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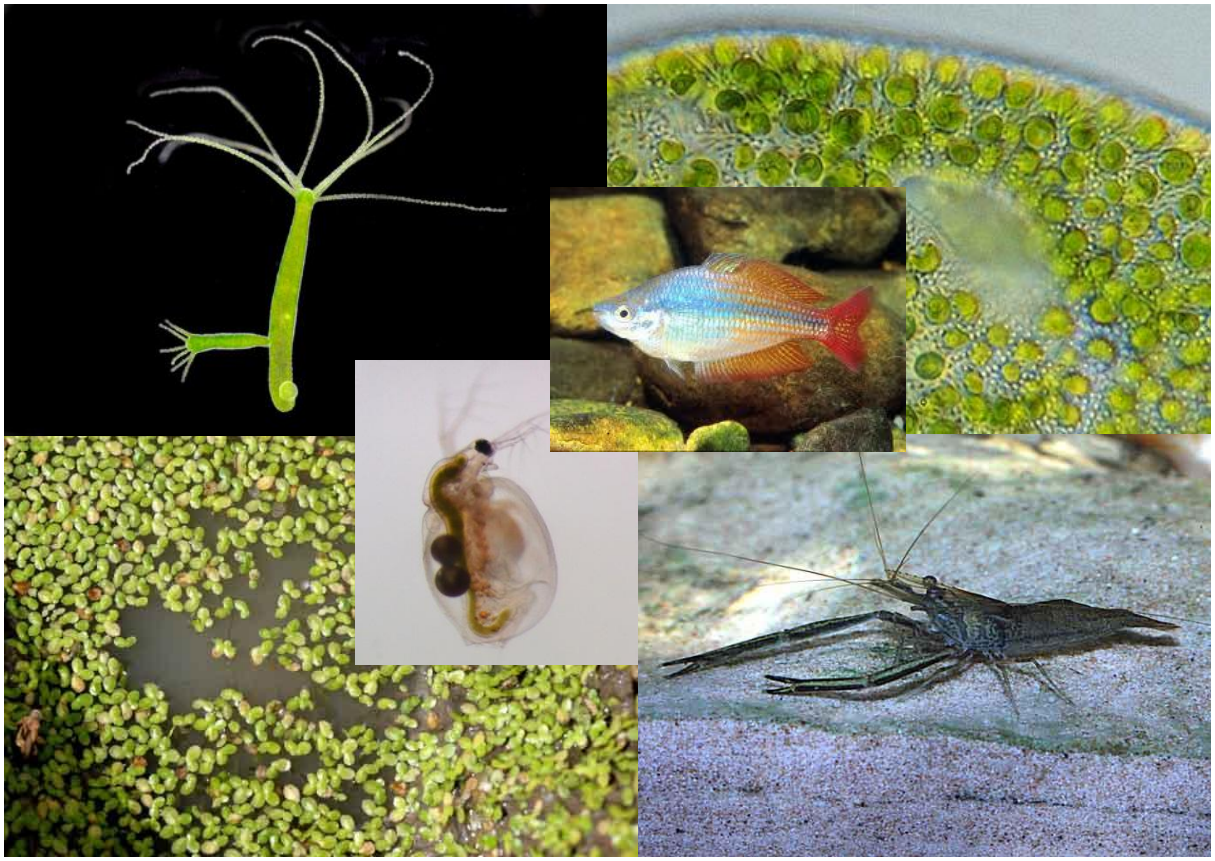

Sulphate Trigger Value for MRM mine

Final

May 2012

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EXECUTIVE SUMMARY

In response to elevated sulphate levels being recorded in waters of Surprise Creek, McArthur River Mining (MRM) initiated the derivation of a trigger value (TV) for sulphate based on ecotoxicity testing of local aquatic biota, to ensure appropriate measures are in place for protecting the receiving McArthur River ecosystem.

The *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC & ARMCANZ 2000) provides a code of practice for establishing trigger values for organic and inorganic contaminants of aquatic ecosystems. The guidelines also provide default trigger values for a large suite of inorganic and organic contaminants, although there are no default trigger values for sulphate. Site-specific *High reliability trigger values* can be derived through the performance of toxicity tests with regionally relevant species and the construction of species sensitivity distributions (SSD) as prescribed by ANZECC & ARMCANZ (2000). This document details the methods and procedures used to perform toxicity tests and analyse the data generated in order to derive a site specific TV for sulphate at the compliance point, SW11, in the McArthur River.

The following species were selected as relevant species for the construction of an SSD:

- 72 h *Chlorella* sp. algal cell division rate test (chronic);
- 96 h *Lemna aequinoctialis* plant growth test (chronic);
- 48 h *Ceriodaphnia* cf. *dubia* (waterflea) immobilisation test (acute);
- 7 d *Ceriodaphnia* cf. *dubia* three brood test (chronic);
- 96 h *Hydra viridissima* (hydra) population growth test (chronic);
- 96 h *Macrobrachium bullatum* juvenile prawn survival test (acute).

The toxicity of sulphate is known to be affected by the chemical composition of the test waters. Thus, toxicity tests were performed in waters obtained from the McArthur River which are relatively hard. The trigger values obtained in this study can only be considered valid within the confines of the water chemistry used in testing, and are therefore specific for the McArthur River in the vicinity of the mine, and cannot be transferred to other river systems where water chemistries will differ. Using the commercially available test species considered appropriate for the region, and performing toxicity tests in water obtained from the McArthur River, the concentrations of sulphate that would protect 95% of species would be 341 mg/L sulphate and the concentration predicted to be protective of 99% of species would be 123 mg/L.

GLOSSARY OF TERMS AND ACRONYMS

The following glossary is based on that provided by *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC and ARMCANZ 2000) and Environment Canada (1999) except where otherwise indicated.

Acute toxicity – Rapid adverse effect caused by a substance in a living organism. The term can be used to define either the exposure or the response to an exposure (effect). ANZECC & ARMCANZ (2000) define acute exposure as being between 24 and 96 hours duration for multi-celled organisms and being between 24 and 72 hours duration for single-celled organisms.

Acute to chronic ratio (ACR) – The ratio of the acute toxicity to the chronic toxicity of a species to a toxicant. The acute and chronic data did not have to have the same measure of toxicity or endpoint, but they must be for the same species and have been presented in the same paper or at least determined in the same laboratory (Warne 2001).

Chronic toxicity – A biological response to exposure to a toxicant that takes a prolonged period to appear and persists for a prolonged period. The term can be used to define either the exposure of an aquatic species or its response to an exposure (effect). The ANZECC & ARMCANZ (2000) define chronic exposure as being greater than 96 hours duration for multi-celled organisms and being equal to or greater than 72 hours duration for single-celled organisms.

Control (control treatment) – In toxicity tests, the control is that treatment in which the test organisms are not subjected to the test substance. The control is used as a standard comparison, to check that the outcome of the experiment is a reflection of the test conditions and not some unknown factor.

Direct toxicity assessment (DTA) – The use of toxicity tests to determine the acute and/or chronic toxicity of effluents and other mixtures of potential toxicants.

EC – Electrical Conductivity, which is an estimate of the amount of total dissolved salts (TDS).

EC10 – The concentration of a chemical that is estimated to cause a response in 10% of the test organisms or causes the mean response of the organisms to differ from the control by 10%. The EC10 is usually expressed as a time-dependent value, e.g. 24-hour EC10 is the concentration estimated to cause an effect on 10% of the test organisms after 24 hours of exposure.

EC50 – The concentration of chemical that is estimated to cause a response in 50% of the test organisms or causes the mean response of the organisms to differ from the control by 50%. The EC50 is usually expressed as a time-dependent value, e.g. 24-hour EC50 is the concentration estimated to be cause an effect on 50% of the test organisms after 24 hours of exposure.

Endpoint – The biological response of test organisms in toxicity tests that is measured (e.g. lethality, immobilisation).

ESA – Ecotox Services Australasia.

Ecosystem trigger values – These are the concentration (or loads) of the key performance indicators measured for the ecosystem, below which there exists a low risk that adverse biological (ecological) effects will occur. They indicate a risk of impact if exceeded and should 'trigger' some action, either further ecosystem-specific investigations or implementation of management/remedial actions.

Goodness of Fit – A statistical measure of how well a set of observations fit the predicted pattern of a probability distribution function.

ICp – The concentration that inhibits an endpoint by 'p' percent (e.g. the $IC50_{(reprod)}$ is the concentration that inhibits reproduction by 50%). It represents a point estimate of a concentration of test material that causes a designated percent inhibition (p) compared to the control. The ICp is usually expressed as a time-dependent value, e.g. 24-hour IC50 is the concentration estimated to cause an effect on 50% of the test organisms after 24 hours of exposure.

LC50 – The concentration of material in water that is estimated to be lethal to 50% of the test organisms. The LC50 is usually expressed as a time-dependent value, e.g. 24-hour or 96-hour LC50, the concentration estimated to be lethal to 50% of the test organisms after 24 or 96 hours of exposure.

Level of protection – The ANZECC & ARMCANZ (2000) provide three levels of protection depending on the current status of the ecosystem being considered. The levels are (1) high conservation ecosystems where the default is to protect 99% of species (i.e. PC99 values apply), (2) slightly to moderately modified ecosystems where the default is to protect 95% of species (i.e. PC95 values apply) and (3) highly modified ecosystems where the default is to protect between 80 to 90% of species (i.e. PC80 to PC90 values apply).

LOEC – The lowest observed concentration of a toxicant used in a toxicity test that has a statistically significant ($P \leq 0.05$) adverse effect on the exposed population of test organisms compared with the controls. This is estimated by hypothesis-based statistical methods and is therefore not a point estimate.

Mixing zones – An explicitly defined area around a discharge point where discharge concentrations may exceed guideline values and therefore result in certain environmental values not being protected. The size of the mixing zone is site specific.

NATA – National Association of Testing Authorities.

NOEC – The highest observed concentration of a toxicant used in a toxicity test that does not exert a statistically significant adverse effect ($P > 0.05$) on the exposed population of test

organisms compared to the controls. This is estimated by hypothesis based statistical methods and is therefore not a point estimate.

Protective concentrations (PC) – The concentration predicted by species sensitivity distribution methods that will protect a chosen percentage of species from experiencing toxic effects. For example, the PC99 should protect 99% of species in the ecosystem being considered. The toxic effects that are being prevented will depend on the type of toxicity data used to derive the PC values. Thus, if sub-lethal EC10 data are used to generate a PC95 – it will protect 95% of species from experiencing sub-lethal EC10 effects.

Safe dilution factors – The concentration that a chemical or discharge must be diluted by in order to meet a selected PC value. The lower the PC value the higher the dilution factor must be to protect the selected percentage of species.

Species Sensitivity Distribution (SSD) – SSD is a statistical approach for predicting the threshold concentrations of a contaminant or effluent that will protect a specific proportion of aquatic species with a predetermined level of confidence.

Sub-lethal – A biological response that is less severe than death. Examples of sub-lethal effects include inhibition of reproduction, reduction in growth, reduction in population growth, inhibition of fertilisation and inhibition of development.

Toxicity – The inherent potential or capacity of a chemical to cause adverse effects in a living organism.

Toxicity test – A test that exposes living organisms to several concentrations of a substance that is under investigation, and evaluates the organism's responses.

Trigger Value (TV) – The numerical limit for the aqueous concentration of a toxicant which if exceeded leads to further investigation or action to remediate the site or to reduce the concentration of the toxicant.

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1 PROJECT BACKGROUND AND OBJECTIVES

In response to elevated sulphate levels being recorded in waters of Surprise Creek, McArthur River Mining (MRM) initiated the derivation of a trigger value (TV) for sulphate based on ecotoxicity testing of local aquatic biota, to ensure appropriate measures are in place for protecting the receiving McArthur River ecosystem. .

The *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC & ARMCANZ 2000) provides a code of practice for establishing trigger values for organic and inorganic contaminants of aquatic ecosystems. The guidelines also provide default trigger values for a large suite of inorganic and organic contaminants, although there are no default trigger values for sulphate. Site-specific *High reliability trigger values* can be derived through the performance of toxicity tests with regionally relevant species and the construction of species sensitivity distributions (SSD) as prescribed by ANZECC & ARMCANZ (2000). This document details the methods and procedures used to perform toxicity tests and analyse the data generated in order to derive a site specific TV for sulphate for MRM mine.

The objectives of this study were to:

- Use the results obtained in ecotoxicity testing performed by Ecotox Services Australasia to construct a species sensitivity distribution;
- Use the species sensitivity distribution to predict the concentrations that would protect specified percentages of species in the receiving McArthur River ecosystem.

2 METHODS

2.1 Test Solution Preparation

Test waters were formulated in-house using diluent water sourced from the McArthur River upstream of the mine and sodium sulphate salts.

2.2 Toxicity testing

2.2.1 Test regime

Below is a list of test species used in the toxicity testing program to derive the site specific water quality criteria for sulphate:

- 72 h *Chlorella* sp. algal cell division rate test (chronic);
- 96 h *Lemna aequinoctialis* plant growth test (chronic);
- 48 h *Ceriodaphnia* cf. *dubia* (waterflea) immobilisation test (acute);
- 7 d *Ceriodaphnia* cf. *dubia* three brood test (chronic);
- 96 h *Hydra viridissima* (hydra) population growth test (chronic);

- 96 h *Macrobrachium bullatum* juvenile prawn survival test (acute).

The selection of the species above met the requirements of ANZECC and ARMCANZ (2000) guidelines for the assessment of toxicants in receiving waters by having at least five species from four trophic levels as part of the testing suite. The suite of tests provided a range of acute and chronic endpoint measurements of toxicity to use in the derivation of the discharge and ambient toxicant trigger values (TV). The use of both the immobilisation and three brood *C.* cf. *dubia* tests allowed for the calculation of an acute to chronic ratio. The acute to chronic ratio was then used to convert the acute data of the crustacean tests to chronic equivalents so that a moderate reliability (uses a mix of acute and chronic toxicity data to derive a trigger value) water quality trigger value could be calculated.

2.2.2 Toxicity test methods

The toxicity tests used are summarised below.

2.2.2.1 *Chlorella* sp. (green alga) cell division test

The unicellular freshwater green alga *Chlorella* sp. (Chlorophyceae) was isolated from surface water collected within Kakadu National Park. Exponentially growing cells of *Chlorella* sp. were exposed to dilution series of the test toxicant over several generations under defined conditions. The test was conducted over 72 hours with cell counts undertaken at both 48 and 72 h. From these counts, cell division rates were calculated. A test substance was considered toxic when a statistically significant ($P \leq 0.05$) concentration-dependent inhibition of algal growth occurred. Development of this method is described by Franklin *et al.* (1998).

2.2.2.2 *Lemna aequinoctialis* (duckweed) plant growth test

The test species *L. aequinoctialis*, is a small aquatic, flowering macrophyte commonly known as duckweed. The duckweeds are ecologically relevant test organisms in that they are primary producers and a source of food for water fowl, fish and small invertebrates. By floating in mats on the surface of still waters they also provide habitat for many small organisms. Unlike many other evolutionary more complex plants, their small size and fast growth rates make them ideal for testing in the laboratory. This test was based on an OECD protocol (2006). A standard number of vegetatively reproducing lemna plants were exposed to dilution series of the test toxicant over 96 hours under controlled conditions. The number of fronds was counted at the end of the test and from this, the degree of plant growth was calculated and compared with an appropriate control to determine the percentage inhibition of growth for each treatment.

2.2.2.3 *Ceriodaphnia* cf. *dubia* (cladoceran) immobilisation test

The *Ceriodaphnia* cf. *dubia* freshwater cladoceran (water flea) 48 h acute survival test is one of the most commonly used tests to assess the potential harm a toxicant poses to freshwater aquatic ecosystems. The test is based on, and modified from, a U.S. EPA protocol (Bailey *et al.* 2000; U.S. EPA 2002). Laboratory cultured juvenile *Ceriodaphnia* were exposed to a dilution series of the test toxicant for 48 hours. At the end of the exposure, the number of

surviving *Ceriodaphnia* was counted. Statistical analyses were then applied to determine the concentration that caused a percentage of mortality to the test population (e.g. LC50). The *C. dubia* acute toxicity test has been demonstrated to be sensitive to heavy metals (Hickey 1989; Hall and Golding 1998; Hickey 2000), organics (Mulhall 1997; Rose *et al.* 1998), and pesticides (Hickey 1989; Julli 1993; Sunderam *et al.* 1994). The test has been used routinely in Australia for assessing the toxicity of sewage effluents, mine tailings and pulp/paper mill effluents (e.g. Bailey *et al.* 2000).

