client Name	SSC - Pacific
Test ID	SSC-2016-Pier 13 End_3hr	Test Species	<i>A. bahia (mysid shrimp)</i>
Test Date	3/25/2016	Test Type	Acute
Test Duration	4 day	Endpoint	Survival
Critical Conc.	100		

Statistic	Control	Critical Concentration
Percent Mean of Raw Data	0.95	0.90
Mean used in Calculation (transformed)	1.29	1.23
Variance used in Calculation (transformed)	0.014	0.019
Standard Deviation of Transformed Data	0.119	0.137
CV of Transformed Data	0.093	0.112
n	4	4

Mean % Effect at Critical Conc.

5.26

Calculated t-value	Degrees of Freedom	Table t-value	Percent Difference
2.3630	5	1.4759	

Results

Pass Sample is Non-toxic

Raw Data

Control Data		Critical Concentration Data	
No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)	No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)
5	5	5	4
5	4	5	5
5	5	5	5
5	5	5	4

TST Summary Sheet

Lab Name	SSC - Pacific	Client Name	SSC - Pacific
Test ID	SSC-2016-Pier 13 End_6hr	Test Species	<i>A. bahia (mysid shrimp)</i>
Test Date	3/25/2016	Test Type	Acute
Test Duration	4 day	Endpoint	Survival
Critical Conc.	100		

Statistic	Control	Critical Concentration
Percent Mean of Raw Data	0.95	0.65
Mean used in Calculation (transformed)	1.29	0.95
Variance used in Calculation (transformed)	0.014	0.041
Standard Deviation of Transformed Data	0.119	0.203
CV of Transformed Data	0.093	0.215
n	4	4

Mean % Effect at Critical Conc.

31.58

Calculated t-value	Degrees of Freedom	Table t-value	Percent Difference
-0.7339	4	1.5332	

Results

Fail Sample is Toxic

Raw Data

Control Data		Critical Concentration Data	
No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)	No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)
5	5	5	2
5	4	5	3
5	5	5	4
5	5	5	4

TST Summary Sheet

Lab Name	SSC - Pacific	Client Name	SSC - Pacific
Test ID	SSC-2016-Pier 13 End_12hr	Test Species	<i>A. bahia (mysid shrimp)</i>
Test Date	3/25/2016	Test Type	Acute
Test Duration	4 day	Endpoint	Survival
Critical Conc.	100		

Statistic	Control	Critical Concentration
Percent Mean of Raw Data	0.95	0.55
Mean used in Calculation (transformed)	1.29	0.84
Variance used in Calculation (transformed)	0.014	0.072
Standard Deviation of Transformed Data	0.119	0.269
CV of Transformed Data	0.093	0.322
n	4	4

Mean % Effect at Critical Conc.

42.11

Calculated t-value	Degrees of Freedom	Table t-value	Percent Difference
-1.3514	3	1.6377	

Results

Fail Sample is Toxic

Raw Data

Control Data		Critical Concentration Data	
No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)	No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)
5	5	5	3
5	4	5	1
5	5	5	4
5	5	5	3

TST Summary Sheet

Lab Name	SSC - Pacific	Client Name	SSC - Pacific
Test ID	SSC-2016-Pier 13 End_96hr	Test Species	<i>A. bahia (mysid shrimp)</i>
Test Date	3/25/2016	Test Type	Acute
Test Duration	4 day	Endpoint	Survival
Critical Conc.	100		

Statistic	Control	Critical Concentration
Percent Mean of Raw Data	0.95	0.25
Mean used in Calculation (transformed)	1.29	0.51
Variance used in Calculation (transformed)	0.014	0.076
Standard Deviation of Transformed Data	0.119	0.275
CV of Transformed Data	0.093	0.539
n	4	4

Mean % Effect at Critical Conc.

73.68

Calculated t-value	Degrees of Freedom	Table t-value	Percent Difference
-3.5673	3	1.6377	

Results

Fail Sample is Toxic

Raw Data

Control Data		Critical Concentration Data	
No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)	No. of Organisms Exposed or Counted	Response (Final Count, Weight, Length, etc.)
5	5	5	0
5	4	5	1
5	5	5	3
5	5	5	1

Marine Acute Bioassay
Static-Renewal Conditions

Water Quality Measurements
& Test Organism Survival

Project: MBSD Stormwater Pulsed
Sample ID: 3 hr Exposure
Test No.: _____

Test Species: A. balearica
Start Date/Time: 3/8/2016 1030
End Date/Time: 3/12/2016 1000

Tech Initials					
0	24	48	72	96	
Counts: <u>NH</u>	<u>NH</u>	<u>NH</u>	<u>MC</u>	<u>MC</u>	
Readings: <u>MC</u>	<u>NH</u>	<u>NH</u>	<u>MC</u>	<u>MC</u>	
Dilutions made by: <u>MS</u>	<u>MS</u>				

Sample ID	Rep	Number of Live Organisms					Salinity (ppt)					Temperature (°C)					Dissolved Oxygen (mg/L)					pH (units)				
		0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96
Lab Control	A	5	5	5	5	5	33.2	34.3	34.6	34.2	34.2	20.1	20.1	20.5	19.9	20.3	8.7	7.9	7.6	7.4	7.3	7.77	7.65	7.73	7.87	7.89
34ppt	B	5	5	5	5	5																				
	C	5	5	5	5	5																				
	D	5	5	5	5	5																				
Salt Control	A	5	5	5	5	5	33.7	34.3	34.5	34.2	34.2	20.1	20.2	19.9	20.6	20.4	8.0	6.7	7.3	7.0	6.8	7.70	7.58	7.81	7.90	
34ppt	B	5	5	5	5	4																				
	C	5	5	5	5	5																				
	D	5	5	5	5	5																				
Sample #1	A	5	5	5	5	5	33.8	34.1	34.1	34.3	34.3	20.2	20.5	20.6	20.1	20.1	8.11	7.5	7.0	7.3	7.0	8.73	7.96	7.97	7.91	7.91
	B	5	5	5	5	5																				
100%	C	5	5	5	5	4																				
	D	5	5	5	5	5																				
Sample #2	A	5	5	5	5	5	33.2	33.4	33.2	33.4	33.6	20.1	20.2	20.7	19.8	20.2	8.5	7.5	7.2	7.3	6.9	8.56	7.75	7.69	7.74	7.79
	B	5	5	5	5	5																				
100%	C	5	5	5	5	5																				
	D	5	5	5	5	5																				
Sample #3	A	5	5	5	5	5	33.9	34.7	34.9	34.7	34.2	20.1	20.2	21.0	19.9	20.3	8.6	7.6	7.3	7.4	6.9	8.72	7.95	7.70	7.72	7.76
	B	5	4	4	4	4																				
100%	C	5	5	5	5	5																				
	D	5	4	4	4	4																				
Sample #4	A	5	5	5	5	5	34.3	35.5	35.6	35.6	35.4	20.1	20.2	21.0	19.8	20.4	8.5	8.0	7.4	7.4	6.7	8.91	7.72	7.75	7.81	7.76
	B	5	5	4	4	4																				
	C	5	5	5	5	5																				
100%	D	5	5	5	5	5																				
Sample #5	A	5	5	5	5	4	33.6	34.8	34.8	34.6	34.0	20.1	20.6	20.9	19.8	20.3	8.4	8.3	6.8	7.0	6.8	8.83	7.92	7.67	7.74	7.70
	B	5	5	5	5	5																				
100%	C	5	5	5	5	5																				
	D	5	5	5	5	5																				
Sample #6	A	5	5	5	5	4	34.7	35.0	35.6	35.1	34.8	20.1	20.6	20.8	19.8	20.4	8.5	7.1	7.1	6.8	7.1	8.84	7.82	7.62	7.55	7.71
	B	5	5	5	5	5																				
100%	C	5	5	5	5	5																				
	D	5	5	5	4	4																				

Initial Counts
QC'd by: NH/JM

Animal Source/Date Received: ARO 3/5/2016 Age at Initiation: 6 days

Comments: i = initial reading in fresh test solution, f = final reading in test chamber prior to renewal
Organisms fed prior to initiation, circle one (y/n)
Tests aerated? Circle one (y/n) (if yes, sample ID(s): _____ Duration: _____
Aeration source: _____

QC Check: JMD 6/1/2016
SPAWAR Systems Center Pacific Bioassay Lab, 53475 Stroh Rd, Bldg 111 Rm 116, San Diego, CA 92152

Feeding Times					
0	24	48	72	96	
AM: <u>0730</u>	<u>1000</u>	<u>1030</u>	<u>1200</u>	<u>1800</u>	
PM: <u>1500</u>	<u>1500</u>	<u>1530</u>	<u>1500</u>		

Final Review: lll 6/2/16

Marine Acute Bioassay
Static-Renewal Conditions

Water Quality Measurements
& Test Organism Survival

Project: NBSD Storm water Pulsed Exposure Test Species: A. bahia
Sample ID: 6hr Start Date/Time: 3/8/2016 1030
Test No.: 1000 End Date/Time: 3/12/2016 1000