2.2.2.4 *Ceriodaphnia* cf. *dubia* (cladoceran) 3 brood reproduction test

This method measures chronic toxicity to the daphnid, *Ceriodaphnia* cf. *dubia*, using less than 24 h old neonates during a three-brood (seven-day), static renewal test. The test began with asexually reproducing female freshwater cladocera (waterfleas) that were less than six hours old (i.e. neonates). These neonate females were exposed to a dilution series of the test substance, an effluent or reference toxicant under 'static-renewal' conditions. These females were transferred daily to fresh solutions of the same concentration. Each day, observations were made on the survival of each female, the number of neonates produced and neonate survival. Each female were accounted for as alive, dead or missing, rather than assuming missing animals were dead. The test was terminated when three broods were produced by each surviving control female (normally over a 5-7 day period). The method is based on the *Ceriodaphnia* Survival and Reproduction Test developed by the U.S. EPA (U.S. EPA 2002).

2.2.2.5 *Macrobrachium bullatum* juvenile survival test

This test is a 96 h test undertaken with the freshwater prawn, *Macrobrachium bullatum*. This freshwater prawn is found in the McArthur River adjacent to the mine. Juvenile prawns were exposed to a dilution series of the test toxicant for 96 hours. The test containers were checked every 24 h for prawn mortality and the results were statistically compared to the controls to determine significant differences. This test is based on the USEPA (1996) Penaeid shrimp test protocol.

2.2.2.6 *Hydra viridissima* population growth test

Hydra viridissima is referred to as 'green' hydra because of its green colouration resulting from the presence of a symbiotic green alga in the gastrodermal cells of the animal. Although the precise distribution of this species has not been mapped, it has been found in a variety of aquatic habitats in northern Australia. Asexually reproducing (budding) test hydra were exposed to a dilution series of the test toxicant for 96 hours. Observations of any changes to the hydra population (i.e. changes in the number of intact hydroids, where one hydroid equals one animal plus any attached buds) were recorded at 24 h intervals. The method is based on the hydra population growth test described by Hyne et al. (1996) and Riethmuller *et al.* (2003).

2.2.3 Statistical analyses

The EC10 (the effective concentration giving 10% reduction in the endpoint compared with the controls) was calculated using Trimmed Spearman-Karber analysis (Hamilton et al.

1977), Maximum Likelihood Probit analysis (Finney 1971) or Log-Logit Interpolations (U.S. EPA 2002), depending on which method was appropriate.

2.2.4 Data used for derivation of protective concentrations (trigger values)

An ambient water TV for sulphate was derived using the species sensitivity distribution (SSD) method described in ANZECC and ARMCANZ (2000) using EC10 data. ANZECC and ARMCANZ (2000)use chronic, no observed effect concentration (NOEC) data to derive high reliability TVs and acute EC50 toxicity data to derive moderate reliability TVs, and either type of toxicological data can be used to derive low reliability TVs (ANZECC & ARMCANZ 2000; Warne 2001). However, ANZECC & ARMCANZ (2000), and the document that proposed the framework for developing these guidelines (Warne 1998), state that the methods used to derive the trigger values are not data specific as long as only one type of data is used. Thus, EC10 values could be used to derive high reliability TVs if there are sufficient data. EC10 data are considered more statistically reliable endpoints to use than NOECs (Warne and van Dam 2008).

Because a mixture of acute and chronic data were obtained from the toxicity tests, it was necessary to convert the acute toxicity data (freshwater prawn) to chronic data by applying and acute to chronic ratio (ACR). The ACR was obtained from the for EC10 data generated for the acute cladoceran survival test and the EC10 data generated in the chronic 3 brood cladoceran reproduction test, and calculated as $EC10_{acute}/EC10_{reproduction}$ = ACR.

2.2.5 Trigger value calculation

The water quality standard for sulphate was derived using the BurrliOZ software package (Campbell *et al.* 2000), provided as part of ANZECC and ARMCANZ (2000) package. BurrliOZ uses a flexible group of distributions, the Burr Type III, to estimate the concentrations of discharges such that a given percentage of species will be protected and conversely that a given percentage will be adversely affected (Campbell *et al.* 2000). The TVs for the 80%, 90%, 95% and 99% protective concentrations were derived as per ANZECC and ARMCANZ (2000).

3 RESULTS

3.1 Quality assurance / Quality control

Quality assurance and quality control of all NATA accredited tests were satisfied. Tests offered by ESA that were not accredited were judged on a case-by-case basis taking into account control results. Specifically, for the test with hydra (*H. viridissima*) the results for the controls were above the minimum growth rate of 25% of the population/day, and for the freshwater prawns (*M. bullatum*) results for the controls were above the minimum 80% un-affected.

3.2 Ecotoxicological analysis

The results of the ecotoxicity testing are shown in Table 3-1. The results indicate that hydra was the most sensitive organism to sulphate. The sulphate concentration that inhibited population growth was 256 mg/L. The least sensitive organism was the freshwater shrimp, where 3310 mg/L was required to result in a 10% mortality rate.

Table 3-1 Results of sulphate ecotoxicity testing

Test Species	EC10 (95% confidence interval) mg/L		EC50 (95% confidence interval) mg/L	
Freshwater prawn survival test (acute)	3310	(1998 - 4422)	7557	(5971 - 9467)
Duckweed growth inhibition test (chronic)	2281	(596 - 3133)	3769	(3650 - 3866)
Microalgal cell division rate test (chronic)	1731	(1004 - 1918)	3511	(3022 - 3891)
Waterflea survival test (acute)	2235	(2161 - 2317)	2600	(2920 - 2738)
Waterflea survival test (chronic)	2213	(2082 - 2500)	2585	(2378 - 2908)
Waterflea reproduction test (chronic)	1315	(903 - 1408)	1871	(1798 - 1925)
Hydra population growth test (chronic)	256	(62.3 - 1672)	1676	(1198 - 1981)

3.3 Sulphate trigger value

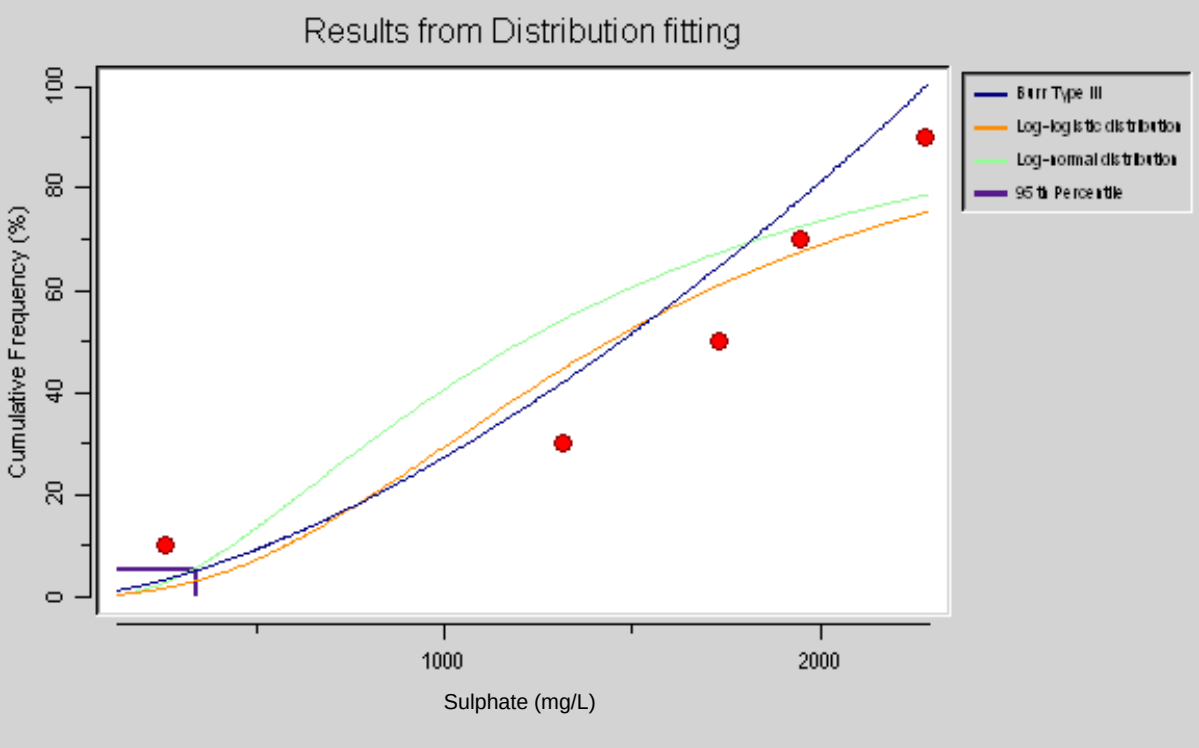
As the data produced by the ecotoxicity testing was a mixture of both chronic and acute endpoints, the acute data was converted to chronic equivalents using an acute to chronic ratio. The acute to chronic ratio was derived by dividing the waterflea neonate survival test (acute) by the waterflea reproduction test (chronic), giving a value of 1.7. The acute prawn survival EC10 values were then converted to chronic equivalents by dividing the acute EC10 values by 1.7.

The five chronic data points were then used in the BurrliOZ program to derive a species sensitivity distribution (SSD) (All toxicity data was inputted as chronic EC10s

Figure 3-1). The SSD was then used to derive ecosystem trigger values (Table 3-3).

Table 3-2 Chronic EC10 values used for derivation of sulphate trigger value

Test Species	EC10 (mg/L)
Freshwater shrimp survival test	1947
Duckweed growth inhibition test	2281
Microalgal cell division rate test	1731
Waterflea reproduction test	1315
Hydra population growth test	256



All toxicity data was inputted as chronic EC10s

Figure 3-1 Species sensitivity distribution (SSD) for sulphate

Table 3-3 Trigger values (TV) for different levels of protection (% of species) estimated from the species sensitivity distribution

Level of Protection	Sulphate concentration (mg/L)
80%	822
90%	529
95%	341
99%	123

4 DISCUSSION

A search of available water quality guidelines from authorities around the world resulted in two maximum concentrations for freshwater aquatic life being found. The first was from British Columbia, Canada, which set at a maximum concentration (not to be exceeded at any time) of 100 mg/L (British Columbia Ministry of Environment 2012). This was considered inappropriate for use outside of this province due to the unique water quality conditions of the streams and rivers in that province. The other guideline was set in the state of Iowa, USA (Iowa DNR 2009). This guideline is based around equations that depend on chloride and hardness to be protective of aquatic life. Note that the Iowa DNR (2009) guidelines are not derived using the ANZECC and ARMCANZ (2000) SSD method, but rather the U.S. EPA approach that uses a calculation based on hardness and chloride concentration.

Both the IOWA DNR (2009) guidelines, and the ANZECC and ARMCANZ (2000) SSD method presented here accommodate the effects of water chemistry. With SSD, this is achieved by performing toxicity tests with dilution waters that represent the receiving environment. The toxicity of sulphate is highly dependent on the environmental water chemistry, chiefly water hardness and salinity, which ameliorate toxicity of many inorganic substances, and particularly in crustaceans (Warne and van Dam 2008). The two ions normally associated with hard waters are Mg^{2+} and Ca^{2+}, and similar indices of water hardness can occur at different ratios of Ca:Mg. Increasing the ratio in favour of Ca^{2+}, was found to increase the protective effect of water hardness against the toxic effects of sulphate in two crustaceans (*Hyalella azteca* and *Daphnia magna*), and it seems likely that Ca^{2+} permeability of gill membranes to sulphate is reduced by either stabilization of cell membranes by calcium or by the formation of $CaSO_4$ complexes which would reduce bioavailability of SO_4^{2-} (Davies and Hall 2007). Similarly, the concentration of chloride will affect sulphate toxicity. At relatively low chloride concentrations (<25 mg/L), increased chloride has an ameliorative effect, but high concentrations (25 – 500 mg/L) will aggravate toxicity (Iowa DNR 2009). For a full discussion on how the local chloride and hardness data were used to calculate the Iowa sulphate water quality guidelines, see Iowa DNR (2009) at http://www.iowadnr.gov/water/standards/files/ws_review.pdf.

Very few sulphate toxicity data are available for Australian species; however, those that do exist illustrate the importance of regional water chemistry for toxicity. van Dam *et al.* (2010) exposed *L. aequinoctialis* and *H. viridissima* to sulphate and derived EC50 values of 332 and 474 mg/L, respectively. The data generated by van Dam *et al.* (2010) were obtained in tests with very soft waters (<5 mg/L as $CaCO_3$). By contrast, the EC50 values derived for the same two species in this study were 3769 and 1676 mg/L, respectively (Table 3-1). However, the toxicity tests presented here were performed in waters obtained from the McArthur River which are relatively hard. Therefore, the trigger values obtained in this study (i.e. 341 mg/L for 95% species protection) should only be considered valid within the confines of the water chemistry used in testing, and cannot be transferred to other river systems where water quality will differ.

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U.S. EPA (2002). Short-term methods for estimating the chronic toxicity of effluents and receiving waters to freshwater organisms. Fourth edition, Report no. EPA-821-R-02-013, U.S. Environmental Protection Agency, Office of Water, Washington DC.

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APPENDIX 1 ECOTOXICITY TEST REPORT

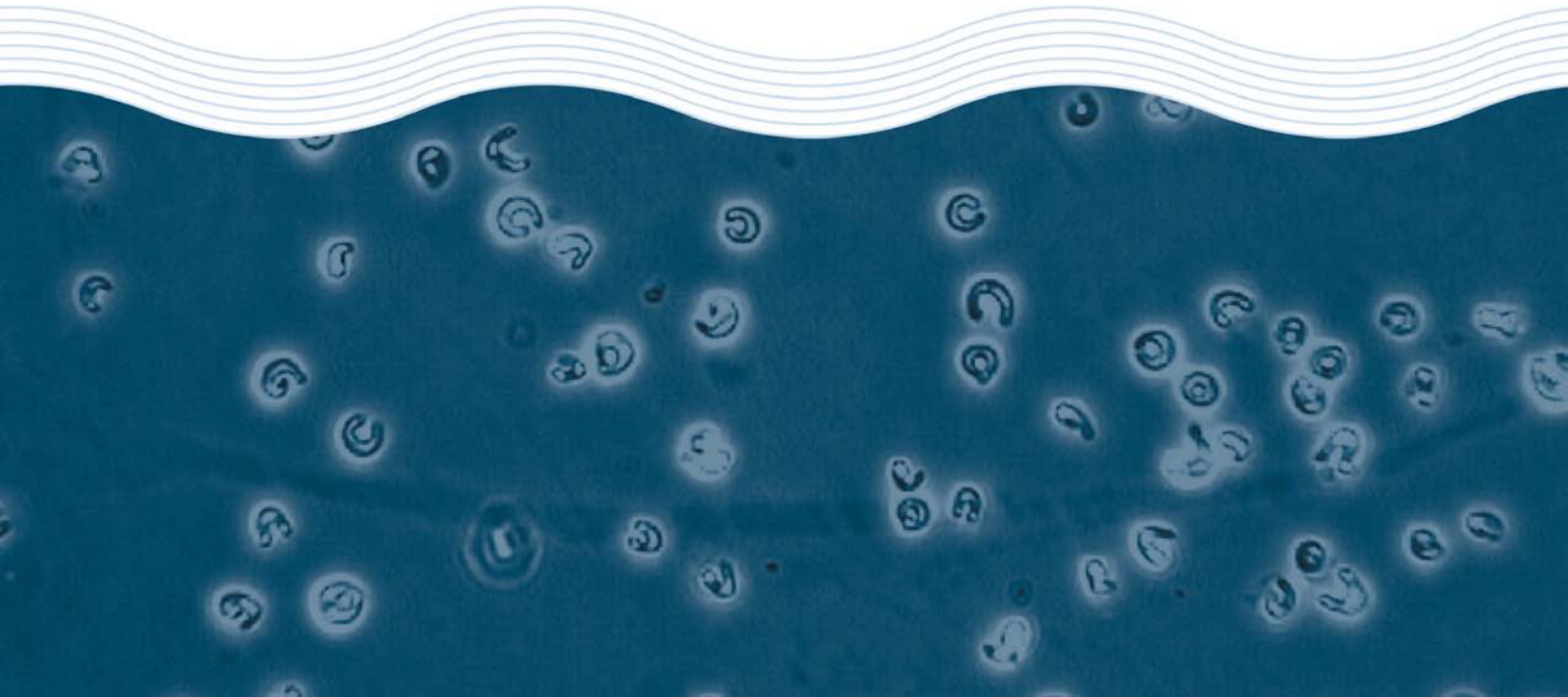
ecotox
SERVICES AUSTRALASIA

Toxicity Assessment of Sulfate in Receiving Water from McArthur River Mine

Hydrobiology Pty Ltd

Test Report

April 2012



Toxicity Assessment of Sulfate in Receiving Water from McArthur River Mine

Hydrobiology Pty Ltd

Test Report

April 2012

ECOTOX Services Australasia Pty Ltd ABN>45 094 714 904
unit 27/2 chaplin drive lane cove nsw 2066 T>61 2 9420 9481 F>61 2 9420 9484 W>www.ecotox.com.au

Toxicity Test Report: TR0840/1

This document is issued in accordance with NATA's accreditation requirements

Client:	Hydrobiology Pty Ltd Unit 27/43 Lange Pde Auchenflower QLD 4066	**ESA Job #:** **Date Sampled:** **Date Received:**	PR0840 9 February 2012 14 February 2012
Attention:	Reinier Mann	**Sampled By:**	Client
Client Ref:	Not supplied	**ESA Quote #:**	PL0840_q01

Lab ID No.:	**Sample Name:**	**Sample Description:**
5259	MRM Diluent	Aqueous sample, pH 8.2, conductivity 504µS/cm, total ammonia <2.0mg/L*. Sample received at room temperature in apparent good condition

*Ammonia analysis is not covered by Ecotox Services Australasia's scope of accreditation

Test Performed:	48-hr acute toxicity test using the freshwater cladoceran *Ceriodaphnia cf dubia*
Test Protocol:	ESA SOP 101 (ESA 2011), based on USEPA (2002) and Bailey *et al*. (2000)
Test Temperature:	The test was performed at 25±1°C.
Deviations from Protocol:	Nil
Comments on Solution Preparation:	The highest sulfate concentration of 11g/L was prepared by adding sodium sulfate to sample 5259 'MRM Diluent'. This concentration was serially diluted with sample 5259 'MRM Diluent' to achieve the test concentrations. A DMW control and a diluent control (MRM Diluent) were tested concurrently with the sodium sulfate solutions. All concentrations are reported as measured sulfate in g/L.
Source of Test Organisms:	ESA Laboratory culture
Test Initiated:	29 February 2012 at 1300h

Sample: *Sulfate* **Concentration (g/L)**	**% non-immobilised (Mean ± SD)**	*Vacant*	*Vacant*
DMW Control	100 ± 0.0		
Diluent Control	100 ± 0.0		
0.3	100 ± 0.0		
0.6	100 ± 0.0		
1.3	100 ± 0.0		
2.6	50.0 ± 11.6 *		
5.3	0.0 ± 0.0		
11	0.0 ± 0.0		
48-hr IC10 = 2.2 (2.2-2.3)g/L **48-hr EC50 = 2.6 (2.2-3.1)g/L** **NOEC = 1.3g/L** **LOEC = 2.6g/L**			

*Significantly lower percent immobilisation compared with the Diluent Control (Steel's Many-One Rank Test, 1-tailed, P=0.05)

Toxicity Test Report: TR0841/1

QA/QC Parameter	Criterion	This Test	Criterion met?
Control mean % non-immobilised	≥90.0%	100%	Yes
Reference Toxicant within cusum chart limits	160.8-328.8mg KCl/L	243.7mg KCl/L	Yes

Test Report Authorised by: Dr Rick Krassoi, Director on 4 April 2012

Results are based on the samples in the condition as received by ESA.

NATA Accredited Laboratory Number: 14709

This document is issued in accordance with NATA's accreditation requirements. Accredited for compliance with ISO/IEC 17025. NATA is a signatory to the APLAC mutual recognition arrangement for the mutual recognition of the equivalence of testing, calibration and inspection reports. This document shall not be reproduced except in full.

Citations:

Bailey, H.C., Krassoi, R., Elphick, J.R., Mulhall, A., Hunt, P., Tedmanson, L. and Lovell, A. (2000) Application of *Ceriodaphnia cf. dubia* for whole effluent toxicity tests in the Hawkesbury-Nepean watershed, New South Wales, Australia: method development and validation. *Environmental Toxicology and Chemistry* 19:88-93.

ESA (2011) *SOP 101 – Acute toxicity test using Ceriodaphnia dubia*. Issue No. 9. Ecotox Services Australasia, Sydney, New South Wales.

USEPA (2002) *Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms.4th Ed.* United States Environmental Protection Agency, Office of Water, Washington DC.

Toxicity Test Report: TR0840/2

This document is issued in accordance with NATA's accreditation requirements

Client:	Hydrobiology Pty Ltd Unit 27/43 Lange Pde Auchenflower QLD 4066	**ESA Job #:** **Date Sampled:** **Date Received:**	PR0840 9 February 2012 14 February 2012
Attention:	Reinier Mann	**Sampled By:**	Client
Client Ref:	Not supplied	**ESA Quote #:**	PL0840_q01

Lab ID No.:	**Sample Name:**	**Sample Description:**
5259	MRM Diluent	Aqueous sample, pH 8.2, conductivity 504µS/cm, total ammonia <2.0mg/L*. Sample received at room temperature in apparent good condition

*Ammonia analysis is not covered by Ecotox Services Australasia's scope of accreditation

Test Performed:	7-day partial life-cycle toxicity test using the freshwater cladoceran *Ceriodaphnia cf dubia*
Test Protocol:	ESA SOP 102 (ESA 2011), based on USEPA (2002) and Bailey *et al*. (2000)
Test Temperature:	The test was performed at 25±1°C.
Deviations from Protocol:	Nil
Comments on Solution Preparation:	The highest sulfate concentration of 5.2g/L was prepared by adding sodium sulfate to sample 5259 'MRM Diluent'. This concentration was serially diluted with sample 5259 'MRM Diluent' to achieve the test concentrations. A DMW control and a diluent control (MRM Diluent) were tested concurrently with the sodium sulfate solutions. All concentrations are reported as measured sulfate in g/L.
Source of Test Organisms:	ESA Laboratory culture
Test Initiated:	8 March 2012 at 1400h

Sample: *Sulfate*

Concentration (g/L)	**% Survival at 7 days (Mean ± SD)**	
DMW Control	100 ± 0.0	
Diluent Control	100 ± 0.0	
0.4	100 ± 0.0	
0.7	100 ± 0.0	
1.3	100 ± 0.0	
2.5	60.0 ± 51.6	*
5.2	0.0 ± 0.0	

7 day IC10 (survival) = 2.2 (2.1-2.5)g/L
7 day EC50 (survival) = 2.7 (2.2-3.4)g/L
NOEC = 1.3g/L
LOEC = 2.5g/L

Sample: *Sulfate*

Concentration (g/L)	**Number of Young (Mean ± SD)**	
DMW Control	15.4 ± 2.1	
Diluent Control	16.5 ± 1.8	
0.4	16.8 ± 1.9	
0.7	17.1 ± 2.5	
1.3	15.3 ± 2.2	
2.5	0.8 ± 1.1	**
5.2	0.0 ± 0.0	

7 day IC10 (reproduction) = 1.3 (0.9-1.4)g/L
7 day IC50 (reproduction) = 1.9 (1.8-1.9)g/L
NOEC = 1.3g/L
LOEC = 2.5g/L

*Significantly lower percent survival compared with the DMW Control (Fisher's Exact Test, 1-tailed, P=0.05)
** Significantly lower number of young compared with DMW Control (Dunnett's Test, 1-tailed, P=0.05)

Toxicity Test Report: TR0840/2

QA/QC Parameter	Criterion	This Test	Criterion met?
Control mean % survival	≥80.0%	100%	Yes
Control mean number of young	≥15.0	15.4	Yes
Reference Toxicant within cusum chart limits	184.7-274.6mg KCl/L	220.5mg KCl/L	Yes

Test Report Authorised by: Dr Rick Krassoi, Director on 4 April 2012

Results are based on the samples in the condition as received by ESA.

NATA Accredited Laboratory Number: 14709

Citations:

Bailey, H.C., Krassoi, R., Elphick, J.R., Mulhall, A., Hunt, P., Tedmanson, L. and Lovell, A. (2000) Application of *Ceriodaphnia cf. dubia* for whole effluent toxicity tests in the Hawkesbury-Nepean watershed, New South Wales, Australia: method development and validation. *Environmental Toxicology and Chemistry* 19:88-93.

ESA (2011) ESA SOP 102 – *Acute Toxicity Test Using Ceriodaphnia dubia.* Issue No 8. Ecotox Services Australasia, Sydney, NSW.

USEPA (2002) *Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms.4th Ed.* United States Environmental Protection Agency, Office of Water, Washington DC.

Toxicity Test Report: TR0840/3

Client:	Hydrobiology Pty Ltd	**ESA Job #:**	PR0840
	Unit 27/43 Lange Pde	**Date Sampled:**	9 February 2012
	Auchenflower QLD 4066	**Date Received:**	14 February 2012
Attention:	Reinier Mann	**Sampled By:**	Client
Client Ref:	Not supplied	**ESA Quote #:**	PL0840_q01

Lab ID No.:	**Sample Name:**	**Sample Description:**
5259	MRM Diluent	Aqueous sample, pH 8.2, conductivity 504µS/cm, total ammonia <2.0mg/L. Sample received at room temperature in apparent good condition

Test Performed:	72-hr microalgal growth inhibition test using the green alga *Chlorella vulgaris*
Test Protocol:	ESA SOP 103 (ESA 2011), based on USEPA (2002)
Test Temperature:	The test was performed at 29±1°C.
Deviations from Protocol:	Nil
Comments on Solution Preparation:	The highest sulfate concentration of 11g/L was prepared by adding sodium sulfate to sample 5259 'MRM Diluent'. This concentration was serially diluted with sample 5259 'MRM Diluent' to achieve the test concentrations. A USEPA control and a diluent control (MRM Diluent) were tested concurrently with the sodium sulfate solutions. All concentrations are reported as measured sulfate in g/L.
Source of Test Organisms:	ESA Laboratory culture, originally sourced from CSIRO Microalgal Supply Service, TAS
Test Initiated:	20 March 2012 at 1400h

Sample: *Sulfate* **Concentration (g/L)**	**Cell Yield x10^4 cells/mL (Mean ± SD)**	*Vacant*	*Vacant*
USEPA Control	247.5 ± 23.1		
Diluent Control	176.9 ± 26.8		
0.7	193.4 ± 26.9		
1.4	182.1 ± 13.8		
2.8	116.6 ± 10.9 *		
5.6	21.9 ± 3.7 *		
11	7.5 ± 7.0 *		
72-hr IC10 = 1.7 (1.0-1.9)g/L			
72-hr IC50 = 3.5 (3.0-3.9)g/L			
NOEC = 1.4g/L			
LOEC = 2.8g/L			

*Significantly lower cell yield compared with the Diluent Control (Dunnett'sTest, 1-tailed, P=0.05)

Toxicity Test Report: TR0840/3

QA/QC Parameter	Criterion	This Test	Criterion met?
Control mean cell density	≥16.0x10^4 cells/mL	248.5x10^4 cells/mL	Yes
Control coefficient of variation	<20%	9.3%	Yes
Reference Toxicant within cusum chart limits	Not available*	0.7g KCl/L	n/a

*Reference toxicant cusum chart limits are not available for *C. vulgaris* due to limited testing with this species

Test Report Authorised by: Dr Rick Krassoi, Director on 4 April 2012

Results are based on the samples in the condition as received by ESA. This document shall not be reproduced except in full.

Citations:

ESA (2011) *ESA SOP 103 – Green Alga, Selenastrum capricornutum, Growth Test*. Issue No 9. Ecotox Services Australasia, Sydney, NSW.

USEPA (2002) *Short-term methods for estimating the chronic toxicity of effluents and receiving waters to freshwater organisms*. Fourth Edition. EPA-821-R-02-013. United States Environmental Protection Agency, Office of Research and Development, Washington DC, USA,

Toxicity Test Report: TR0840/4

This document is issued in accordance with NATA's accreditation requirements

Client:	Hydrobiology Pty Ltd Unit 27/43 Lange Pde Auchenflower QLD 4066	**ESA Job #:** **Date Sampled:** **Date Received:**	PR0840 9 February 2012 14 February 2012
Attention:	Reinier Mann	**Sampled By:**	Client
Client Ref:	Not supplied	**ESA Quote #:**	PL0840_q01

Lab ID No.:	**Sample Name:**	**Sample Description:**
5259	MRM Diluent	Aqueous sample, pH 8.2, conductivity 504µS/cm, total ammonia <2.0mg/L*. Sample received at room temperature in apparent good condition

*Ammonia analysis is not covered by Ecotox Services Australasia's scope of accreditation

Test Performed:	96-hr Growth inhibition of the freshwater aquatic duckweed *Lemna aequinoctialis*
Test Protocol:	ESA SOP 112 (ESA 2011), based on OECD method 221 (2006)
Test Temperature:	The test was performed at 29±2°C.
Deviations from Protocol:	Nil
Comments on Solution Preparation:	The highest sulfate concentration of 11g/L was prepared by adding sodium sulfate to sample 5259 'MRM Diluent'. This concentration was serially diluted with sample 5259 'MRM Diluent' to achieve the test concentrations. A CAAC control and a diluent control (MRM Diluent) were tested concurrently with the sodium sulfate solutions. All concentrations are reported as measured sulfate in g/L.
Source of Test Organisms:	ESA Laboratory culture
Test Initiated:	16 March 2012 at 1300h

Sample: *Sulfate* **Concentration (g/L)**	**Specific Growth Rate (Mean ± SD)**	*Vacant*	*Vacant*
CAAC Control	0.24 ± 0.03		
Diluent Control	0.30 ± 0.01		
0.7	0.30 ± 0.00		
1.4	0.29 ± 0.03		
2.8	0.26 ± 0.01 *		
5.1	0.0 ± 0.08		
11	0.0 ± 0.0		
96-hr IC10 = 2.3g/L**			
96-hr IC50 = 3.8 (3.7-3.9)g/L			
NOEC = 1.4g/L			
LOEC = 2.8g/L			

*Significantly lower specific growth rate compared with the CAAC Control (Steel's Many-One Rank Test, 1-tailed, P=0.05)
**95% confidence limits are not reliable

Toxicity Test Report: TR0840/4

QA/QC Parameter	Criterion	This Test	Criterion met?
Control frond doubling time	<3.0 days	2.9days	Yes
Reference Toxicant within cusum chart limits	7.5-62.7mg $MgSO_4$/L	23.9mg $MgSO_4$/L	Yes

Test Report Authorised by: Dr Rick Krassoi, Director on 4 April 2012

Results are based on the samples in the condition as received by ESA.

NATA Accredited Laboratory Number: 14709

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Citations:

ESA (2011) *SOP 112 – Duckweed Growth Inhibition Test.* Issue No. 3. Ecotox Services Australasia, Sydney NSW

OECD (2006) *Lemna sp*. Growth Inhibition Test. Method 221. OECD Guideline for the Testing of Chemicals. Organisation for Economic Cooperation and Development, Paris

Toxicity Test Report: TR0840/5

Client:	Hydrobiology Pty Ltd Unit 27/43 Lange Pde Auchenflower QLD 4066	**ESA Job #:** **Date Sampled:** **Date Received:**	PR0840 9 February 2012 14 February 2012
Attention:	Reinier Mann	**Sampled By:**	Client
Client Ref:	Not supplied	**ESA Quote #:**	PL0840_q01

Lab ID No.:	**Sample Name:**	**Sample Description:**
5259	MRM Diluent	Aqueous sample, pH 8.2, conductivity 504µS/cm, total ammonia <2.0mg/L. Sample received at room temperature in apparent good condition

Test Performed:	96-hr acute survival test using the freshwater shrimp *Macrobrachium bullatum*
Test Protocol:	ESA SOP 123 (ESA 2011), based on methods described by the USEPA (1996) and the Department of Transport and Communications (1990)
Test Temperature:	The test was performed at 25±1°C, except on one occasion where the temperature was recorded at 27°C.
Deviations from Protocol:	Nil
Comments on Solution Preparation:	The highest sulfate concentration of 44g/L was prepared by adding sodium sulfate to sample 5259 'MRM Diluent'. This concentration was serially diluted with sample 5259 'MRM Diluent' to achieve the test concentrations. A DMW control and a diluent control (MRM Diluent) were tested concurrently with the sodium sulfate solutions. All concentrations are reported as measured sulfate in g/L.
Source of Test Organisms:	Hatchery reared, NT
Test Initiated:	8 March 2012 at 1130h

Sample: *Sulfate* **Concentration (%)**	**% Un-affected (Mean ± SD)**	*Vacant*	*Vacant*
DMW Control	100 ± 0.0		
Diluent Control	100 ± 0.0		
2.9	90.0 ± 11.6		
5.6	80.0 ± 28.3		
11	15.0 ± 19.2 *		
21	10.0 ± 20.0 *		
44	0.0 ± 0.0		
96-hr EC10 = 3.3g/L**			
96-hr EC50 = 7.6 (6.0-9.5)g/L			
NOEC = 5.6g/L			
LOEC = 11g/L			

*Significantly lower percentage of un-affected shrimp compared with the Diluent Control (Steel's Many-One Rank Test, 1-tailed, P=0.05)

**95% confidence limits are not reliable

Toxicity Test Report: TR0840/5

QA/QC Parameter	Criterion	This Test	Criterion met?
Control mean % un-affected	≥80.0%	100%	Yes
Reference Toxicant within cusum chart limits	Not applicable*	116.4µg Cu/L	n/a

*Reference toxicant cusum chart limits are not available for *M. bullatum* due to limited testing with this species

Test Report Authorised by: Dr Rick Krassoi, Director on 4 April 2012

Results are based on the samples in the condition as received by ESA. This document shall not be reproduced except in full.