Tech Initials					
0	24	48	72	96	
Counts: <u>AM</u>	<u>NH</u>	<u>NH</u>	<u>MC</u>	<u>MC</u>	
Readings: <u>MC</u>	<u>NH</u>	<u>NH</u>	<u>MC</u>	<u>MC</u>	
Dilutions made by: <u>AM</u>	<u>NH</u>	<u>NH</u>	<u>MC</u>	<u>MC</u>	

Concentration %	Rep	Number of Live Organisms					Salinity (ppt)					Temperature (°C)					Dissolved Oxygen (mg/L)					pH (units)				
		0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96
Lab Control	A	5	5	5	5	5	33.2	34.3	34.6	34.2	34.2	20.1	20.1	20.5	19.9	20.3	8.7	7.9	7.6	7.3	7.3	7.7	7.65	7.73	7.81	7.85
30ppt	B	5	5	5	5	5																				
(Shared w/ Static)	C	5	5	5	5	5																				
	D	5	5	5	5	5																				
Salt Control	A	5	5	5	5	5	33.7	34.3	34.5	34.2	34.2	20.1	20.7	20.6	19.8	20.4	7.0	6.7	7.3	7.0	6.8	7.10	7.58	7.81	7.81	7.10
30ppt	B	5	5	5	5	4																				
(Shared w/ Static)	C	5	5	5	5	5																				
	D	5	5	5	5	5																				
Sample #1	A	5	5	5	5	5	33.8	34.7	34.9	34.8	34.8	20.2	20.0	20.4	19.9	19.8	8.4	7.2	7.5	7.2	7.0	8.78	7.58	7.65	7.71	7.92
100%	B	5	5	5	5	5																				
Salted	C	5	5	4	4	4																				
	D	5	5	5	5	5																				
Sample #2	A	5	5	5	5	5	33.2	34.1	33.2	33.9	33.6	20.1	20.2	19.9	20.7	20.2	8.5	7.5	7.2	7.3	6.9	8.56	7.75	7.69	7.74	7.79
100%	B	5	4	4	4	4																				
Salted	C	5	5	5	5	5																				
	D	5	5	5	5	5																				
Sample #3	A	5	5	5	5	5	33.8	34.7	34.9	34.8	34.8	20.2	20.2	21.0	19.9	20.3	8.5	7.6	7.3	7.4	6.8	8.72	7.95	7.70	7.72	7.76
100%	B	5	5	5	5	5																				
Salted	C	5	5	5	5	5																				
	D	5	5	5	5	5																				
Sample #4	A	5	5	5	5	5	34.3	34.5	34.6	34.6	34.5	20.1	20.2	21.0	19.8	20.4	8.5	8.0	7.9	7.4	6.7	8.99	7.72	7.83	7.81	7.76
100%	B	5	5	5	5	5																				
Salted	C	5	5	5	5	5																				
	D	5	5	5	5	5																				
Sample #5	A	5	5	5	5	5	33.6	34.8	34.8	34.6	34.4	20.1	20.4	20.9	19.8	20.3	8.4	8.3	8.3	7.0	6.8	8.63	7.78	7.67	7.70	7.70
100%	B	5	4	4	4	4																				
Salted	C	5	5	5	5	5																				
	D	5	5	4	4	4																				
Sample #6	A	5	3	3	2	2	34.7	34.9	34.8	34.8	34.8	20.1	20.6	20.8	19.8	20.4	8.5	7.1	7.1	7.1	6.8	8.54	7.82	7.59	7.62	7.11
100%	B	5	4	3	3	3																				
Salted	C	5	4	4	4	4																				
	D	5	4	4	4	4																				

Initial Counts QC'd

by: JMD

Animal Source/Date Received: ARO 3/5/2016 Age at Initiation: 6 days

Comments: i = initial reading in fresh test solution, f = final reading in test chamber prior to renewal

Organisms fed prior to initiation, circle one (y / n)

Tests aerated? Circle one (y / n) if yes, sample ID(s):

Duration:

Feeding Times					
0	24	48	72	96	
AM: <u>0900</u>	<u>0900</u>	<u>1030</u>	<u>1000</u>	<u>1030</u>	
PM: <u>1500</u>	<u>1500</u>	<u>1530</u>	<u>1500</u>	<u>1500</u>	

QC Check: JMD 6/1/2016

Final Review: lll 6/2/16

Marine Acute Bioassay
Static-Renewal Conditions

Water Quality Measurements
& Test Organism Survival

Project: NBSD Storm water Pulsed Exposure
Sample ID: 12 hr
Test No.:
Test Species: *A. bahia*
Start Date/Time: 3/8/2016 1030
End Date/Time: 3/12/2016 1000

Tech Initials					
0	24	48	72	96	
MC	MC	MC	MC	MC	Counts:
MC	MC	MC	MC	MC	Readings:
MC	MC	MC	MC	MC	Dilutions made by:

Concentration %	Rep	Number of Live Organisms					Salinity (ppt)					Temperature (°C)					Dissolved Oxygen (mg/L)					pH (units)				
		0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96
Lab Control	A	5	5	5	5	5	33.2	34.3	34.5	34.2	34.2	20.1	20.1	20.5	19.9	20.3	8.9	7.9	7.6	7.4	7.3	7.17	7.65	7.73	7.89	7.83
30ppt	B	5	5	5	5	5																				
(shaded w/ static)	C	5	5	5	5	5																				
	D	5	5	5	5	5																				
Salt Control	A	5	5	5	5	5	33.7	34.3	34.5	34.2	34.2	20.1	20.2	20.6	19.9	20.4	7.0	6.7	7.3	7.0	6.8	7.90	7.58	7.67	7.81	7.90
30ppt	B	5	5	5	5	4																				
(shaded w/ static)	C	5	5	5	5	5																				
	D	5	5	5	5	5																				
Sample #1	A	5	5	5	5	5	33.8	34.7	34.9	34.8	34.8	20.2	20.0	20.4	19.9	19.8	8.4	7.2	7.5	7.2	7.0	8.78	7.58	7.62	7.71	7.82
100%	B	5	5	5	5	5																				
Salted	C	5	5	5	5	5																				
	D	5	5	5	5	5																				
Sample #2	A	5	4	4	4	4	33.2	34.4	34.2	34.4	34.6	20.1	20.2	19.9	20.7	20.2	8.5	7.5	7.2	7.3	6.9	8.56	7.75	7.67	7.74	7.79
100%	B	5	5	5	5	5																				
Salted	C	5	4	4	4	4																				
	D	5	5	5	5	5																				
Sample #3	A	5	5	5	5	5	33.9	34.7	34.8	34.7	34.5	20.1	20.2	19.9	20.3	20.3	8.5	7.6	7.3	7.4	6.8	8.72	7.55	7.70	7.72	7.76
100%	B	5	4	4	4	4																				
Salted	C	5	5	5	5	5																				
	D	5	5	5	4	4																				
Sample #4	A	5	5	5	5	5	34.3	34.5	34.6	34.6	34.5	20.1	20.2	19.8	20.4	20.4	8.5	8.0	7.9	7.4	6.7	8.71	7.72	7.93	7.81	7.76
100%	B	5	5	5	5	5																				
Salted	C	5	5	5	5	5																				
	D	5	5	5	5	5																				
Sample #5	A	5	4	4	4	4	33.5	34.8	34.5	34.6	34.4	20.1	20.6	19.7	19.8	20.3	8.4	8.3	7.9	7.4	6.7	8.71	7.72	7.93	7.81	7.76
100%	B	5	5	4	4	4																				
Salted	C	5	5	4	4	4																				
	D	5	3	3	3	3																				
Sample #6	A	5	4	4	3	3	34.7	34.9	34.8	34.9	34.8	20.1	20.6	19.8	20.4	20.4	8.5	7.1	7.1	7.1	6.8	8.74	7.82	7.89	7.62	7.11
100%	B	5	3	2	1	1																				
Salted	C	5	4	4	4	4																				
	D	5	3	3	3	3																				

Initial Counts QC'd by: JMD

Animal Source/Date Received: ARO 3/5/2016 Age at Initiation: 6 days

Comments: i = initial reading in fresh test solution, f = final reading in test chamber prior to renewal
Organisms fed prior to initiation, circle one (i / n)
Tests aerated? Circle one (y / n) If yes, sample ID(s): Duration:

Feeding Times					
0	24	48	72	96	
AM	7:00	10:00	10:30	10:00	10:30
PM	1:00	5:00	5:30	5:00	5:30

QC Check: Awar Systems Center Pacific Bioassay Lab, 53476 Stroh Rd, Bldg 111 Rm 116, San Diego, CA 92152

Final Review: JMD 6/1/2016

QC Check JMD 6/1/2016

Marine Acute Bioassay
Static-Renewal Conditions

Water Quality Measurements
& Test Organism Survival

Project: NBSD Stormwater Pulsed Exposure
Sample ID: Static Exposure
Test No.:

Test Species: A. bahia
Start Date/Time: 3/8/2016 1030
End Date/Time: 3/12/2016 1000