Citations:

ESA (2011) SOP 123 –*Acute Toxicity Test Using Freshwater Shrimp.* Issue No 1. Ecotox Services Australasia, Sydney, NSW

Department of Transport and Communications (1990) Guidelines for Acceptance of Oil Spill Dispersants in Australian Waters. Pollution Prevention Section, Department of Transport and Communications, Canberra ACT.

USEPA (1996) Ecological Effects Test Guidelines, OPPTS 850.1045, Penaeid Acute Toxicity Test. Public Draft. United States Environmental Protection Agency, Washington DC.

Toxicity Test Report: TR0840/6

Client:	Hydrobiology Pty Ltd Unit 27/43 Lange Pde Auchenflower QLD 4066	**ESA Job #:** **Date Sampled:** **Date Received:**	PR0840 9 February 2012 14 February 2012
Attention:	Reinier Mann	**Sampled By:**	Client
Client Ref:	Not supplied	**ESA Quote #:**	PL0840_q01

Lab ID No.:	**Sample Name:**	**Sample Description:**
5259	MRM Diluent	Aqueous sample, pH 8.2, conductivity 504µS/cm, total ammonia <2.0mg/L. Sample received at room temperature in apparent good condition

Test Performed:	96-hr acute toxicity test using the freshwater hydra *hydra viridissima*
Test Protocol:	Based on Riethmuller et al. (2003)
Test Temperature:	The test was performed at 27±1°C.
Deviations from Protocol:	Nil
Comments on Solution Preparation:	The highest sulfate concentration of 11g/L was prepared by adding sodium sulfate to sample 5259 'MRM Diluent'. This concentration was serially diluted with sample 5259 'MRM Diluent' to achieve the test concentrations. A laboratory water control (2.5% Perrier mineral water) and a diluent control (MRM Diluent) were tested concurrently with the sodium sulfate solutions. All concentrations are reported as measured sulfate in g/L.
Source of Test Organisms:	ESA Laboratory culture
Test Initiated:	13 March 2012 at 1500h

Sample: *Sulphate* **Concentration (g/L)**	**Population Growth Rate (Mean ± SD)**			*Vacant*
Laboratory Water Control	0.38	± 0.02		
Diluent Control	0.26	± 0.04		
0.3	0.22	± 0.04		
0.7	0.24	± 0.01		
1.3	0.19	± 0.05	*	
2.6	0.00	± 0.0		
5.2	0.00	± 0.0		
11	0.00	± 0.0		

96-hr IC10 = <0.3g/L
96-hr IC50 = 1.7 (1.2-2.0)g/L
NOEC = 0.7g/L
LOEC = 1.3g/L

*Significantly lower population growth rate compared with the Diluent Control (Dunnett's Test, 1-tailed, P=0.05)

Toxicity Test Report: TR0840/6

QA/QC Parameter	Criterion	This Test	Criterion met?
Control mean population growth rate	≥0.25	0.38	Yes
Reference Toxicant within cusum chart limits	Not available*	5.5µg Cu/L	n/a

*Reference toxicant cusum chart limits are not available for *H. viridissima* due to limited testing with this species

Test Report Authorised by: Dr Rick Krassoi, Director on 4 April 2012

Citations:

Riethmuller N, Camilleri C, Franklin N, Hogan A, King A, Koch A, Markich SJ, Turley C and van Dam R (2003). Green Hydra Population Growth Test. In: *Ecotoxicological testing protocols for Australian tropical freshwater ecosystems*. Supervising Scientist Report 173, Supervising Scientist, Darwin NT.

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SERVICES AUSTRALASIA

Chain-of-Custody Documentation

Datasheet ID: 601.2
Last Revised: 30 April 2009

Sample Receipt Notification

Attention : Dean Thornburn

Client : Hydrobiology/ Indo-Pacific Environmental Pty Ltd
1/194 Scarborough Bch Rd
Mt Hawthorn WA 6016

Email : dthorburn@indopacific.net.au
Telephone : (08) 9444 1422
Facsimile : (08) 9444 1466

Date : 16/02/2012

Re : Recept of Diluent **Pages : 2**

ESA Project : PR0840 ☑ For Review ☐ Additional Documentation Required - Please Respond

Sample Delivery Details

Completed Chain of Custody accompanied samples: **YES**
Samples received in apparent good condition and correctly bottled: **YES**
Security seals on sample bottles and esky intact: **YES**

Date samples received : 14/02/2012
Time samples received : 9:30
No. of samples received : 1
Sample matrix : aqueous
Sample temperature : room temperature

Comments : Includes 5 x 20L MRM Diluent (ESA ID# 5259)

Contact Details

Customer Services Officer : Tina Micevska
Telephone : 61 2 9420 9481
Facsimile : 61 2 9420 9484
Email : tmicevska@ecotox.com.au

Please contact customer services officer for all queries or issues regarding samples

Note that the chain-of-custody provides definitive information on the tests to be performed

Ecotox Services Australia
ABN 45 094 714 904
Unit 27, 2 Chaplin Drive
Lane Cove NSW 2066 Australia

Phone : 61 2 9420 9481
Fax : 61 2 9420 9484
Email : info@ecotox.com.au

Datasheet ID: 601.1
Last Revised: 23 March 2010

Chain-of-Custody / Service Request Form

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SERVICES AUSTRALASIA

Customer: McARTHUR RIVER MINING
Contact Name: DR DEAN THORBURN
Phone: 0439694262 Email: ..... (please provide an email address for sample receipt notification)
Sampled by: MATTHEW BIRD

Ship To: .....
Attention: .....

Sample Date (day/month /year)	Sample Time	Sample Name (exactly as written on the sample vessel)	Sample Method (eg. Grab, composite etc.)	Number and Volume of Containers (eg 2 x 1L)	Tests Requested (See reverse for guidance)	Comments / Instructions
						Note that testing will be delayed if an incomplete chain of custody is received • Additional treatment of samples (i.e. spiking) • Sub-contracted services (i.e. chemical analyses) • Dilutions required (if different than 100% down to 6.25%) • Sample holding time restriction (if applicable) • Sample used for litigation (if applicable) *Note: An MSDS must be attached if Available* **ESA Project Number: PR 0840**
9/2/12	09:00 AM	MRM DILUENT	GRAB	5 X 20L		

$295 room temp

1) Released By:	Date:	2) Received By:	Date:	3) Released By:	Date:	4) Received By:	Date:
Of:	Time:	Tina Of: ESA	14/2/12 Time: 9:30	Of:	Time:	Of:	Time:

Note that the chain-of-custody documentation will provide definitive information on the tests to be performed.

Ecotox Services Australasia . Unit 27, 2 Chaplin Drive, Lane Cove NSW 2066 AUSTRALIA
Phone: 61 2 9420-9481 Fax 61 2 9420-9484 info@ecotox.com.au

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SERVICES AUSTRALASIA

Report of Chemical Analyses

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
enquiries@envirolabservices.com.au
www.envirolabservices.com.au

CERTIFICATE OF ANALYSIS 70877

Client:
Ecotox Services Australasia Pty Ltd
Unit 27, 2 Chaplin Dr
Lane Cove
NSW 2066

Attention: Tina Micevska

Sample log in details:

Your Reference:	**PR0840**		
No. of samples:	43 Waters		
Date samples received / completed instructions received	26/03/2012	/	26/03/2012

Analysis Details:
Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by: / Issue Date:	2/04/12	/	2/04/12
Date of Preliminary Report:	Not Issued		

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Accredited for compliance with ISO/IEC 17025. **Tests not covered by NATA are denoted with *.**

Results Approved By:

Giovanni Agosti
Technical Manager

Miscellaneous Inorganics						
Our Reference:	UNITS	70877-1	70877-2	70877-3	70877-4	70877-5
Your Reference	----------	Acute Cerio-DMW Control	Acute Cerio-Dilute Control	Acute Cerio-0.3g/L	Acute Cerio-0.6g/L	Acute Cerio-1.3g/L
Type of sample	----------	Water	Water	Water	Water	Water
Date prepared	-	02/04/2012	02/04/2012	02/04/2012	02/04/2012	02/04/2012
Date analysed	-	02/04/2012	02/04/2012	02/04/2012	02/04/2012	02/04/2012
Sulphate, SO4	mg/L	8	4	320	640	1,300

Miscellaneous Inorganics						
Our Reference:	UNITS	70877-6	70877-7	70877-8	70877-9	70877-10
Your Reference	----------	Acute Cerio-2.5g/L	Acute Cerio-5g/L	Acute Cerio-10g/L	Chronic Cerio-DMW Control	Chronic Cerio-Diluent Control
Type of sample	----------	Water	Water	Water	Water	Water
Date prepared	-	02/04/2012	02/04/2012	02/04/2012	02/04/2012	02/04/2012
Date analysed	-	02/04/2012	02/04/2012	02/04/2012	02/04/2012	02/04/2012
Sulphate, SO4	mg/L	2,600	5,300	11,000	7	4

Miscellaneous Inorganics						
Our Reference:	UNITS	70877-11	70877-12	70877-13	70877-14	70877-15
Your Reference	----------	Chronic Cerio-0.3g/L	Chronic Cerio-0.6g/L	Chronic Cerio-1.3g/L	Chronic Cerio-2.5g/L	Chronic Cerio-5g/L
Type of sample	----------	Water	Water	Water	Water	Water
Date prepared	-	02/04/2012	02/04/2012	02/04/2012	02/04/2012	02/04/2012
Date analysed	-	02/04/2012	02/04/2012	02/04/2012	02/04/2012	02/04/2012
Sulphate, SO4	mg/L	380	680	1,300	2,500	5,200

Miscellaneous Inorganics						
Our Reference:	UNITS	70877-16	70877-17	70877-18	70877-19	70877-20
Your Reference	----------	Lemna-CAAC Control	Lemna-Diluent Control	Lemna-0.6g/L	Lemna-1.3g/L	Lemna-2.5g/L
Type of sample	----------	Water	Water	Water	Water	Water
Date prepared	-	02/04/2012	02/04/2012	02/04/2012	02/04/2012	02/04/2012
Date analysed	-	02/04/2012	02/04/2012	02/04/2012	02/04/2012	02/04/2012
Sulphate, SO4	mg/L	2	6	680	1,400	2,800

Miscellaneous Inorganics						
Our Reference:	UNITS	70877-21	70877-22	70877-23	70877-24	70877-25
Your Reference	----------	Lemna-5g/L	Lemna-10g/L	Macrobrachium-DMW Control	Macrobrachium-Diluent Control	Macrobrachium-2.5g/|L
Type of sample	----------	Water	Water	Water	Water	Water
Date prepared	-	02/04/2012	02/04/2012	02/04/2012	02/04/2012	02/04/2012
Date analysed	-	02/04/2012	02/04/2012	02/04/2012	02/04/2012	02/04/2012
Sulphate, SO4	mg/L	5,100	11,000	8	4	2,900

Miscellaneous Inorganics Our Reference: Your Reference Type of sample	UNITS ---------- ----------	70877-26 Macrobrachium-5g/L Water	70877-27 Macrobrachium-10g/L Water	70877-28 Macrobrachium-20g/L Water	70877-29 Macrobrachium-40g/L Water	70877-30 Hydra-Diluent Control Water
Date prepared	-	02/04/2012	02/04/2012	02/04/2012	02/04/2012	02/04/2012
Date analysed	-	02/04/2012	02/04/2012	02/04/2012	02/04/2012	02/04/2012
Sulphate, SO4	mg/L	5,600	11,000	21,000	44,000	4

Miscellaneous Inorganics Our Reference: Your Reference Type of sample	UNITS ---------- ----------	70877-31 Hydra-0.3g/L Water	70877-32 Hydra-0.6g/L Water	70877-33 Hydra-1.3g/L Water	70877-34 Hydra-2.5g/L Water	70877-35 Hydra-5g/L Water
Date prepared	-	02/04/2012	02/04/2012	02/04/2012	02/04/2012	02/04/2012
Date analysed	-	02/04/2012	02/04/2012	02/04/2012	02/04/2012	02/04/2012
Sulphate, SO4	mg/L	330	660	1,300	2,600	5,200

Miscellaneous Inorganics Our Reference: Your Reference Type of sample	UNITS ---------- ----------	70877-36 Hydra-10g/L Water	70877-37 Chlorella-USEPA Control Water	70877-38 Chlorella-Diluent Control Water	70877-39 Chlorella-0.6g/L Water	70877-40 Chlorella-1.3g/L Water
Date prepared	-	02/04/2012	02/04/2012	02/04/2012	02/04/2012	02/04/2012
Date analysed	-	02/04/2012	02/04/2012	02/04/2012	02/04/2012	02/04/2012
Sulphate, SO4	mg/L	11,000	6	10	700	1,400

Miscellaneous Inorganics Our Reference: Your Reference Type of sample	UNITS ---------- ----------	70877-41 Chlorella-2.5g/L Water	70877-42 Chlorella-5g/L Water	70877-43 Chlorella-10g/L Water
Date prepared	-	02/04/2012	02/04/2012	02/04/2012
Date analysed	-	02/04/2012	02/04/2012	02/04/2012
Sulphate, SO4	mg/L	2,800	5,600	11,000

Method ID	Methodology Summary
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA 21st ED, 4110 -B.

Client Reference: PR0840

QUALITY CONTROL Miscellaneous Inorganics	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			02/04/2012	70877-1	02/04/2012 || 02/04/2012	70877-2	02/04/2012
Date analysed	-			02/04/2012	70877-1	02/04/2012 || 02/04/2012	70877-2	02/04/2012
Sulphate, SO4	mg/L	1	Inorg-081	<1	70877-1	8 || 7 || RPD: 13	70877-2	98%

QUALITY CONTROL Miscellaneous Inorganics	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date prepared	-	70877-11	02/04/2012 || 02/04/2012	70877-22	02/04/2012
Date analysed	-	70877-11	02/04/2012 || 02/04/2012	70877-22	02/04/2012
Sulphate, SO4	mg/L	70877-11	380 || 340 || RPD: 11	70877-22	99%

QUALITY CONTROL Miscellaneous Inorganics	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date prepared	-	70877-21	02/04/2012 || 02/04/2012	70877-42	02/04/2012
Date analysed	-	70877-21	02/04/2012 || 02/04/2012	70877-42	02/04/2012
Sulphate, SO4	mg/L	70877-21	5100 || 5600 || RPD: 9	70877-42	100%

QUALITY CONTROL Miscellaneous Inorganics	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
Date prepared	-	70877-31	02/04/2012 || 02/04/2012
Date analysed	-	70877-31	02/04/2012 || 02/04/2012
Sulphate, SO4	mg/L	70877-31	330 || 330 || RPD: 0

QUALITY CONTROL Miscellaneous Inorganics	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
Date prepared	-	70877-41	02/04/2012 || 02/04/2012
Date analysed	-	70877-41	02/04/2012 || 02/04/2012
Sulphate, SO4	mg/L	70877-41	2800 || 2700 || RPD: 4

Report Comments:

Asbestos ID was analysed by Approved Identifier:	Not applicable for this job
Asbestos ID was authorised by Approved Signatory:	Not applicable for this job

INS: Insufficient sample for this test	PQL: Practical Quantitation Limit	NT: Not tested
NA: Test not required	RPD: Relative Percent Difference	NA: Test not required
<: Less than	>: Greater than	LCS: Laboratory Control Sample

Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.

Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.

Matrix Spike : A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

LCS (Laboratory Control Sample) : This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batched of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.
Matrix Spikes and LCS: Generally 70-130% for inorganics/metals; 60-140% for organics and 10-140% for SVOC and speciated phenols is acceptable.

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Statistical Printouts for the Acute Test with *Ceriodaphnia dubia*

Ceriodaphnia Acute Toxicity Test-48 Hr Immobilisation

Start Date:	29/02/2012 13:00	Test ID:	PR0840/02	Sample ID:	Sulphate
End Date:	2/03/2012 13:00	Lab ID:		Sample Type:	CP-Chemical product
Sample Date:		Protocol:	ESA 101	Test Species:	CD-Ceriodaphnia dubia

Comments: Prepared in sample 5259 'MRM Diluent'

Conc-g/L	1	2	3	4
DMW Control	1.0000	1.0000	1.0000	1.0000
Diluent Control	1.0000	1.0000	1.0000	1.0000
0.32	1.0000	1.0000	1.0000	1.0000
0.64	1.0000	1.0000	1.0000	1.0000
1.3	1.0000	1.0000	1.0000	1.0000
2.6	0.4000	0.6000	0.4000	0.6000
5.3	0.0000	0.0000	0.0000	0.0000
11	0.0000	0.0000	0.0000	0.0000

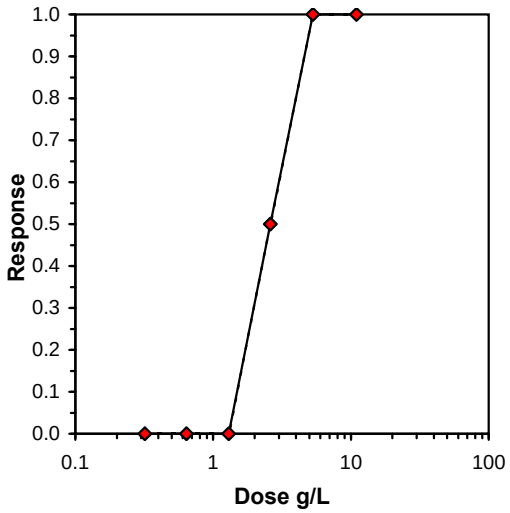
			Transform: Arcsin Square Root					Rank	1-Tailed	Isotonic	
Conc-g/L	Mean	N-Mean	Mean	Min	Max	CV%	N	Sum	Critical	Mean	N-Mean
DMW Control	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4				
Diluent Control	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	*		1.0000	1.0000
0.32	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	18.00	10.00	1.0000	1.0000
0.64	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	18.00	10.00	1.0000	1.0000
1.3	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	18.00	10.00	1.0000	1.0000
*2.6	0.5000	0.5000	0.7854	0.6847	0.8861	14.802	4	10.00	10.00	0.5000	0.5000
5.3	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4			0.0000	0.0000
11	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4			0.0000	0.0000

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.05)	0.63123	0.905	2.7E-15	2.980392
Equality of variance cannot be confirmed				
The control means are not significantly different (p = 1.00)	0	2.446912		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Steel's Many-One Rank Test	1.3	2.6	1.838478	
Treatments vs Diluent Control				

Log-Logit Interpolation (200 Resamples)

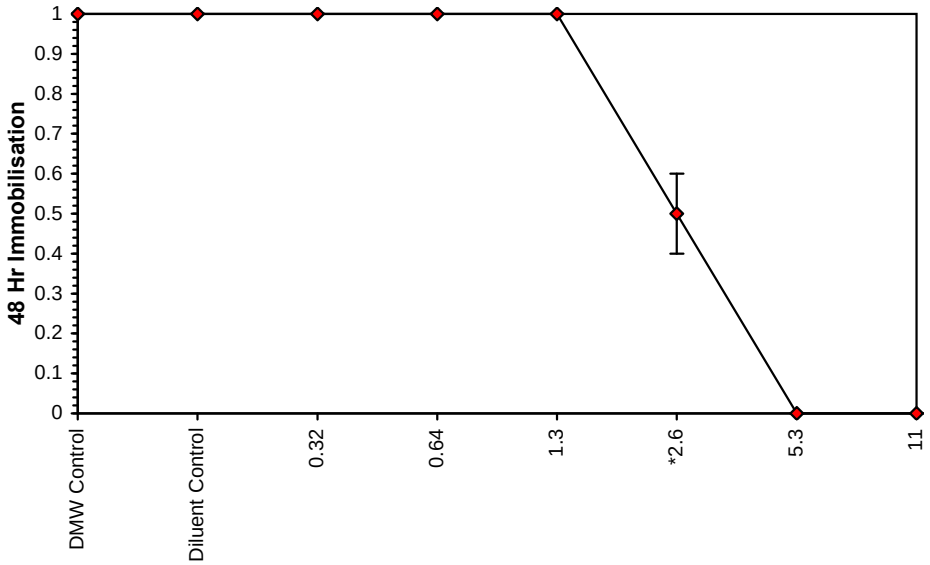
Point	g/L	SD	95% CL(Exp)		Skew
IC05	2.1196	0.0202	2.0559	2.1902	0.1621
IC10	2.2351	0.0234	2.1611	2.3170	0.1643
IC15	2.3087	0.0255	2.2281	2.3981	0.1656
IC20	2.3652	0.0272	2.2795	2.4604	0.1666
IC25	2.4127	0.0286	2.3226	2.5128	0.1675
IC40	2.5297	0.0321	2.4286	2.6422	0.1695
IC50	2.6000	0.0373	2.4922	2.7375	0.3480



Ceriodaphnia Acute Toxicity Test-48 Hr Immobilisation

Start Date:	29/02/2012 13:00	Test ID:	PR0840/02	Sample ID:	Sulphate
End Date:	2/03/2012 13:00	Lab ID:		Sample Type:	CP-Chemical product
Sample Date:		Protocol:	ESA 101	Test Species:	CD-Ceriodaphnia dubia
Comments:	Prepared in sample 5259 'MRM Diluent'				

Dose-Response Plot



Ceriodaphnia Acute Toxicity Test-48 Hr Immobilisation

Start Date:	29/02/2012 13:00	Test ID:	PR0840/02	Sample ID:	Sulphate
End Date:	2/03/2012 13:00	Lab ID:		Sample Type:	CP-Chemical product
Sample Date:		Protocol:	ESA 101	Test Species:	CD-Ceriodaphnia dubia
Comments:	Prepared in sample 5259 'MRM Diluent'				

		Auxiliary Data Summary					
Conc-g/L	**Parameter**	**Mean**	**Min**	**Max**	**SD**	**CV%**	**N**
DMW Control	% Survival	100.00	100.00	100.00	0.00	0.00	4
Diluent Control		100.00	100.00	100.00	0.00	0.00	4
0.32		100.00	100.00	100.00	0.00	0.00	4
0.64		100.00	100.00	100.00	0.00	0.00	4
1.3		100.00	100.00	100.00	0.00	0.00	4
2.6		50.00	40.00	60.00	11.55	6.80	4
5.3		0.00	0.00	0.00	0.00		4
11		0.00	0.00	0.00	0.00		4
DMW Control	pH	8.00	8.00	8.00	0.00	0.00	1
Diluent Control		8.20	8.20	8.20	0.00	0.00	1
0.32		8.20	8.20	8.20	0.00	0.00	1
0.64		8.30	8.30	8.30	0.00	0.00	1
1.3		8.30	8.30	8.30	0.00	0.00	1
2.6		8.30	8.30	8.30	0.00	0.00	1
5.3		8.30	8.30	8.30	0.00	0.00	1
11		8.20	8.20	8.20	0.00	0.00	1
DMW Control	DO %	100.30	100.30	100.30	0.00	0.00	1
Diluent Control		109.60	109.60	109.60	0.00	0.00	1
0.32		112.00	112.00	112.00	0.00	0.00	1
0.64		113.50	113.50	113.50	0.00	0.00	1
1.3		114.50	114.50	114.50	0.00	0.00	1
2.6		111.00	111.00	111.00	0.00	0.00	1
5.3		112.30	112.30	112.30	0.00	0.00	1
11		118.20	118.20	118.20	0.00	0.00	1
DMW Control	Cond uS/cm	174.40	174.40	174.40	0.00	0.00	1
Diluent Control		504.00	504.00	504.00	0.00	0.00	1
0.32		1125.00	1125.00	1125.00	0.00	0.00	1
0.64		1752.00	1752.00	1752.00	0.00	0.00	1
1.3		3000.00	3000.00	3000.00	0.00	0.00	1
2.6		5310.00	5310.00	5310.00	0.00	0.00	1
5.3		9530.00	9530.00	9530.00	0.00	0.00	1
11		17080.00	17080.00	17080.00	0.00	0.00	1

Ceriodaphnia Acute Toxicity Test-48 Hr Immobilisation

Start Date:	29/02/2012 13:00	Test ID:	PR0840/02	Sample ID:	Sulphate
End Date:	2/03/2012 13:00	Lab ID:		Sample Type:	CP-Chemical product
Sample Date:		Protocol:	ESA 101	Test Species:	CD-Ceriodaphnia dubia
Comments:	Prepared in sample 5259 'MRM Diluent'				

Conc-g/L	1	2	3	4
DMW Control	1.0000	1.0000	1.0000	1.0000
Diluent Control	1.0000	1.0000	1.0000	1.0000
0.32	1.0000	1.0000	1.0000	1.0000
0.64	1.0000	1.0000	1.0000	1.0000
1.3	1.0000	1.0000	1.0000	1.0000
2.6	0.4000	0.6000	0.4000	0.6000
5.3	0.0000	0.0000	0.0000	0.0000
11	0.0000	0.0000	0.0000	0.0000

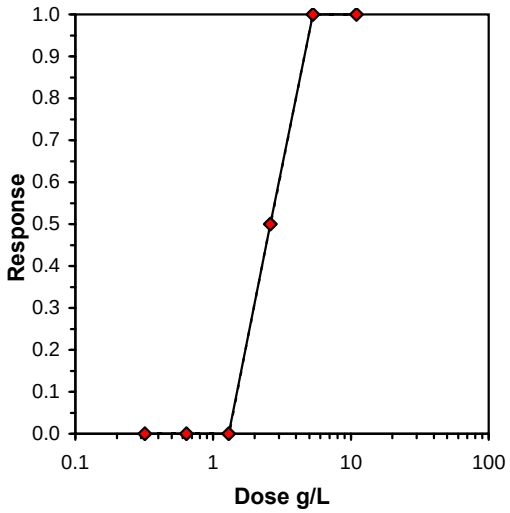
			Transform: Arcsin Square Root					Rank	1-Tailed	Number	Total
Conc-g/L	Mean	N-Mean	Mean	Min	Max	CV%	N	Sum	Critical	Resp	Number
DMW Control	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4				
Diluent Control	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	*		0	20
0.32	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	18.00	10.00	0	20
0.64	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	18.00	10.00	0	20
1.3	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	18.00	10.00	0	20
*2.6	0.5000	0.5000	0.7854	0.6847	0.8861	14.802	4	10.00	10.00	10	20
5.3	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4			20	20
11	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4			20	20

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.05)	0.63123	0.905	2.7E-15	2.980392
Equality of variance cannot be confirmed				
The control means are not significantly different (p = 1.00)	0	2.446912		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Steel's Many-One Rank Test	1.3	2.6	1.838478	
Treatments vs Diluent Control				

Trimmed Spearman-Karber

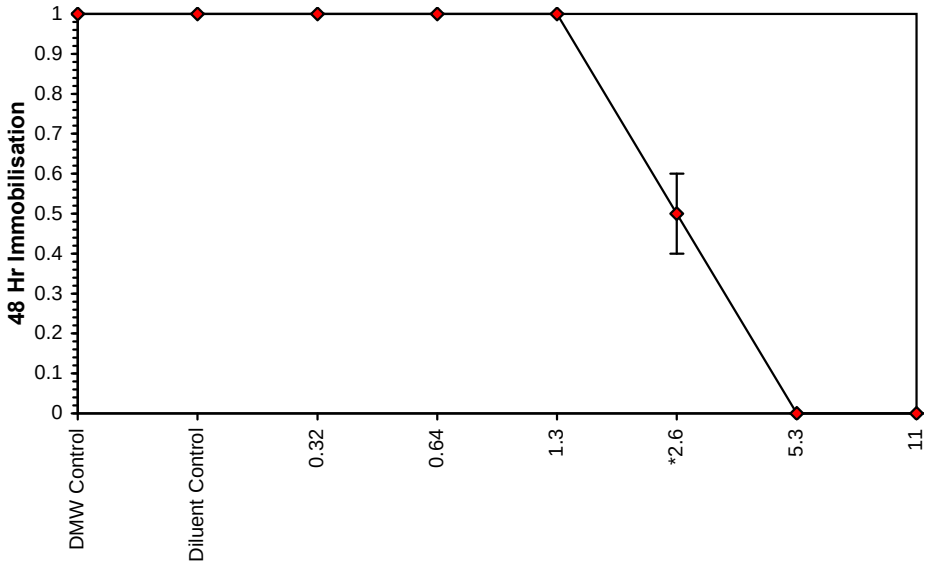
Trim Level	EC50	95% CL	
0.0%	2.6124	2.2326	3.0569
5.0%	2.6112	2.1929	3.1092
10.0%	2.6099	2.1448	3.1760
20.0%	2.6074	2.0079	3.3861
Auto-0.0%	2.6124	2.2326	3.0569



Ceriodaphnia Acute Toxicity Test-48 Hr Immobilisation

Start Date:	29/02/2012 13:00	Test ID:	PR0840/02	Sample ID:	Sulphate
End Date:	2/03/2012 13:00	Lab ID:		Sample Type:	CP-Chemical product
Sample Date:		Protocol:	ESA 101	Test Species:	CD-Ceriodaphnia dubia
Comments:	Prepared in sample 5259 'MRM Diluent'				

Dose-Response Plot



Ceriodaphnia Acute Toxicity Test-48 Hr Immobilisation

Start Date:	29/02/2012 13:00	Test ID:	PR0840/02	Sample ID:	Sulphate
End Date:	2/03/2012 13:00	Lab ID:		Sample Type:	CP-Chemical product
Sample Date:		Protocol:	ESA 101	Test Species:	CD-Ceriodaphnia dubia
Comments:	Prepared in sample 5259 'MRM Diluent'				

		Auxiliary Data Summary					
Conc-g/L	**Parameter**	**Mean**	**Min**	**Max**	**SD**	**CV%**	**N**
DMW Control	% Survival	100.00	100.00	100.00	0.00	0.00	4
Diluent Control		100.00	100.00	100.00	0.00	0.00	4
0.32		100.00	100.00	100.00	0.00	0.00	4
0.64		100.00	100.00	100.00	0.00	0.00	4
1.3		100.00	100.00	100.00	0.00	0.00	4
2.6		50.00	40.00	60.00	11.55	6.80	4
5.3		0.00	0.00	0.00	0.00		4
11		0.00	0.00	0.00	0.00		4
DMW Control	pH	8.00	8.00	8.00	0.00	0.00	1
Diluent Control		8.20	8.20	8.20	0.00	0.00	1
0.32		8.20	8.20	8.20	0.00	0.00	1
0.64		8.30	8.30	8.30	0.00	0.00	1
1.3		8.30	8.30	8.30	0.00	0.00	1
2.6		8.30	8.30	8.30	0.00	0.00	1
5.3		8.30	8.30	8.30	0.00	0.00	1
11		8.20	8.20	8.20	0.00	0.00	1
DMW Control	DO %	100.30	100.30	100.30	0.00	0.00	1
Diluent Control		109.60	109.60	109.60	0.00	0.00	1
0.32		112.00	112.00	112.00	0.00	0.00	1
0.64		113.50	113.50	113.50	0.00	0.00	1
1.3		114.50	114.50	114.50	0.00	0.00	1
2.6		111.00	111.00	111.00	0.00	0.00	1
5.3		112.30	112.30	112.30	0.00	0.00	1
11		118.20	118.20	118.20	0.00	0.00	1
DMW Control	Cond uS/cm	174.40	174.40	174.40	0.00	0.00	1
Diluent Control		504.00	504.00	504.00	0.00	0.00	1
0.32		1125.00	1125.00	1125.00	0.00	0.00	1
0.64		1752.00	1752.00	1752.00	0.00	0.00	1
1.3		3000.00	3000.00	3000.00	0.00	0.00	1
2.6		5310.00	5310.00	5310.00	0.00	0.00	1
5.3		9530.00	9530.00	9530.00	0.00	0.00	1
11		17080.00	17080.00	17080.00	0.00	0.00	1