Tech Initials					
0	24	48	72	96	
Counts: <u>NH</u>	<u>NH</u>	<u>NH</u>	<u>NC</u>	<u>NC</u>	
Readings: <u>NC</u>	<u>NH</u>	<u>NH</u>	<u>NC</u>	<u>NC</u>	
Dilutions made by: <u>NH</u>	<u>NC</u>	<u>NC</u>	<u>NC</u>	<u>NC</u>	

Concentration %	Rep	Number of Live Organisms					Salinity (ppt)					Temperature (°C)					Dissolved Oxygen (mg/L)					pH (units)				
		0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96
Lab Control	A	5	5	5	5	5	33.2	34.3	34.6	34.2	34.2	20.1	20.1	19.9	20.3	20.3	7.9	7.9	7.6	7.4	7.3	7.97	7.65	7.73	7.87	7.93
	B	5	5	5	5	5																				
	C	5	5	5	5	5																				
	D	5	5	5	5	5																				
Salt Control 34 ppt	A	5	5	5	5	5	33.7	34.3	34.5	34.2	34.2	20.1	20.1	19.9	20.4	20.4	7.0	6.7	6.3	7.0	6.8	7.90	7.98	7.87	7.81	7.80
	B	5	5	5	5	4																				
	C	5	5	5	5	5																				
	D	5	5	5	5	5																				
Sample # 1	A	5	5	5	5	4	33.8	34.9	34.9	34.9	34.9	20.2	20.2	20.4	19.9	19.9	8.4	7.2	7.5	7.2	7.0	8.78	7.58	7.65	7.71	7.82
	B	5	5	5	5	5																				
	C	5	5	5	5	4																				
	D	5	5	5	5	5																				
Sample # 2	A	5	5	5	5	4	33.2	34.4	34.2	34.4	34.6	20.1	20.2	19.9	20.7	20.2	8.5	7.5	7.2	7.3	6.9	8.86	7.75	7.69	7.74	7.79
	B	5	5	5	5	5																				
	C	5	5	5	5	5																				
	D	5	5	5	5	5																				
Sample # 3	A	5	5	5	5	5	33.9	34.7	34.9	34.7	34.5	20.1	20.2	21.0	19.9	20.3	8.5	7.6	7.3	7.4	6.8	8.72	7.95	7.70	7.72	7.76
	B	5	5	5	5	4																				
	C	5	5	5	5	5																				
	D	5	5	5	5	5																				
Sample # 4	A	5	5	5	5	5	34.3	34.5	34.6	34.6	34.5	20.1	20.2	21.0	19.8	20.4	8.5	8.0	7.9	7.4	6.7	8.71	7.72	7.53	7.81	7.74
	B	5	5	5	5	5																				
	C	5	5	5	5	5																				
	D	5	5	5	5	5																				
Sample # 5	A	5	5	5	5	4	33.6	34.8	34.8	34.6	34.6	20.1	20.6	20.9	19.8	20.3	8.4	8.3	6.8	7.0	6.8	8.93	7.92	7.67	7.74	7.76
	B	5	5	5	5	4																				
	C	5	5	5	5	3																				
	D	5	5	5	5	4																				
Sample # 6	A	5	5	5	5	0	34.7	34.9	34.9	34.9	34.8	20.1	20.6	20.9	19.8	20.4	8.5	7.1	7.1	7.1	6.8	8.34	7.82	7.57	7.62	7.11
	B	5	5	5	5	1																				
	C	5	5	5	5	3																				
	D	5	5	5	5	1																				

Initial Counts
QC'd by: JMD

Animal Source/Date Received: Aquatic Biosystems 3/5/2016 Age at Initiation: 6 days

Comments: I = initial reading in fresh test solution, f = final reading in test chamber prior to renewal

Organisms fed prior to initiation, circle one (y / n)

Tests aerated? Circle one (y / n) if yes, sample ID(s):

Duration:

QC Check: JMD 6/1/2016

Final Review: ML 6/2/16

Feeding Times					
0	24	48	72	96	
AM: <u>0700</u>	<u>1000</u>	<u>1030</u>	<u>1000</u>	<u>1030</u>	
PM: <u>1500</u>	<u>1500</u>	<u>1530</u>	<u>1500</u>	<u>1530</u>	

Marine Chronic Bioassay

Brine Dilution Worksheet

Project: NBSD Storm Water Pulsed Exposure

Analyst: MC

Sample ID: _____

Test Date: 3/8/2016

Date of Brine used: 3/5/2016

Test Type: Sp-dev

Salinity of Brine: 95

Target Salinity: 34

Test Dilution Volume: 160

Salinity Adjustment Factor:

$(TS - SE)/(SB - TS) =$

TS = target salinity

SB = salinity of brine

SE = salinity of effluent

Sample ID	Salinity of Sample	Salinity Adjustment Factor	Concentration %	Effluent Volume (ml)	Brine Volume (ml)	Dilute to: (ml)
Control			Control	NA	NA	200
#1 OF73	0.0	0.56	64.2	112.4	62.6	175
#2 Pier 10 Eff	0.1	0.56	64.3	112.5	62.5	175
#3 Pier 10 In	0.0	0.56	64.2	112.4	62.6	175
#4 Pier 13 Base	0.1	0.56	64.3	112.5	62.5	175
#5 Pier 13 Mid	0.1	0.56	64.3	112.5	62.5	175
#10 Pier 13 End	0.0	0.56	64.2	112.4	62.6	175

DI Volume

Brine Control #2	112.4	0.56	62.6	175
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Total Brine Volume Required (ml): 438.1

QC Check: MC

Final Review: lll

C.3. COPPER EXPOSURES – ANALYTICAL CHEMISTRY REPORTS:

13 April 2016

Metal concentrations in samples from Stormwater Runoff at Naval Base San Diego

Sample ID	Copper		Zinc		Lead	
	Average (µg/L)	Std Dev (µg/L)	Average (µg/L)	Std Dev (µg/L)	Average (µg/L)	Std Dev (µg/L)
Pier 13 0853 NBSD Filt	0.23		34		0.24	
Pier 13 MID 0902 NBSD Filt	51.4		600		1.48	
Pier 13 END 0916 NBSD Filt	55.9		2137		0.30	
Pier 10 IN 0935 NBSD Filt Duplicate	17.2	0.13	162	1.36	0.62	0.091
Pier 10 EFF 0943 NBSD Filt	15.0		145		0.48	
OF73 1045 NBSD Filt	48.9		343		0.39	
Pier 13 0853 NBSD Total	21.0		350		5.87	
Pier 13 MID 0902 NBSD Total	83.6		944		14.0	
Pier 13 END 0916 NBSD Total	75.4		2361		2.19	
Pier 10 IN 0935 NBSD Total	24.2		220		2.54	
Pier 10 EFF 0943 NBSD Total	25.1		230		2.80	
OF73 1045 NBSD Total	56.7		384		1.72	
Blanks						
Limit Of Detection (3*SD)	0.0069		0.23		0.0084	
Limit Of Reporting (10*SD)	0.023		0.77		0.028	
Recovery SRM 1643e (%)						
Average	118		116		109	
Standard deviation	12		6		6	
Number of SRMs	4		4		4	
Spike						
Recovery (%)	90		174		93	

C.4. COPPER EXPOSURES – REFERENCE TOXICANT TEST RESULTS:

CETIS Summary Report

Report Date: 02 Jun-16 11:36 (p 1 of 1)
Test Code: SSC-2016-003 | 15-8182-3876

Echinoid Embryo-Larval Development Test							SPAWAR Systems Center				
Batch ID:	20-3527-1111	Test Type:	Development-Survival				Analyst:	Marianne A Colvin			
Start Date:	08 Mar-16 10:00	Protocol:	EPA/600/R-95/136 (1995)				Diluent:	Laboratory Seawater			
Ending Date:	12 Mar-16 10:30	Species:	Strongylocentrotus purpuratus				Brine:	Not Applicable			
Duration:	4d 1h	Source:	Field Collected				Age:				
Sample ID:	01-5795-2142	Code:	96A288E				Client:	SPAWAR			
Sample Date:	08 Mar-16	Material:	Copper sulfate				Project:	Pulsed Exposure			
Receive Date:		Source:	Reference Toxicant								
Sample Age:	10h	Station:	Reference Toxicant								
Comparison Summary											
Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method				
01-0920-6898	Proportion Normal	8.4	12	10.04	3.27%		Dunnett Multiple Comparison Test				
Point Estimate Summary											
Analysis ID	Endpoint	Level	µg/L	95% LCL	95% UCL	TU	Method				
02-4063-3610	Proportion Normal	EC50	17.97	17.1	18.85		Linear Regression (MLE)				
Proportion Normal Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	% Effect
0	Lab Control	5	0.98	0.9438	1	0.93	1	0.01304	0.02915	2.98%	0.0%
5.8		5	0.992	0.9816	1	0.98	1	0.003742	0.008367	0.84%	-1.22%
8.4		5	0.99	0.9812	0.9988	0.98	1	0.003162	0.007071	0.71%	-1.02%
12		5	0.89	0.8366	0.9434	0.83	0.94	0.01924	0.04301	4.83%	9.18%
17.2		5	0.466	0.3356	0.5964	0.33	0.57	0.04697	0.105	22.54%	52.45%
24		5	0.27	0.1965	0.3435	0.18	0.34	0.02646	0.05916	21.91%	72.45%
35		5	0	0	0	0	0	0	0		100.0%
Proportion Normal Detail											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5					
0	Lab Control	0.93	0.99	0.98	1	1					
5.8		0.99	0.99	1	0.98	1					
8.4		0.99	0.99	0.98	1	0.99					
12		0.83	0.89	0.94	0.87	0.92					
17.2		0.33	0.56	0.48	0.39	0.57					
24		0.26	0.27	0.18	0.34	0.3					
35		0	0	0	0	0					
Proportion Normal Binomials											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5					
0	Lab Control	93/100	99/100	98/100	100/100	100/100					
5.8		99/100	99/100	100/100	98/100	100/100					
8.4		99/100	99/100	98/100	100/100	99/100					
12		83/100	89/100	94/100	87/100	92/100					
17.2		33/100	56/100	48/100	39/100	57/100					
24		26/100	27/100	18/100	34/100	30/100					
35		0/100	0/100	0/100	0/100	0/100					

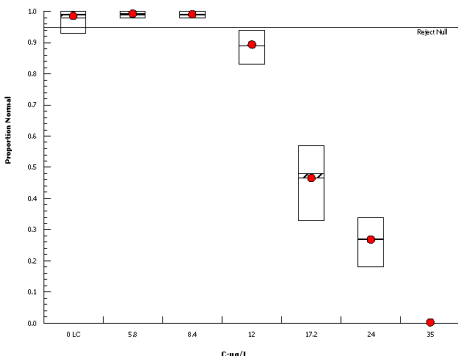
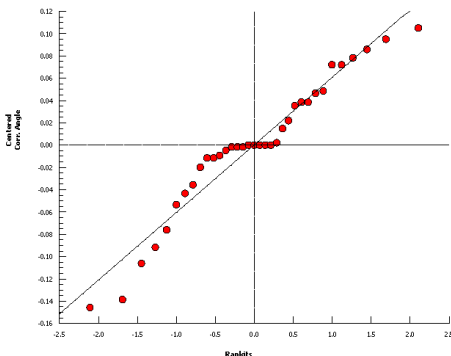
CETIS Analytical Report

Report Date: 02 Jun-16 11:36 (p 1 of 2)
Test Code: SSC-2016-003 | 15-8182-3876

Echinoid Embryo-Larval Development Test								SPAWAR Systems Center			
Analysis ID:	01-0920-6898		Endpoint:	Proportion Normal				CETIS Version:	CETISv1.8.7		
Analyzed:	06 May-16 10:30		Analysis:	Parametric-Control vs Treatments				Official Results:	Yes		
Batch ID:	20-3527-1111		Test Type:	Development-Survival				Analyst:	Marianne A Colvin		
Start Date:	08 Mar-16 10:00		Protocol:	EPA/600/R-95/136 (1995)				Diluent:	Laboratory Seawater		
Ending Date:	12 Mar-16 10:30		Species:	Strongylocentrotus purpuratus				Brine:	Not Applicable		
Duration:	4d 1h		Source:	Field Collected				Age:			
Sample ID:	01-5795-2142		Code:	96A288E				Client:	SPAWAR		
Sample Date:	08 Mar-16		Material:	Copper sulfate				Project:	Pulsed Exposure		
Receive Date:			Source:	Reference Toxicant							
Sample Age:	10h		Station:	Reference Toxicant							
Data Transform	Zeta	Alt Hyp	Trials	Seed			PMSD	NOEL	LOEL	TOEL	TU
Angular (Corrected)	NA	C > T	NA	NA			3.27%	8.4	12	10.04	
Dunnnett Multiple Comparison Test											
Control	vs	C-µg/L	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)		
Lab Control		5.8	-0.7313	2.362	0.108	8	0.9658	CDF	Non-Significant Effect		
		8.4	-0.5125	2.362	0.108	8	0.9418	CDF	Non-Significant Effect		
		12*	4.609	2.362	0.108	8	0.0003	CDF	Significant Effect		
		17.2*	15.23	2.362	0.108	8	<0.0001	CDF	Significant Effect		
		24*	19.73	2.362	0.108	8	<0.0001	CDF	Significant Effect		
ANOVA Table											
Source	Sum Squares		Mean Square		DF	F Stat	P-Value	Decision(α:5%)			
Between	4.187028		0.8374056		5	159.4	<0.0001	Significant Effect			
Error	0.1260463		0.005251929		24						
Total	4.313074				29						
Distributional Tests											
Attribute	Test			Test Stat	Critical	P-Value	Decision(α:1%)				
Variances	Bartlett Equality of Variance			6.703	15.09	0.2437	Equal Variances				
Distribution	Shapiro-Wilk W Normality			0.9586	0.9031	0.2847	Normal Distribution				
Proportion Normal Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Lab Control	5	0.98	0.9438	1	0.99	0.93	1	0.01304	2.98%	0.0%
5.8		5	0.992	0.9816	1	0.99	0.98	1	0.003742	0.84%	-1.22%
8.4		5	0.99	0.9812	0.9988	0.99	0.98	1	0.003163	0.71%	-1.02%
12		5	0.89	0.8366	0.9434	0.89	0.83	0.94	0.01924	4.83%	9.18%
17.2		5	0.466	0.3356	0.5964	0.48	0.33	0.57	0.04697	22.54%	52.45%
24		5	0.27	0.1965	0.3435	0.27	0.18	0.34	0.02646	21.91%	72.45%
35		5	0	0	0	0	0	0	0		100.0%
Angular (Corrected) Transformed Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Lab Control	5	1.449	1.337	1.561	1.471	1.303	1.521	0.0403	6.22%	0.0%
5.8		5	1.482	1.434	1.531	1.471	1.429	1.521	0.01744	2.63%	-2.31%
8.4		5	1.472	1.432	1.513	1.471	1.429	1.521	0.01456	2.21%	-1.62%
12		5	1.238	1.151	1.324	1.233	1.146	1.323	0.03101	5.6%	14.58%
17.2		5	0.7506	0.6185	0.8827	0.7654	0.6119	0.8556	0.04758	14.18%	48.19%
24		5	0.5444	0.4594	0.6293	0.5464	0.4381	0.6225	0.0306	12.57%	62.43%
35		5	0.05002	0.05001	0.05003	0.05002	0.05002	0.05002	0	0.0%	96.55%

CETIS Analytical Report

Report Date: 02 Jun-16 11:36 (p 2 of 2)
Test Code: SSC-2016-003 | 15-8182-3876

Echinoid Embryo-Larval Development Test				SPAWAR Systems Center		
Analysis ID: 01-0920-6898		Endpoint: Proportion Normal		CETIS Version: CETISv1.8.7		
Analyzed: 06 May-16 10:30		Analysis: Parametric-Control vs Treatments		Official Results: Yes		
Proportion Normal Detail						
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
0	Lab Control	0.93	0.99	0.98	1	1
5.8		0.99	0.99	1	0.98	1
8.4		0.99	0.99	0.98	1	0.99
12		0.83	0.89	0.94	0.87	0.92
17.2		0.33	0.56	0.48	0.39	0.57
24		0.26	0.27	0.18	0.34	0.3
35		0	0	0	0	0
Angular (Corrected) Transformed Detail						
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
0	Lab Control	1.303	1.471	1.429	1.521	1.521
5.8		1.471	1.471	1.521	1.429	1.521
8.4		1.471	1.471	1.429	1.521	1.471
12		1.146	1.233	1.323	1.202	1.284
17.2		0.6119	0.8455	0.7654	0.6745	0.8556
24		0.5351	0.5464	0.4381	0.6225	0.5796
35		0.05002	0.05002	0.05002	0.05002	0.05002
Proportion Normal Binomials						
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
0	Lab Control	93/100	99/100	98/100	100/100	100/100
5.8		99/100	99/100	100/100	98/100	100/100
8.4		99/100	99/100	98/100	100/100	99/100
12		83/100	89/100	94/100	87/100	92/100
17.2		33/100	56/100	48/100	39/100	57/100
24		26/100	27/100	18/100	34/100	30/100
35		0/100	0/100	0/100	0/100	0/100
Graphics						
 						

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CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Analytical Report