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Statistical Printouts for the 7-d Chronic Test with *Ceriodaphnia dubia*

Ceriodaphnia Partial Life-Cycle Test-7 Day Survival

Start Date:	8/03/2012 14:00	Test ID:	PR0840/03	Sample ID:	Sulphate
End Date:	15/03/2012 14:00	Lab ID:		Sample Type:	CP-Chemical product
Sample Date:		Protocol:	ESA 102	Test Species:	CD-Ceriodaphnia dubia
Comments:	Prepared in sample 5259 'MRM Diluent'				

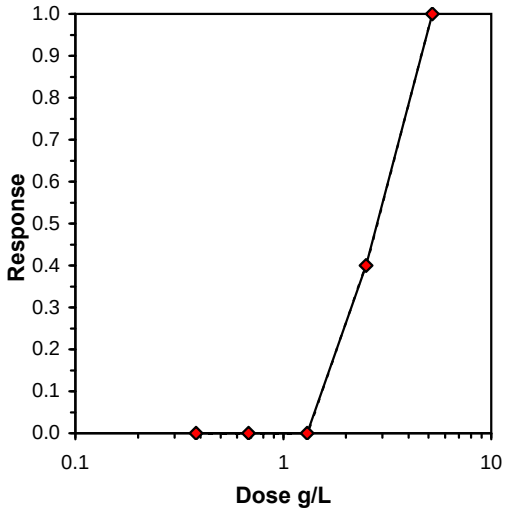
Conc-g/L	1	2	3	4	5	6	7	8	9	10
DMW Control	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Diluent Control	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
0.38	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
0.68	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1.3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2.5	1.0000	1.0000	1.0000	0.0000	0.0000	1.0000	1.0000	0.0000	0.0000	1.0000
5.2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Conc-g/L	Mean	N-Mean	Resp	Not Resp	Total	N	Fisher's Exact P	1-Tailed Critical	Number Resp	Total Number
DMW Control	1.0000	1.0000	0	10	10	10	0.6238			
Diluent Control	1.0000	1.0000	0	10	10	10	*		0	10
0.38	1.0000	1.0000	0	10	10	10	1.0000	0.0500	0	10
0.68	1.0000	1.0000	0	10	10	10	1.0000	0.0500	0	10
1.3	1.0000	1.0000	0	10	10	10	1.0000	0.0500	0	10
*2.5	0.6000	0.6000	4	6	10	10	0.0433	0.0500	4	10
5.2	0.0000	0.0000	10	0	10	10			10	10

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Fisher's Exact Test	1.3	2.5	1.802776	
Treatments vs Diluent Control				

Trimmed Spearman-Karber

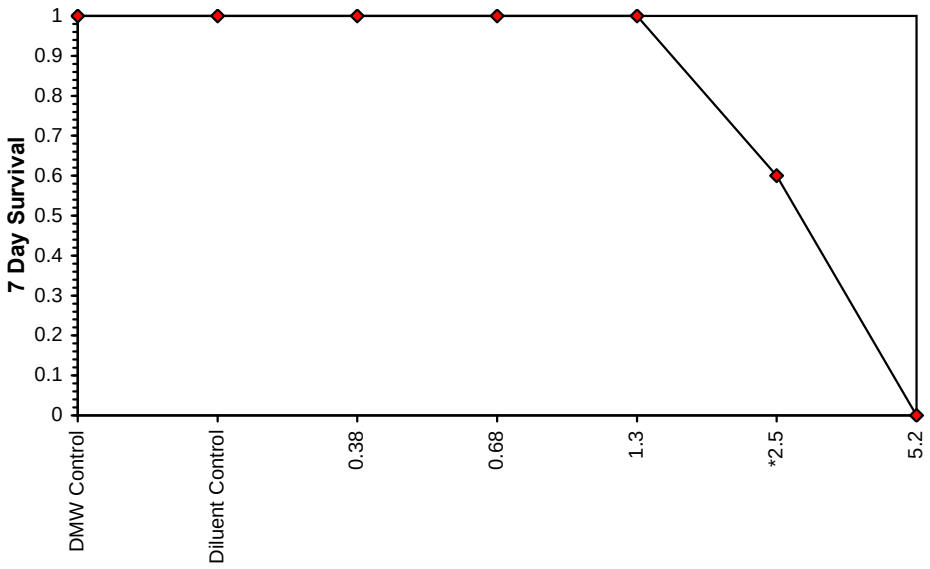
Trim Level	EC50	95% CL	
0.0%	2.7325	2.2044	3.3871
5.0%	2.7460	2.1612	3.4892
10.0%	2.7595	2.1014	3.6237
20.0%	2.7858	1.9068	4.0702
Auto-0.0%	2.7325	2.2044	3.3871



Ceriodaphnia Partial Life-Cycle Test-7 Day Survival

Start Date:	8/03/2012 14:00	Test ID:	PR0840/03	Sample ID:	Sulphate
End Date:	15/03/2012 14:00	Lab ID:		Sample Type:	CP-Chemical product
Sample Date:		Protocol:	ESA 102	Test Species:	CD-Ceriodaphnia dubia
Comments:	Prepared in sample 5259 'MRM Diluent'				

Dose-Response Plot



Ceriodaphnia Partial Life-Cycle Test-7 Day Survival

Start Date:	8/03/2012 14:00	Test ID:	PR0840/03	Sample ID:	Sulphate
End Date:	15/03/2012 14:00	Lab ID:		Sample Type:	CP-Chemical product
Sample Date:		Protocol:	ESA 102	Test Species:	CD-Ceriodaphnia dubia
Comments:	Prepared in sample 5259 'MRM Diluent'				

		Auxiliary Data Summary					
Conc-g/L	**Parameter**	**Mean**	**Min**	**Max**	**SD**	**CV%**	**N**
DMW Control	No of Young	15.40	13.00	20.00	2.07	9.33	10
Diluent Control		16.50	14.00	19.00	1.84	8.22	10
0.38		16.80	14.00	20.00	1.87	8.15	10
0.68		17.10	13.00	20.00	2.51	9.27	10
1.3		15.30	13.00	20.00	2.16	9.61	10
2.5		0.80	0.00	3.00	1.14	133.19	10
5.2		0.00	0.00	0.00	0.00		10
DMW Control	% survival	100.00	100.00	100.00	0.00	0.00	10
Diluent Control		100.00	100.00	100.00	0.00	0.00	10
0.38		100.00	100.00	100.00	0.00	0.00	10
0.68		100.00	100.00	100.00	0.00	0.00	10
1.3		100.00	100.00	100.00	0.00	0.00	10
2.5		60.00	0.00	100.00	51.64	11.98	10
5.2		0.00	0.00	0.00	0.00		10
DMW Control	pH	8.20	8.20	8.20	0.00	0.00	1
Diluent Control		8.40	8.40	8.40	0.00	0.00	1
0.38		8.40	8.40	8.40	0.00	0.00	1
0.68		8.40	8.40	8.40	0.00	0.00	1
1.3		8.40	8.40	8.40	0.00	0.00	1
2.5		8.40	8.40	8.40	0.00	0.00	1
5.2		8.40	8.40	8.40	0.00	0.00	1
DMW Control	DO %	104.50	104.50	104.50	0.00	0.00	1
Diluent Control		103.60	103.60	103.60	0.00	0.00	1
0.38		104.80	104.80	104.80	0.00	0.00	1
0.68		104.20	104.20	104.20	0.00	0.00	1
1.3		103.80	103.80	103.80	0.00	0.00	1
2.5		103.90	103.90	103.90	0.00	0.00	1
5.2		103.10	103.10	103.10	0.00	0.00	1
DMW Control	Cond uS/cm	183.70	183.70	183.70	0.00	0.00	1
Diluent Control		517.00	517.00	517.00	0.00	0.00	1
0.38		1163.00	1163.00	1163.00	0.00	0.00	1
0.68		1821.00	1821.00	1821.00	0.00	0.00	1
1.3		2960.00	2960.00	2960.00	0.00	0.00	1
2.5		5230.00	5230.00	5230.00	0.00	0.00	1
5.2		9440.00	9440.00	9440.00	0.00	0.00	1

Ceriodaphnia Partial Life-Cycle Test-7 Day Survival

Start Date:	8/03/2012 14:00	Test ID:	PR0840/03	Sample ID:	Sulphate
End Date:	15/03/2012 14:00	Lab ID:		Sample Type:	CP-Chemical product
Sample Date:		Protocol:	ESA 102	Test Species:	CD-Ceriodaphnia dubia
Comments:	Prepared in sample 5259 'MRM Diluent'				

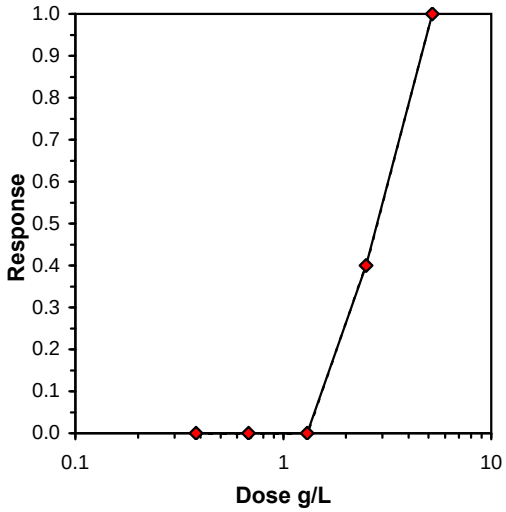
Conc-g/L	1	2	3	4	5	6	7	8	9	10
DMW Control	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Diluent Control	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
0.38	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
0.68	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1.3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2.5	1.0000	1.0000	1.0000	0.0000	0.0000	1.0000	1.0000	0.0000	0.0000	1.0000
5.2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Conc-g/L	Mean	N-Mean	Resp	Not Resp	Total	N	Fisher's Exact P	1-Tailed Critical	Isotonic Mean	Isotonic N-Mean
DMW Control	1.0000	1.0000	0	10	10	10	0.6238			
Diluent Control	1.0000	1.0000	0	10	10	10	*		1.0000	1.0000
0.38	1.0000	1.0000	0	10	10	10	1.0000	0.0500	1.0000	1.0000
0.68	1.0000	1.0000	0	10	10	10	1.0000	0.0500	1.0000	1.0000
1.3	1.0000	1.0000	0	10	10	10	1.0000	0.0500	1.0000	1.0000
*2.5	0.6000	0.6000	4	6	10	10	0.0433	0.0500	0.6000	0.6000
5.2	0.0000	0.0000	10	0	10	10			0.0000	0.0000

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Fisher's Exact Test	1.3	2.5	1.802776	
Treatments vs Diluent Control				

Log-Logit Interpolation (200 Resamples)

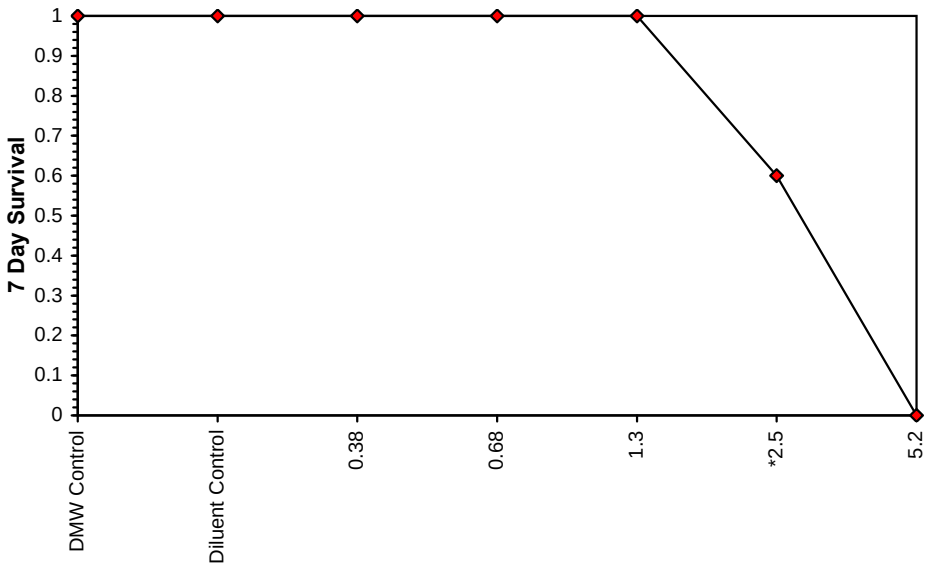
Point	g/L	SD	95% CL		Skew
IC05	2.1009	0.0836	1.9876	2.3469	-0.1747
IC10	2.2134	0.0970	2.0823	2.5000	-0.1434
IC15	2.2851	0.1043	2.1424	2.5821	-0.2289
IC20	2.3401	0.1100	2.1884	2.6452	-0.2833
IC25	2.3862	0.1149	2.2269	2.6981	-0.3212
IC40	2.5000	0.1287	2.3217	2.8289	-0.4218
IC50	2.5854	0.1375	2.3784	2.9075	-0.5575



Ceriodaphnia Partial Life-Cycle Test-7 Day Survival

Start Date:	8/03/2012 14:00	Test ID:	PR0840/03	Sample ID:	Sulphate
End Date:	15/03/2012 14:00	Lab ID:		Sample Type:	CP-Chemical product
Sample Date:		Protocol:	ESA 102	Test Species:	CD-Ceriodaphnia dubia
Comments:	Prepared in sample 5259 'MRM Diluent'				

Dose-Response Plot



Ceriodaphnia Partial Life-Cycle Test-7 Day Survival

Start Date:	8/03/2012 14:00	Test ID:	PR0840/03	Sample ID:	Sulphate
End Date:	15/03/2012 14:00	Lab ID:		Sample Type:	CP-Chemical product
Sample Date:		Protocol:	ESA 102	Test Species:	CD-Ceriodaphnia dubia
Comments:	Prepared in sample 5259 'MRM Diluent'				

		Auxiliary Data Summary					
Conc-g/L	**Parameter**	**Mean**	**Min**	**Max**	**SD**	**CV%**	**N**
DMW Control	No of Young	15.40	13.00	20.00	2.07	9.33	10
Diluent Control		16.50	14.00	19.00	1.84	8.22	10
0.38		16.80	14.00	20.00	1.87	8.15	10
0.68		17.10	13.00	20.00	2.51	9.27	10
1.3		15.30	13.00	20.00	2.16	9.61	10
2.5		0.80	0.00	3.00	1.14	133.19	10
5.2		0.00	0.00	0.00	0.00		10
DMW Control	% survival	100.00	100.00	100.00	0.00	0.00	10
Diluent Control		100.00	100.00	100.00	0.00	0.00	10
0.38		100.00	100.00	100.00	0.00	0.00	10
0.68		100.00	100.00	100.00	0.00	0.00	10
1.3		100.00	100.00	100.00	0.00	0.00	10
2.5		60.00	0.00	100.00	51.64	11.98	10
5.2		0.00	0.00	0.00	0.00		10
DMW Control	pH	8.20	8.20	8.20	0.00	0.00	1
Diluent Control		8.40	8.40	8.40	0.00	0.00	1
0.38		8.40	8.40	8.40	0.00	0.00	1
0.68		8.40	8.40	8.40	0.00	0.00	1
1.3		8.40	8.40	8.40	0.00	0.00	1
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5.2		8.40	8.40	8.40	0.00	0.00	1
DMW Control	DO %	104.50	104.50	104.50	0.00	0.00	1
Diluent Control		103.60	103.60	103.60	0.00	0.00	1
0.38		104.80	104.80	104.80	0.00	0.00	1
0.68		104.20	104.20	104.20	0.00	0.00	1
1.3		103.80	103.80	103.80	0.00	0.00	1
2.5		103.90	103.90	103.90	0.00	0.00	1
5.2		103.10	103.10	103.10	0.00	0.00	1
DMW Control	Cond uS/cm	183.70	183.70	183.70	0.00	0.00	1
Diluent Control		517.00	517.00	517.00	0.00	0.00	1
0.38		1163.00	1163.00	1163.00	0.00	0.00	1
0.68		1821.00	1821.00	1821.00	0.00	0.00	1
1.3		2960.00	2960.00	2960.00	0.00	0.00	1
2.5		5230.00	5230.00	5230.00	0.00	0.00	1
5.2		9440.00	9440.00	9440.00	0.00	0.00	1