Report Date: 02 Jun-16 11:36 (p 1 of 2)
Test Code: SSC-2016-003 | 15-8182-3876

Echinoid Embryo-Larval Development Test							SPAWAR Systems Center				
Analysis ID:	02-4063-3610		Endpoint:	Proportion Normal			CETIS Version:		CETISv1.8.7		
Analyzed:	06 May-16 10:31		Analysis:	Linear Regression (MLE)			Official Results:		Yes		
Batch ID:	20-3527-1111		Test Type:	Development-Survival			Analyst:	Marianne A Colvin			
Start Date:	08 Mar-16 10:00		Protocol:	EPA/600/R-95/136 (1995)			Diluent:	Laboratory Seawater			
Ending Date:	12 Mar-16 10:30		Species:	Strongylocentrotus purpuratus			Brine:	Not Applicable			
Duration:	4d 1h		Source:	Field Collected			Age:				
Sample ID:	01-5795-2142		Code:	96A288E			Client:	SPAWAR			
Sample Date:	08 Mar-16		Material:	Copper sulfate			Project:	Pulsed Exposure			
Receive Date:			Source:	Reference Toxicant							
Sample Age:	10h		Station:	Reference Toxicant							
Linear Regression Options											
Model Function			Threshold Option		Threshold	Optimized	Pooled	Het Corr	Weighted		
Log-Normal [NED=A+B*log(X)]			Control Threshold		0.02	Yes	No	Yes	Yes		
Regression Summary											
Iters	LL	AICc	BIC	Mu	Sigma	Adj R2	F Stat	Critical	P-Value	Decision(α:5%)	
11	-941.9	1890	1894	1.254	0.1414	0.9417	8.6	2.714	0.0001	Significant Lack of Fit	
Point Estimates											
Level	μg/L	95% LCL		95% UCL							
EC50	17.97	17.1		18.85							
Regression Parameters											
Parameter	Estimate	Std Error	95% LCL	95% UCL	t Stat	P-Value	Decision(α:5%)				
Threshold	0.01118	0.006087	-0.00122	0.02358	1.836	0.0756	Non-Significant Parameter				
Slope	7.072	0.5186	6.016	8.129	13.64	<0.0001	Significant Parameter				
Intercept	-8.872	0.6593	-10.22	-7.529	-13.46	<0.0001	Significant Parameter				
ANOVA Table											
Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)					
Model	2120.601	2120.601	1	550.8	<0.0001	Significant					
Lack of Fit	67.92355	16.98089	4	8.6	0.0001	Significant					
Pure Error	55.28708	1.974538	28								
Residual	123.2106	3.850332	32								
Residual Analysis											
Attribute	Method	Test Stat	Critical	P-Value	Decision(α:5%)						
Goodness-of-Fit	Pearson Chi-Sq GOF	123.2	46.19	<0.0001	Significant Heterogeneity						
	Likelihood Ratio GOF	119.2	46.19	<0.0001	Significant Heterogeneity						
Variances	Mod Levene Equality of Variance	2.428	2.573	0.0610	Equal Variances						
	Shapiro-Wilk W Normality	0.948	0.9384	0.0984	Normal Distribution						
Distribution	Anderson-Darling A2 Normality	0.7267	2.492	0.0579	Normal Distribution						
Proportion Normal Summary											
			Calculated Variate(A/B)								
C-μg/L	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
0	Lab Control	5	0.98	0.93	1	0.01304	0.02915	2.98%	0.0%	490	500
5.8		5	0.992	0.98	1	0.003742	0.008367	0.84%	-1.22%	496	500
8.4		5	0.99	0.98	1	0.003163	0.007072	0.71%	-1.02%	495	500
12		5	0.89	0.83	0.94	0.01924	0.04301	4.83%	9.18%	445	500
17.2		5	0.466	0.33	0.57	0.04697	0.105	22.54%	52.45%	233	500
24		5	0.27	0.18	0.34	0.02646	0.05916	21.91%	72.45%	135	500
35		5	0	0	0	0	0		100.0%	0	500

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CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Analytical Report

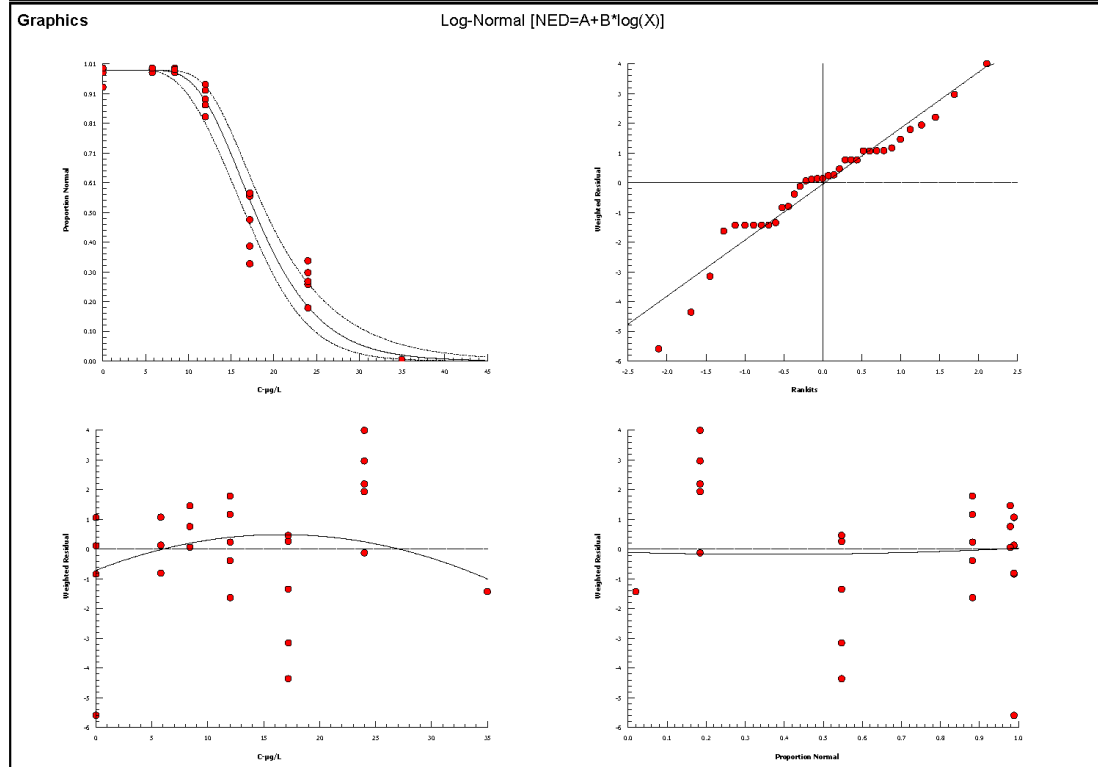
Report Date: 02 Jun-16 11:36 (p 2 of 2)
Test Code: SSC-2016-003 | 15-8182-3876

Echinoid Embryo-Larval Development Test SPAWAR Systems Center

Analysis ID: 02-4063-3610 Endpoint: Proportion Normal CETIS Version: CETISv1.8.7
Analyzed: 06 May-16 10:31 Analysis: Linear Regression (MLE) Official Results: Yes

Proportion Normal Detail						
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
0	Lab Control	0.93	0.99	0.98	1	1
5.8		0.99	0.99	1	0.98	1
8.4		0.99	0.99	0.98	1	0.99
12		0.83	0.89	0.94	0.87	0.92
17.2		0.33	0.56	0.48	0.39	0.57
24		0.26	0.27	0.18	0.34	0.3
35		0	0	0	0	0

Proportion Normal Binomials						
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
0	Lab Control	93/100	99/100	98/100	100/100	100/100
5.8		99/100	99/100	100/100	98/100	100/100
8.4		99/100	99/100	98/100	100/100	99/100
12		83/100	89/100	94/100	87/100	92/100
17.2		33/100	56/100	48/100	39/100	57/100
24		26/100	27/100	18/100	34/100	30/100
35		0/100	0/100	0/100	0/100	0/100



000-010-187-1

CETIS™ v1.8.7.16

Analyst:_____ QA:_____

Embryo Larval Bioassay

96-Hour Development

Project: NBSD Stormwater - Pulsed
 Sample ID: CuSO₄ Reference Toxicant Test
 Test No.: _____

Test Species: S. purpuratus
 Start Date: 3/8/2016 1000
 End Date: 3/12/2016 1030

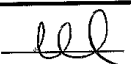
Random #	Number Counted	Number Normal	Technician Initials
1	100	100	MC
2	100	99	MC
3	100	87	MC
4	100	99	MC
5	100	0	MC
6	100	92	MC
7	100	33	MC
8	100	100	MC
9	100	18	MC
10	100	100	MC
11	100	89	MC
12	100	39	MC
13	100	34	MC
14	100	98	MC
15	100	0	MC
16	100	0	MC
17	100	100	MC
18	100	0	MC
19	100	98	MC
20	100	30	MC
21	100	94	MC
22	100	100	MC
23	100	99	MC
24	100	0	MC
25	100	56	MC
26	100	48	MC
27	100	98	MC
28	100	26	MC
29	100	27	MC
30	100	99	MC
31	100	83	MC
32	100	99	MC
33	100	57	MC
34	100	99	MC
35	100	93	MC

QC Check: JND 3/26/2016Final Review: MC 6/16/16

SPAWAR Systems Center Pacific Bioassay Lab, 53475 Strothe Rd, Bldg 111 Rm 116, San Diego, CA 92152

SPAWAR Pulsed Exposure Definitive Study
Echinoderm Development Tests
Test Initiation Date: 3/8/2016
Copper Reference Toxicant

Copper Concentration (µg/L)	Rand#
Lab Control	35
	34
	14
	1
	17
5.8	23
	32
	10
	19
	8
8.4	30
	4
	27
	22
	2
12	31
	11
	21
	3
	6
17.2	7
	25
	26
	12
	33
24	28
	29
	9
	13
	20
35	15
	5
	24
	16
	18

QC Check: 

SPAWAR Systems Center Pacific Bioassay Lab, 53475 Strothe Rd, Bldg 111 Rm 116, San Diego, CA 92152

Water Quality Measurements

Project: NBSD Storm H₂O - Pulsed
Sample ID: CaSO₄ Reference Toxicant
Test No.: 1

Test Species: S. purpuratus

Start Date/Time: 3/8/2016 1000

End Date/Time: 3/12/2016 10:00

[illegible]

Technician Initials:	0	24	48	72	96
WQ Readings:	mc	1/2	1/4	mc	mc
Dilutions made by:	mc				

Animal Source/Date Received: F. (us) collected 1/28/16

Comments: 0 hrs:

24 hrs:

48 hrs:

72 hrs:

QC Check: Final 6/1/2010

Final Review: all 6/2/16

CETIS Summary Report

Report Date: 03 Jun-16 08:35 (p 1 of 1)
 Test Code: SSC-2016-004 | 04-4234-0175

Americamysis 96-h Acute Survival Test							SPAWAR Systems Center				
Batch ID:	13-4930-5900	Test Type:	Survival (96h)				Analyst:	Marianne A Colvin			
Start Date:	08 Mar-16 10:00	Protocol:	EPA/821/R-02-014 (2002)				Diluent:	Laboratory Seawater			
Ending Date:	12 Mar-16 10:30	Species:	Americamysis bahia				Brine:	Not Applicable			
Duration:	4d 1h	Source:	Aquatic Research Organisms, NH				Age:	6			
Sample ID:	01-5795-2142	Code:	96A288E				Client:	SPAWAR			
Sample Date:	08 Mar-16	Material:	Copper sulfate				Project:	Pulsed Exposure			
Receive Date:		Source:	Reference Toxicant								
Sample Age:	10h	Station:	Reference Toxicant								
Comparison Summary											
Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method				
03-9723-9025	96h Survival Rate	100	200	141.4	20.2%		Dunnett Multiple Comparison Test				
Point Estimate Summary											
Analysis ID	Endpoint	Level	µg/L	95% LCL	95% UCL	TU	Method				
10-6425-4746	96h Survival Rate	LC50	253.1	195.4	313.2		Linear Regression (MLE)				
96h Survival Rate Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Lab Control	4	1	1	1	1	1	0	0	0.0%	0.0%
50		4	0.95	0.7909	1	0.8	1	0.05	0.1	10.53%	5.0%
100		4	0.95	0.7909	1	0.8	1	0.05	0.1	10.53%	5.0%
200		4	0.65	0.3453	0.9547	0.4	0.8	0.09574	0.1915	29.46%	35.0%
400		4	0.2	0	0.4598	0	0.4	0.08165	0.1633	81.65%	80.0%
800		4	0	0	0	0	0	0	0		100.0%
96h Survival Rate Detail											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
0	Lab Control	1	1	1	1						
50		0.8	1	1	1						
100		1	0.8	1	1						
200		0.8	0.6	0.8	0.4						
400		0.4	0.2	0.2	0						
800		0	0	0	0						
96h Survival Rate Binomials											
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4						
0	Lab Control	5/5	5/5	5/5	5/5						
50		4/5	5/5	5/5	5/5						
100		5/5	4/5	5/5	5/5						
200		4/5	3/5	4/5	2/5						
400		2/5	1/5	1/5	0/5						
800		0/5	0/5	0/5	0/5						

000-010-187-1

CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Analytical Report

Report Date: 03 Jun-16 08:35 (p 1 of 2)
Test Code: SSC-2016-004 | 04-4234-0175

Americamysis 96-h Acute Survival Test								SPAWAR Systems Center			
Analysis ID: 03-9723-9025		Endpoint: 96h Survival Rate		CETIS Version: CETISv1.8.7							
Analyzed: 03 Jun-16 8:33		Analysis: Parametric-Control vs Treatments		Official Results: Yes							
Batch ID: 13-4930-5900		Test Type: Survival (96h)		Analyst: Marienne A Colvin							
Start Date: 08 Mar-16 10:00		Protocol: EPA/821/R-02-014 (2002)		Diluent: Laboratory Seawater							
Ending Date: 12 Mar-16 10:30		Species: Americamysis bahia		Brine: Not Applicable							
Duration: 4d 1h		Source: Aquatic Research Organisms, NH		Age: 6							
Sample ID: 01-5795-2142		Code: 96A288E		Client: SPAWAR							
Sample Date: 08 Mar-16		Material: Copper sulfate		Project: Pulsed Exposure							
Receive Date:		Source: Reference Toxicant									
Sample Age: 10h		Station: Reference Toxicant									
Data Transform		Zeta	Alt Hyp	Trials	Seed		PMSD	NOEL	LOEL	TOEL	TU
Angular (Corrected)		NA	C > T	NA	NA		20.2%	100	200	141.4	
Dunnett Multiple Comparison Test											
Control	vs	C-µg/L	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)		
Lab Control		50	0.5816	2.356	0.241	6	0.5682	CDF	Non-Significant Effect		
		100	0.5816	2.356	0.241	6	0.5682	CDF	Non-Significant Effect		
		200*	3.898	2.356	0.241	6	0.0025	CDF	Significant Effect		
		400*	8.654	2.356	0.241	6	<0.0001	CDF	Significant Effect		
ANOVA Table											
Source	Sum Squares		Mean Square		DF	F Stat	P-Value	Decision(α:5%)			
Between	2.227548		0.556887		4	26.57	<0.0001	Significant Effect			
Error	0.3143655		0.0209577		15						
Total	2.541914				19						
Distributional Tests											
Attribute	Test		Test Stat	Critical	P-Value		Decision(α:1%)				
Variances	Mod Levene Equality of Variance		1.335	4.893	0.3024		Equal Variances				
Variances	Levene Equality of Variance		2.248	4.893	0.1125		Equal Variances				
Distribution	Shapiro-Wilk W Normality		0.9099	0.866	0.0635		Normal Distribution				
96h Survival Rate Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Lab Control	4	1	1	1	1	1	1	0	0.0%	0.0%
50		4	0.95	0.7909	1	1	0.8	1	0.05	10.53%	5.0%
100		4	0.95	0.7909	1	1	0.8	1	0.05	10.53%	5.0%
200		4	0.65	0.3453	0.9547	0.7	0.4	0.8	0.09574	29.46%	35.0%
400		4	0.2	0	0.4598	0.2	0	0.4	0.08165	81.65%	80.0%
800		4	0	0	0	0	0	0	0		100.0%
Angular (Corrected) Transformed Summary											
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Lab Control	4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
50		4	1.286	1.096	1.475	1.345	1.107	1.345	0.05953	9.26%	4.43%
100		4	1.286	1.096	1.475	1.345	1.107	1.345	0.05953	9.26%	4.43%
200		4	0.9463	0.623	1.27	0.9966	0.6847	1.107	0.1016	21.47%	29.66%
400		4	0.4594	0.161	0.7578	0.4636	0.2255	0.6847	0.09377	40.82%	65.85%
800		4	0.2255	0.2255	0.2256	0.2255	0.2255	0.2255	0	0.0%	83.24%

000-010-187-1

CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Analytical Report

Report Date: 03 Jun-16 08:35 (p 2 of 2)
Test Code: SSC-2016-004 | 04-4234-0175

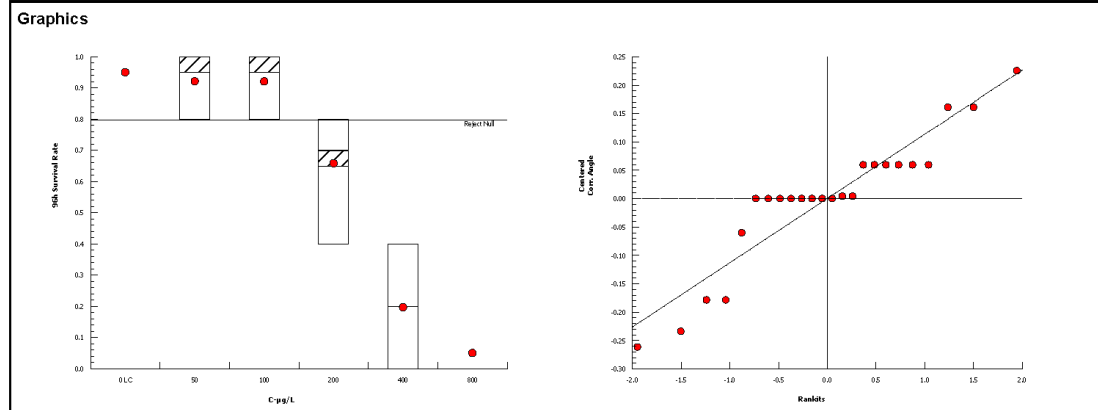
Americamysis 96-h Acute Survival Test SPAWAR Systems Center