Ceriodaphnia Partial Life-Cycle Test-Reproduction

Start Date:	8/03/2012 14:00	Test ID:	PR0840/03	Sample ID:	Sulphate
End Date:	15/03/2012 14:00	Lab ID:		Sample Type:	CP-Chemical product
Sample Date:		Protocol:	ESA 102	Test Species:	CD-Ceriodaphnia dubia
Comments:	Prepared in sample 5259 'MRM Diluent'				

Conc-g/L	1	2	3	4	5	6	7	8	9	10
DMW Control	13.000	17.000	15.000	14.000	15.000	14.000	20.000	14.000	15.000	17.000
Diluent Control	18.000	19.000	14.000	19.000	15.000	16.000	17.000	17.000	16.000	14.000
0.38	16.000	20.000	17.000	19.000	18.000	17.000	17.000	15.000	14.000	15.000
0.68	20.000	19.000	13.000	18.000	20.000	18.000	13.000	17.000	16.000	17.000
1.3	15.000	20.000	15.000	13.000	16.000	16.000	15.000	17.000	13.000	13.000
2.5	2.000	0.000	0.000	0.000	0.000	3.000	1.000	0.000	2.000	0.000
5.2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

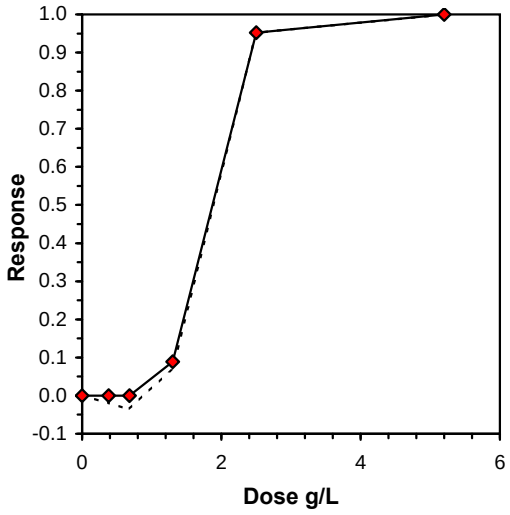
			Transform: Untransformed					1-Tailed			Isotonic	
Conc-g/L	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Mean	N-Mean
DMW Control	15.400	0.9333	15.400	13.000	20.000	13.413	10					
Diluent Control	16.500	1.0000	16.500	14.000	19.000	11.157	10	*			16.800	1.0000
0.38	16.800	1.0182	16.800	14.000	20.000	11.154	10	-0.342	2.223	1.948	16.800	1.0000
0.68	17.100	1.0364	17.100	13.000	20.000	14.704	10	-0.685	2.223	1.948	16.800	1.0000
1.3	15.300	0.9273	15.300	13.000	20.000	14.136	10	1.370	2.223	1.948	15.300	0.9107
*2.5	0.800	0.0485	0.800	0.000	3.000	141.912	10	17.920	2.223	1.948	0.800	0.0476
5.2	0.000	0.0000	0.000	0.000	0.000	0.000	10				0.000	0.0000

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.05)	0.985004	0.947	0.041253	-0.01162
Bartlett's Test indicates equal variances (p = 0.26)	5.23362	13.2767		
The control means are not significantly different (p = 0.22)	1.2572	2.100922		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	1.3	2.5	1.802776		1.947868	0.118053	492.95	3.837778	5.3E-24	4, 45
Treatments vs Diluent Control										

Linear Interpolation (200 Resamples)

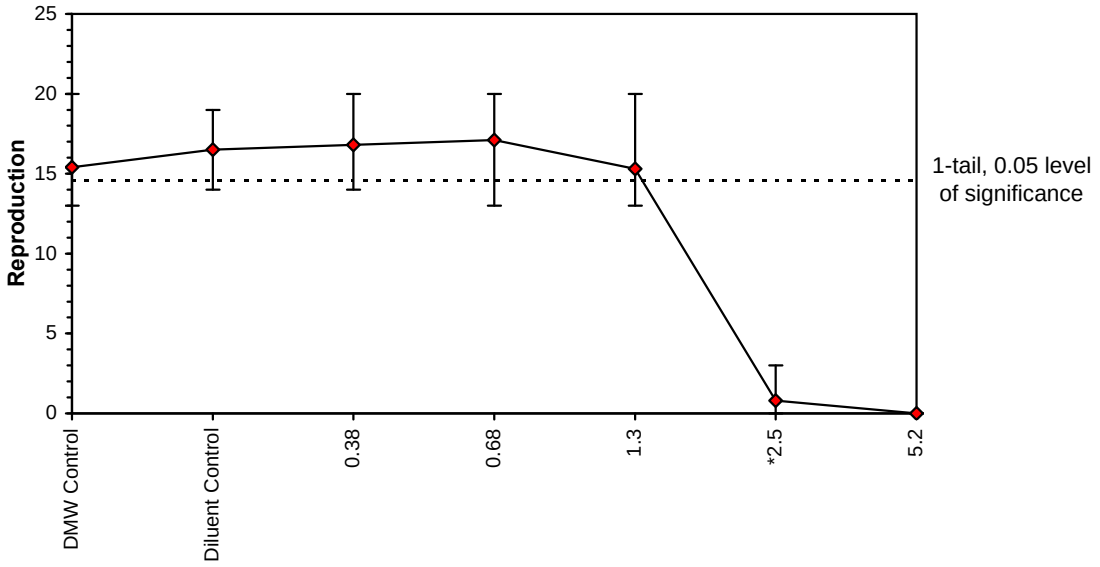
Point	g/L	SD	95% CL		Skew
IC05	1.0272	0.2272	0.3779	1.3436	-0.5242
IC10	1.3149	0.1334	0.9027	1.4082	-1.2179
IC15	1.3844	0.0639	1.2163	1.4728	-1.2459
IC20	1.4539	0.0498	1.3460	1.5375	-0.2806
IC25	1.5234	0.0465	1.4218	1.6038	-0.2376
IC40	1.7320	0.0379	1.6467	1.7959	-0.1840
IC50	1.8710	0.0328	1.7976	1.9252	-0.1024



Ceriodaphnia Partial Life-Cycle Test-Reproduction

Start Date:	8/03/2012 14:00	Test ID:	PR0840/03	Sample ID:	Sulphate
End Date:	15/03/2012 14:00	Lab ID:		Sample Type:	CP-Chemical product
Sample Date:		Protocol:	ESA 102	Test Species:	CD-Ceriodaphnia dubia
Comments:	Prepared in sample 5259 'MRM Diluent'				

Dose-Response Plot



Ceriodaphnia Partial Life-Cycle Test-Reproduction

Start Date:	8/03/2012 14:00	Test ID:	PR0840/03	Sample ID:	Sulphate
End Date:	15/03/2012 14:00	Lab ID:		Sample Type:	CP-Chemical product
Sample Date:		Protocol:	ESA 102	Test Species:	CD-Ceriodaphnia dubia
Comments:	Prepared in sample 5259 'MRM Diluent'				

Auxiliary Data Summary

Conc-g/L	Parameter	Mean	Min	Max	SD	CV%	N
DMW Control	No of Young	15.40	13.00	20.00	2.07	9.33	10
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0.38		16.80	14.00	20.00	1.87	8.15	10
0.68		17.10	13.00	20.00	2.51	9.27	10
1.3		15.30	13.00	20.00	2.16	9.61	10
2.5		0.80	0.00	3.00	1.14	133.19	10
5.2		0.00	0.00	0.00	0.00		10
DMW Control	% survival	100.00	100.00	100.00	0.00	0.00	10
Diluent Control		100.00	100.00	100.00	0.00	0.00	10
0.38		100.00	100.00	100.00	0.00	0.00	10
0.68		100.00	100.00	100.00	0.00	0.00	10
1.3		100.00	100.00	100.00	0.00	0.00	10
2.5		60.00	0.00	100.00	51.64	11.98	10
5.2		0.00	0.00	0.00	0.00		10
DMW Control	pH	8.20	8.20	8.20	0.00	0.00	1
Diluent Control		8.40	8.40	8.40	0.00	0.00	1
0.38		8.40	8.40	8.40	0.00	0.00	1
0.68		8.40	8.40	8.40	0.00	0.00	1
1.3		8.40	8.40	8.40	0.00	0.00	1
2.5		8.40	8.40	8.40	0.00	0.00	1
5.2		8.40	8.40	8.40	0.00	0.00	1
DMW Control	DO %	104.50	104.50	104.50	0.00	0.00	1
Diluent Control		103.60	103.60	103.60	0.00	0.00	1
0.38		104.80	104.80	104.80	0.00	0.00	1
0.68		104.20	104.20	104.20	0.00	0.00	1
1.3		103.80	103.80	103.80	0.00	0.00	1
2.5		103.90	103.90	103.90	0.00	0.00	1
5.2		103.10	103.10	103.10	0.00	0.00	1
DMW Control	Cond uS/cm	183.70	183.70	183.70	0.00	0.00	1
Diluent Control		517.00	517.00	517.00	0.00	0.00	1
0.38		1163.00	1163.00	1163.00	0.00	0.00	1
0.68		1821.00	1821.00	1821.00	0.00	0.00	1
1.3		2960.00	2960.00	2960.00	0.00	0.00	1
2.5		5230.00	5230.00	5230.00	0.00	0.00	1
5.2		9440.00	9440.00	9440.00	0.00	0.00	1

ecotox
SERVICES AUSTRALASIA

Statistical Printouts for the *Chlorella vulgaris* Growth Inhibition Tests

Microalgal Growth inhibition Test-Growth-Cell Yield

Start Date:	20/03/2012 14:00	Test ID:	PR0840/07	Sample ID:	SULPHATE
End Date:	23/03/2012 14:00	Lab ID:		Sample Type:	CP-Chemical product
Sample Date:		Protocol:	ESA 103	Test Species:	CV-Chlorella vulgaris
Comments:	Prepared in sample 5259 'MRM Diluent'				

Conc-g/L	1	2	3	4
USEPA Control	2143930	2497930	2599930	2659930
Diluent Control	1483930	1987930	1597930	2005930
0.7	1729930	1843930	2329930	1831930
1.4	1627930	1885930	1945930	1825930
2.8	1081930	1189930	1081930	1309930
5.6	181930	253930	247930	193930
11	67930	61930	0	169930

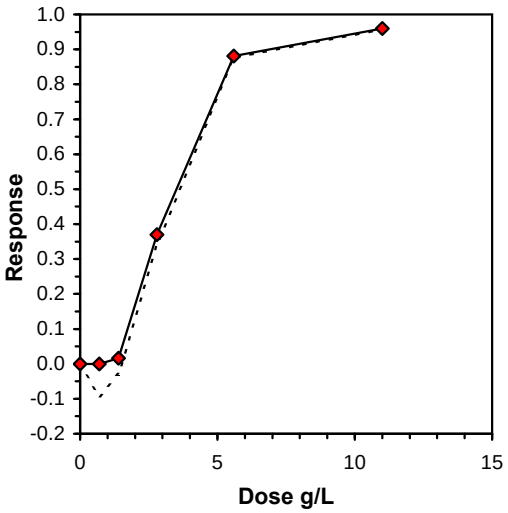
			Transform: Untransformed					1-Tailed			Isotonic	
Conc-g/L	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Mean	N-Mean
USEPA Control	2475430	1.3994	2475430	2143930	2659930	9.328	4					
Diluent Control	1768930	1.0000	1768930	1483930	2005930	15.120	4	*			1851430	1.0000
0.7	1933930	1.0933	1933930	1729930	2329930	13.905	4	-1.343	2.410	295981.1	1851430	1.0000
1.4	1821430	1.0297	1821430	1627930	1945930	7.576	4	-0.427	2.410	295981.1	1821430	0.9838
*2.8	1165930	0.6591	1165930	1081930	1309930	9.320	4	4.910	2.410	295981.1	1165930	0.6297
*5.6	219430	0.1240	219430	181930	253930	16.763	4	12.617	2.410	295981.1	219430	0.1185
*11	74947.5	0.0424	74947.5	0	169930	93.898	4	13.793	2.410	295981.1	74947.5	0.0405

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.05)	0.973254	0.916	0.584229	0.790661
Bartlett's Test indicates equal variances (p = 0.03)	12.14111	15.08627		
The control means are significantly different (p = 7.13E-03)	3.999048	2.446912		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test Treatments vs Diluent Control	1.4	2.8	1.979899		295981.1	0.167322	2.78E+12	3.02E+10	3.6E-12	5, 18

Linear Interpolation (200 Resamples)

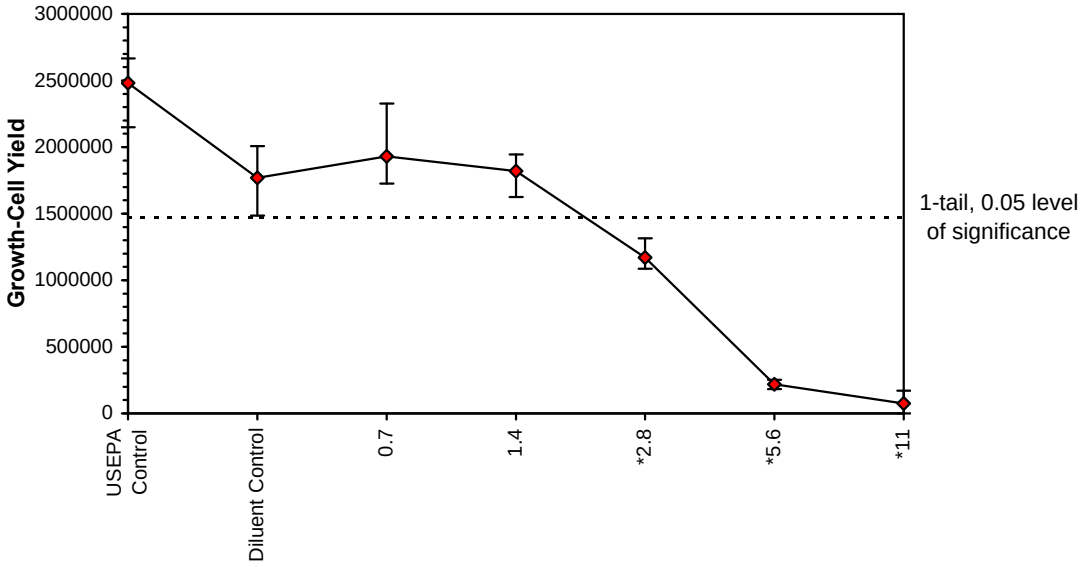
Point	g/L	SD	95% CL(Exp)		Skew
IC05	1.5336	0.2517	0.4394	1.6760	-1.8169
IC10	1.7314	0.1790	1.0038	1.9175	-2.3280
IC15	1.9291	0.1423	1.3248	2.1574	-0.9834
IC20	2.1268	0.1359	1.5780	2.3970	-0.7212
IC25	2.3245	0.1333	1.8151	2.6367	-0.4118
IC40	2.9629	0.1617	2.4822	3.4317	0.0226
IC50	3.5106	0.1436	3.0217	3.8914	-0.2238



Microalgal Growth inhibition Test-Growth-Cell Yield

Start Date:	20/03/2012 14:00	Test ID:	PR0840/07	Sample ID:	SULPHATE
End Date:	23/03/2012 14:00	Lab ID:		Sample Type:	CP-Chemical product
Sample Date:		Protocol:	ESA 103	Test Species:	CV-Chlorella vulgaris
Comments:	Prepared in sample 5259 'MRM Diluent'				

Dose-Response Plot



Microalgal Growth inhibition Test-Growth-Cell Yield

Start Date:	20/03/2012 14:00	Test ID:	PR0840/07	Sample ID:	SULPHATE
End Date:	23/03/2012 14:00	Lab ID:		Sample Type:	CP-Chemical product
Sample Date:		Protocol:	ESA 103	Test Species:	CV-Chlorella vulgaris
Comments:	Prepared in sample 5259 'MRM Diluent'				