Analysis ID: 03-9723-9025 Endpoint: 96h Survival Rate CETIS Version: CETISv1.8.7
Analyzed: 03 Jun-16 8:33 Analysis: Parametric-Control vs Treatments Official Results: Yes

96h Survival Rate Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Control	1	1	1	1
50		0.8	1	1	1
100		1	0.8	1	1
200		0.8	0.6	0.8	0.4
400		0.4	0.2	0.2	0
800		0	0	0	0

Angular (Corrected) Transformed Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Control	1.345	1.345	1.345	1.345
50		1.107	1.345	1.345	1.345
100		1.345	1.107	1.345	1.345
200		1.107	0.8861	1.107	0.6847
400		0.6847	0.4636	0.4636	0.2255
800		0.2255	0.2255	0.2255	0.2255

96h Survival Rate Binomials					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Control	5/5	5/5	5/5	5/5
50		4/5	5/5	5/5	5/5
100		5/5	4/5	5/5	5/5
200		4/5	3/5	4/5	2/5
400		2/5	1/5	1/5	0/5
800		0/5	0/5	0/5	0/5



000-010-187-1

CETIS™ v1.8.7.16

Analyst:_____ QA:_____

CETIS Analytical Report

Report Date: 03 Jun-16 08:35 (p 1 of 2)
 Test Code: SSC-2016-004 | 04-4234-0175

Americamysis 96-h Acute Survival Test							SPAWAR Systems Center				
Analysis ID:	10-6425-4746		Endpoint:	96h Survival Rate			CETIS Version:	CETISv1.8.7			
Analyzed:	03 Jun-16 8:34		Analysis:	Linear Regression (MLE)			Official Results:	Yes			
Batch ID:	13-4930-5900		Test Type:	Survival (96h)			Analyst:	Marianne A Colvin			
Start Date:	08 Mar-16 10:00		Protocol:	EPA/821/R-02-014 (2002)			Diluent:	Laboratory Seawater			
Ending Date:	12 Mar-16 10:30		Species:	Americamysis bahia			Brine:	Not Applicable			
Duration:	4d 1h		Source:	Aquatic Research Organisms, NH			Age:	6			
Sample ID:	01-5795-2142		Code:	96A288E			Client:	SPAWAR			
Sample Date:	08 Mar-16		Material:	Copper sulfate			Project:	Pulsed Exposure			
Receive Date:			Source:	Reference Toxicant							
Sample Age:	10h		Station:	Reference Toxicant							
Linear Regression Options											
Model Function			Threshold Option	Threshold	Optimized	Pooled	Het Corr	Weighted			
Log-Normal [NED=A+B*log(X)]			Control Threshold	1E-07	Yes	No	No	Yes			
Regression Summary											
Iters	LL	AICc	BIC	Mu	Sigma	Adj R2	F Stat	Critical	P-Value	Decision(α:5%)	
18	-31.85	70.9	73.24	2.403	0.2133	0.7933	2.485	3.16	0.0936	Non-Significant Lack of Fit	
Point Estimates											
Level	μg/L	95% LCL	95% UCL								
LC50	253.1	195.4	313.2								
Regression Parameters											
Parameter	Estimate	Std Error	95% LCL	95% UCL	t Stat	P-Value	Decision(α:5%)				
Threshold	0.02421	0.02358	-0.02201	0.07042	1.027	0.3163	Non-Significant Parameter				
Slope	4.687	1.014	2.7	6.675	4.622	0.0001	Significant Parameter				
Intercept	-11.27	2.476	-16.12	-6.412	-4.549	0.0002	Significant Parameter				
ANOVA Table											
Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)					
Model	68.27331	68.27331	1	90.25	<0.0001	Significant					
Lack of Fit	4.653317	1.551106	3	2.485	0.0936	Non-Significant					
Pure Error	11.23337	0.624076	18								
Residual	15.88669	0.756509	21								
Residual Analysis											
Attribute	Method			Test Stat	Critical	P-Value	Decision(α:5%)				
Goodness-of-Fit	Pearson Chi-Sq GOF			15.89	32.67	0.7760	Non-Significant Heterogeneity				
	Likelihood Ratio GOF			13.49	32.67	0.8905	Non-Significant Heterogeneity				
Variances	Mod Levene Equality of Variance			0.719	2.773	0.6176	Equal Variances				
Distribution	Shapiro-Wilk W Normality			0.8455	0.9169	0.0018	Non-normal Distribution				
	Anderson-Darling A2 Normality			1.744	2.492	<0.0001	Non-normal Distribution				
96h Survival Rate Summary											
			Calculated Variate(A/B)								
C-μg/L	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
0	Lab Control	4	1	1	1	0	0	0.0%	0.0%	20	20
50		4	0.95	0.8	1	0.05	0.1	10.53%	5.0%	19	20
100		4	0.95	0.8	1	0.05	0.1	10.53%	5.0%	19	20
200		4	0.65	0.4	0.8	0.09574	0.1915	29.46%	35.0%	13	20
400		4	0.2	0	0.4	0.08165	0.1633	81.65%	80.0%	4	20
800		4	0	0	0	0	0	100.0%	100.0%	0	20

CETIS Analytical Report

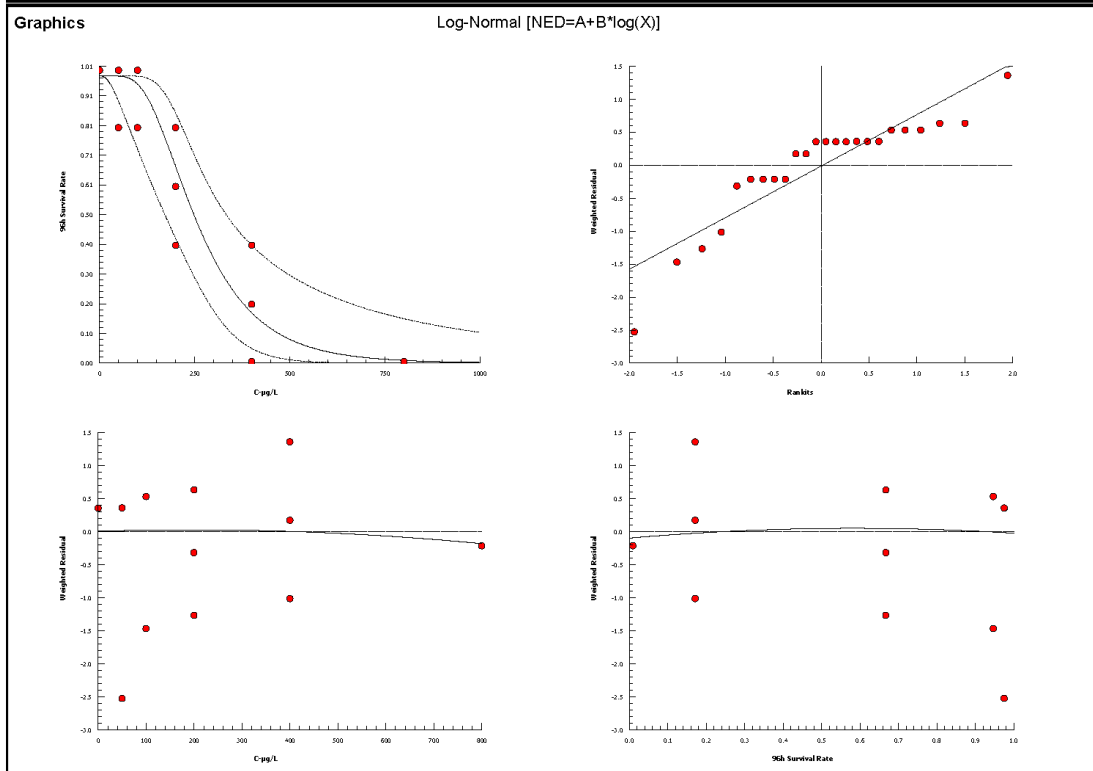
Report Date: 03 Jun-16 08:35 (p 2 of 2)
Test Code: SSC-2016-004 | 04-4234-0175

Americamysis 96-h Acute Survival Test SPAWAR Systems Center

Analysis ID: 10-6425-4746 Endpoint: 96h Survival Rate CETIS Version: CETISv1.8.7
Analyzed: 03 Jun-16 8:34 Analysis: Linear Regression (MLE) Official Results: Yes

96h Survival Rate Detail					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Control	1	1	1	1
50		0.8	1	1	1
100		1	0.8	1	1
200		0.8	0.6	0.8	0.4
400		0.4	0.2	0.2	0
800		0	0	0	0

96h Survival Rate Binomials					
C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Control	5/5	5/5	5/5	5/5
50		4/5	5/5	5/5	5/5
100		5/5	4/5	5/5	5/5
200		4/5	3/5	4/5	2/5
400		2/5	1/5	1/5	0/5
800		0/5	0/5	0/5	0/5



000-010-187-1

CETIS™ v1.8.7.16

Analyst: QA:

Marine Acute Bioassay
Static-Renewal Conditions

Water Quality Measurements
& Test Organism Survival

Project: NBSD Storm water Pulsed Exposure
Sample ID: Reference Toxicant CuSO₄
Test No.: _____

Test Species: *A. bahia*

Start Date/Time: 3/8/2016 1000

End Date/Time: 3/12/2016 1030

Tech Initials				
0	24	48	72	96
Count: NH	MC	NH	MC	MC
Readings: MC	NH	NH	MC	MC
Dilutions made by: MC		NH		

Concentration CuSO ₄ (µg/L)	Rep	Number of Live Organisms					Salinity (ppt)					Temperature (°C)					Dissolved Oxygen (mg/L)					pH (units)				
		0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96
Lab Control	A	5	5	5	5	5	30.1	30.7	30.9	30.0	30.9	19.1	20.1	20.6	19.6	19.7	7.8	7.5	7.4	7.9	7.8	8.06	7.85	7.78	7.95	7.76
	B	5	5	5	5	5		30.2					20.7					7.8					8.02			
	C	5	5	5	5	5																				
	D	5	5	5	5	5																				
50	A	5	5	5	4	4	30.1	30.7	30.1	30.0	30.5	19.1	20.3	20.9	19.6	19.9	7.7	7.5	7.6	7.7	7.7	8.06	7.95	8.02	7.96	7.79
	B	5	5	5	5	5		30.9					20.9					7.1						7.84		
	C	5	5	5	5	5																				
	D	5	5	5	5	5																				
100	A	5	5	5	5	5	30.0	30.6	30.1	30.0	30.4	19.2	20.5	20.9	19.7	19.8	7.8	7.4	7.5	7.5	7.6	8.06	7.94	8.02	7.94	7.95
	B	5	5	4	4	4		30.8					20.9					7.8						7.94		
	C	5	5	5	5	5																				
	D	5	5	5	5	5																				
200	A	5	5	4	4	4	30.0	30.6	30.0	30.0	30.7	19.7	20.5	20.9	19.6	19.7	7.7	7.4	7.4	7.5	7.7	8.06	7.94	8.02	7.96	7.77
	B	5	5	4	3	3		30.1					20.7					7.2						7.94		
	C	5	5	4	4	4																				
	D	5	5	4	2	2																				
400	A	5	4	4	3	2	30.0	30.9	30.0	30.4	30.8	19.6	20.9	19.9	19.9	19.9	7.7	7.4	7.4	7.4	7.6	8.06	7.94	8.02	7.90	7.91
	B	5	5	5	2	1		30.2					20.7					7.3						7.94		
	C	5	5	5	2	1																				
	D	5	4	4	2	0																				
800	A	5	3	3	2	0	30.0	30.9	30.4	30.3	30.4	19.4	20.9	19.9	19.9	19.9	7.7	7.4	7.5	7.5	7.7	8.06	7.94	8.02	7.92	7.92
	B	5	5	5	3	0		30.6					20.8					7.6						7.93		
	C	5	4	3	1	0																				
	D	5	3	2	0	0																				
	A																									
	B																									
	C																									
	D																									

Initial Counts QC'd

by: NH

Animal Source/Date Received: ARO 3/5/2016

Age at Initiation: 6 days

Comments:

i = initial reading in fresh test solution, f = final reading in test chamber prior to renewal

Organisms fed prior to initiation, circle one (y / n)

Tests aerated? Circle one (y / n) if yes, sample ID(s):

Duration:

QC Check:

IMD 6/1/2016

Feeding Times				
0	24	48	72	96
AM: 0900	1030	1030	1030	1030
PM: 1500	1500	1500	1500	1500

Final Review: NH 6/2/16

C.5. COPPER EXPOSURES – SAMPLE INFORMATION AND CHAIN OF CUSTODY:

SAMPLE COLLECTION AND ARRIVAL LOG

[illegible]

Comments _____



Systems Center
San Diego

ENVIRONMENTAL SCIENCES AND APPLIED
SYSTEMS, Code 71760
53605 Hull Street
San Diego, CA 92152-5000

Chain of Custody

Date March 7, 2016 Page 1 of 1

Sample Collection By:										
Project Information:										
Project Title		March 7, 2016 Stormwater Pier Test								
Project Number										
Project Leader		H. Colvin								
Phone										
Fax										
Email										
Report To:		Company								
		Address								
		City/State/Zip								
		Contact								
		Phone								
		Email								
SAMPLE ID	DATE	TIME	MATRIX	CONTAINER TYPE	NO. OF CONTAINERS	COMMENTS	ANALYSES REQUIRED			Receipt Temperature (°C)
1 OF 73	March 7, 2016	10:45	Stormwater	4L	1					14.2
2 Pier 10 ECC	March 7, 2016	09:43	Stormwater	4L	1					14.2
3 Pier 10 MID	March 7, 16	09:02	Stormwater	4L	1					14.2
4 Pier 10 IN	March 7, 16	09:35	Stormwater	4L	1					14.2
5 Pier 13 FWD	March 7, 16	09:16	Stormwater	4L	1					14.2
6 Pier 13 Base	March 7, 16	08:53	Stormwater	4L	1					14.2
7										
8										
9										
10										
SAMPLE RECEIPT										
Total No. of Containers Received:	6	Received Good Condition?	Yes	Good			RELINQUISHED BY (CLIENT)			
Shipped Via:							RELINQUISHED BY (COURIER)			
SPECIAL INSTRUCTIONS/COMMENTS:										
RECEIVED BY (COURIER)										
RECEIVED BY (LABORATORY)										

APPENDIX D

GLOSSARY OF QUALIFIER CODES

Glossary of Qualifier Codes:

- Q1 – pH out of recommended range; refer to CAR
- Q2 – Temperatures out of recommended range; corrective action taken and recorded in Test Temperature Correction Log
- Q3 – Temperatures out of recommended range; no action taken, test terminated same day
- Q4 – Sample aerated prior to initiation or renewal
- Q5 – Salinity out of recommended range; refer to QA section of report
- Q6 – Spilled test chamber/ Lost test animal
- Q7 – Instrumentation Error/Failure; refer to CAR
- Q8 – Inadequate sample volume, 50% renewal performed
- Q9 – Inadequate sample volume, no renewal performed
- Q10 – Sample out of holding time; refer to QA section of report
- Q11 – Refer to QA section of report for explanation
- Q12 – Supplemental information is footnoted
- Q13 – Test initiated with an incorrect number of test organisms
- Q14 – Replicate(s) not initiated
- Q15 – Survival counts not recorded due to poor visibility or heavy debris
- Q16 – Test aerated due to dissolved oxygen levels dropping below 4.0 mg/L
- Q17 – Test initiated with aeration due to an anticipated drop in dissolved oxygen
- Q18 – Airline obstructed or fell out of replicate and replaced, drop in dissolved oxygen occurred
- Q19 – Animals out of appropriate age range at test initiation
- Q20 – Readings not taken, tech error
- Q21 – Organisms in replicate not counted, tech error
- Q22 – Dissolved oxygen above recommended range, but remained within the 100% $\pm$ 10% saturation requirement

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October 2019		Final			
4. TITLE AND SUBTITLE				5a. CONTRACT NUMBER	
Pulsed Exposure Toxicity Testing: Method Development and Initial Evaluation for Stormwater Compliance				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
				5d. PROJECT NUMBER	
6. AUTHORS				5e. TASK NUMBER	
Gunther Rosen Jacob Munson-Decker Molly Colvin Nicholas Hayman Chuck Katz San Diego State University NIWC Pacific Research Foundation				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)				8. PERFORMING ORGANIZATION REPORT NUMBER	
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14. ABSTRACT					
This report describes a preliminary research effort to modify whole effluent toxicity (WET) testing protocols designed for continuous flow discharges for application to episodic and/or ephemeral discharges such as those associated with storm water runoff. The effort was undertaken in response to a Naval Base San Diego industrial stormwater National Pollutant Discharge Elimination System (NPDES) permit (R9-2013-0064) condition that allows the Navy to assess and propose alternative testing parameters. The research was conducted for Naval Base San Diego by environmental toxicologists at the Navy's Information Warfare Center Pacific (NIWC Pacific). The technical approach taken was to modify the WET testing method to simulate a range of exposure conditions found at the end-of-pipe. The test conditions matrix included: acute and chronic endpoints with commonly used test organisms; copper, zinc, and a combination of the two toxicants at various concentrations found to cause toxicity under standard WET testing; and short-term exposure conditions representing the 50th, 75th, and 95th percentile historical rainfall durations observed in San Diego over the past 55 years. The initial testing culminated in its application to multiple stormwater samples collected from Naval Base San Diego outfalls during a single rain event in March 2016. All testing was conducted concurrently with standard test method durations for comparison.					
15. SUBJECT TERMS					
Mixed metal exposures; stormwater exposures; zinc exposures; copper exposures; stormwater samples; pulsed exposure testing					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
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					619-553-0886

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