Auxiliary Data Summary

Conc-g/L	Parameter	Mean	Min	Max	SD	CV%	N
USEPA Control	Cell Yield	247.54	214.39	265.99	23.09	1.94	4
Diluent Control		176.89	148.39	200.59	26.75	2.92	4
0.7		193.39	172.99	232.99	26.89	2.68	4
1.4		182.14	162.79	194.59	13.80	2.04	4
2.8		116.59	108.19	130.99	10.87	2.83	4
5.6		21.94	18.19	25.39	3.68	8.74	4
11		7.49	0.00	16.99	7.04	35.40	4
USEPA Control	pH	7.50	7.50	7.50	0.00	0.00	1
Diluent Control		8.40	8.40	8.40	0.00	0.00	1
0.7		8.40	8.40	8.40	0.00	0.00	1
1.4		8.40	8.40	8.40	0.00	0.00	1
2.8		8.40	8.40	8.40	0.00	0.00	1
5.6		8.40	8.40	8.40	0.00	0.00	1
11		8.30	8.30	8.30	0.00	0.00	1
USEPA Control	Conductivity uS/cm	100.90	100.90	100.90	0.00	0.00	1
Diluent Control		581.00	581.00	581.00	0.00	0.00	1
0.7		1848.00	1848.00	1848.00	0.00	0.00	1
1.4		3130.00	3130.00	3130.00	0.00	0.00	1
2.8		5450.00	5450.00	5450.00	0.00	0.00	1
5.6		9690.00	9690.00	9690.00	0.00	0.00	1
11		17180.00	17180.00	17180.00	0.00	0.00	1

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Statistical Printouts for the Duckweed Growth Inhibition Tests

Duckweed Growth Inhibtion Test-Specific Growth Rate

Start Date:	16/03/2012 13:00	Test ID:	PR0840/04	Sample ID:	Sulphate
End Date:	20/03/2012 13:00	Lab ID:		Sample Type:	CP-Chemical product
Sample Date:		Protocol:	ESA 112	Test Species:	LA-Lemna aequinoctialis
Comments:	Prepared in sample 5259 'MRM Diluent'				

Conc-g/L	1	2	3	4
CAAC Control	0.2218	0.2496	0.2747	0.2218
Diluent Control	0.3182	0.2974	0.2974	0.2863
0.68	0.2974	0.2974	0.2974	0.2974
1.4	0.2974	0.2496	0.2974	0.3080
2.8	0.2625	0.2747	0.2496	0.2496
5.1	0.0000	0.0000	0.0000	0.0000
11	0.0000	0.0000	0.0000	0.0000

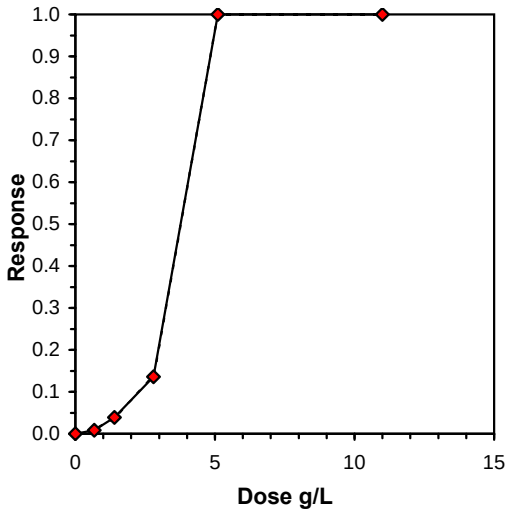
			Transform: Untransformed					Rank	1-Tailed	Isotonic	
Conc-g/L	Mean	N-Mean	Mean	Min	Max	CV%	N	Sum	Critical	Mean	N-Mean
CAAC Control	0.2420	0.8071	0.2420	0.2218	0.2747	10.505	4				
Diluent Control	0.2998	1.0000	0.2998	0.2863	0.3182	4.451	4	*		0.2998	1.0000
0.68	0.2974	0.9919	0.2974	0.2974	0.2974	0.000	4	18.00	10.00	0.2974	0.9919
1.4	0.2881	0.9609	0.2881	0.2496	0.3080	9.073	4	17.00	10.00	0.2881	0.9609
*2.8	0.2591	0.8641	0.2591	0.2496	0.2747	4.634	4	10.00	10.00	0.2591	0.8641
5.1	0.0000	0.0000	0.0000	0.0000	0.0000	0.000	4			0.0000	0.0000
11	0.0000	0.0000	0.0000	0.0000	0.0000	0.000	4			0.0000	0.0000

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.05)	0.905379	0.887	-1.11249	2.668041
Equality of variance cannot be confirmed				
The control means are significantly different (p = 6.88E-03)	4.02958	2.446912		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Steel's Many-One Rank Test	1.4	2.8	1.979899	
Treatments vs Diluent Control				

Linear Interpolation (200 Resamples)

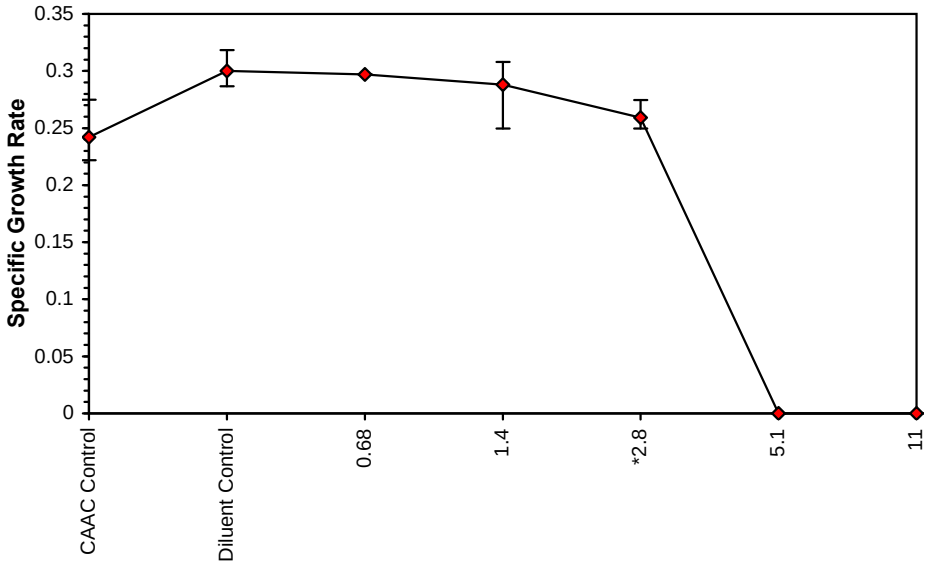
Point	g/L	SD	95% CL(Exp)		Skew
IC05	1.5581	0.3921	0.2781	2.3479	-0.2254
IC10	2.2813	0.4251	0.5957	3.1330	-0.6720
IC15	2.8376	0.1542	2.0594	3.0024	-2.0636
IC20	2.9707	0.0558	2.7801	3.1258	-0.1416
IC25	3.1038	0.0521	2.9251	3.2492	-0.1061
IC40	3.5030	0.0417	3.3601	3.6193	-0.1061
IC50	3.7692	0.0347	3.6501	3.8661	-0.1061



Duckweed Growth Inhibtion Test-Specific Growth Rate

Start Date:	16/03/2012 13:00	Test ID:	PR0840/04	Sample ID:	Sulphate
End Date:	20/03/2012 13:00	Lab ID:		Sample Type:	CP-Chemical product
Sample Date:		Protocol:	ESA 112	Test Species:	LA-Lemna aequinoctialis
Comments:	Prepared in sample 5259 'MRM Diluent'				

Dose-Response Plot



Duckweed Growth Inhibtion Test-Specific Growth Rate

Start Date:	16/03/2012 13:00	Test ID:	PR0840/04	Sample ID:	Sulphate
End Date:	20/03/2012 13:00	Lab ID:		Sample Type:	CP-Chemical product
Sample Date:		Protocol:	ESA 112	Test Species:	LA-Lemna aequinoctialis
Comments:	Prepared in sample 5259 'MRM Diluent'				

Auxiliary Data Summary

Conc-g/L	Parameter	Mean	Min	Max	SD	CV%	N
CAAC Control	Specific Growth Rate	0.24	0.22	0.27	0.03	65.89	4
Diluent Control		0.30	0.29	0.32	0.01	38.53	4
0.68		0.30	0.30	0.30	0.00	0.00	4
1.4		0.29	0.25	0.31	0.03	56.12	4
2.8		0.26	0.25	0.27	0.01	42.29	4
5.1		-0.20	-0.31	-0.14	0.08		4
11		-0.49	-0.49	-0.49	0.00		4
CAAC Control	pH	6.00	6.00	6.00	0.00	0.00	1
Diluent Control		8.20	8.20	8.20	0.00	0.00	1
0.68		8.30	8.30	8.30	0.00	0.00	1
1.4		8.30	8.30	8.30	0.00	0.00	1
2.8		8.30	8.30	8.30	0.00	0.00	1
5.1		8.30	8.30	8.30	0.00	0.00	1
11		8.20	8.20	8.20	0.00	0.00	1
CAAC Control	Cond uS/cm	35.90	35.90	35.90	0.00	0.00	1
Diluent Control		524.00	524.00	524.00	0.00	0.00	1
0.68		1843.00	1843.00	1843.00	0.00	0.00	1
1.4		3110.00	3110.00	3110.00	0.00	0.00	1
2.8		5410.00	5410.00	5410.00	0.00	0.00	1
5.1		9660.00	9660.00	9660.00	0.00	0.00	1
11		17220.00	17220.00	17220.00	0.00	0.00	1

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Statistical Printouts for the Freshwater Shrimp Tests

Freshwater Shrimp Acute Toxicity Test-96 hr Survival

Start Date:	8/03/2012 11:30	Test ID:	PR0840/07	Sample ID:	Sulphate
End Date:	12/03/2012 11:30	Lab ID:		Sample Type:	CP-Chemical product
Sample Date:		Protocol:	ESA 123	Test Species:	MB-Macrobrachium bullatum
Comments:	Prepared in sample 5259 'MRM Diluent'				

Conc-g/L	1	2	3	4
DMW Control	1.0000	1.0000	1.0000	1.0000
Diluent Control	1.0000	1.0000	1.0000	1.0000
2.9	1.0000	1.0000	0.8000	0.8000
5.6	0.4000	1.0000	1.0000	0.8000
11	0.2000	0.0000	0.0000	0.4000
21	0.0000	0.0000	0.0000	0.4000
44	0.0000	0.0000	0.0000	0.0000

			Transform: Arcsin Square Root					Rank	1-Tailed	Number	Total
Conc-g/L	Mean	N-Mean	Mean	Min	Max	CV%	N	Sum	Critical	Resp	Number
DMW Control	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4				
Diluent Control	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	*		0	20
2.9	0.9000	0.9000	1.2262	1.1071	1.3453	11.212	4	14.00	10.00	2	20
5.6	0.8000	0.8000	1.1206	0.6847	1.3453	27.799	4	14.00	10.00	4	20
*11	0.1500	0.1500	0.3998	0.2255	0.6847	55.174	4	10.00	10.00	17	20
*21	0.1000	0.1000	0.3403	0.2255	0.6847	67.468	4	10.00	10.00	18	20
44	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4			20	20

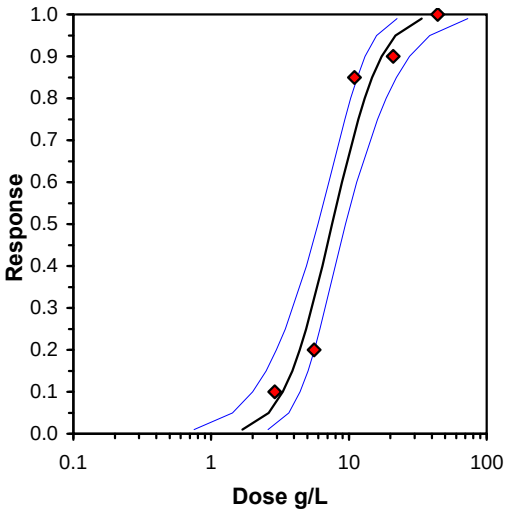
Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.05)	0.954847	0.905	-0.10162	0.45066
Equality of variance cannot be confirmed				
The control means are not significantly different (p = 1.00)	0	2.446912		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Steel's Many-One Rank Test	5.6	11	7.848567	
Treatments vs Diluent Control				

Maximum Likelihood-Probit

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	3.574943	0.606136	2.386917	4.76297	0	4.110593	7.814728	0.25	0.878363	0.279725	3
Intercept	1.859903	0.569913	0.742873	2.976933							
TSCR											

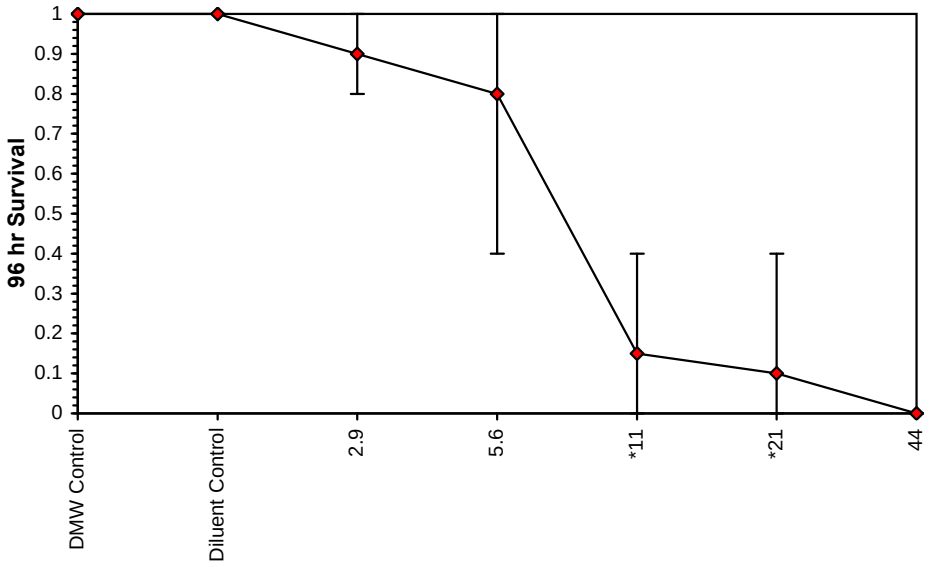
Point	Probits	g/L	95% Fiducial Limits	
EC01	2.674	1.688985	0.750745	2.592282
EC05	3.355	2.619731	1.426279	3.660701
EC10	3.718	3.310406	1.997959	4.422464
EC15	3.964	3.876563	2.499358	5.041714
EC20	4.158	4.394815	2.977242	5.611907
EC25	4.326	4.894309	3.449451	6.169986
EC40	4.747	6.419414	4.91116	7.974589
EC50	5.000	7.557234	5.970477	9.467039
EC60	5.253	8.896728	7.144628	11.41759
EC75	5.674	11.66902	9.327026	16.09419
EC80	5.842	12.99526	10.28159	18.5978
EC85	6.036	14.73258	11.47098	22.1024
EC90	6.282	17.2522	13.10438	27.59173
EC95	6.645	21.80063	15.86251	38.57497
EC99	7.326	33.81427	22.44258	73.14745



Freshwater Shrimp Acute Toxicity Test-96 hr Survival

Start Date:	8/03/2012 11:30	Test ID:	PR0840/07	Sample ID:	Sulphate
End Date:	12/03/2012 11:30	Lab ID:		Sample Type:	CP-Chemical product
Sample Date:		Protocol:	ESA 123	Test Species:	MB-Macrobrachium bullatum
Comments:	Prepared in sample 5259 'MRM Diluent'				

Dose-Response Plot



Freshwater Shrimp Acute Toxicity Test-96 hr Survival

Start Date:	8/03/2012 11:30	Test ID:	PR0840/07	Sample ID:	Sulphate
End Date:	12/03/2012 11:30	Lab ID:		Sample Type:	CP-Chemical product
Sample Date:		Protocol:	ESA 123	Test Species:	MB-Macrobrachium bullatum
Comments:	Prepared in sample 5259 'MRM Diluent'				

Auxiliary Data Summary

Conc-g/L	Parameter	Mean	Min	Max	SD	CV%	N
DMW Control	% Survival	100.00	100.00	100.00	0.00	0.00	4
Diluent Control		100.00	100.00	100.00	0.00	0.00	4
2.9		90.00	80.00	100.00	11.55	3.78	4
5.6		80.00	40.00	100.00	28.28	6.65	4
11		15.00	0.00	40.00	19.15	29.17	4
21		10.00	0.00	40.00	20.00	44.72	4
44		0.00	0.00	0.00	0.00		4
DMW Control	pH	8.10	8.10	8.10	0.00	0.00	1
Diluent Control		8.20	8.20	8.20	0.00	0.00	1
2.9		8.30	8.30	8.30	0.00	0.00	1
5.6		8.30	8.30	8.30	0.00	0.00	1
11		8.20	8.20	8.20	0.00	0.00	1
21		8.20	8.20	8.20	0.00	0.00	1
44		8.10	8.10	8.10	0.00	0.00	1
DMW Control	Cond uS/cm	173.30	173.30	173.30	0.00	0.00	1
Diluent Control		512.00	512.00	512.00	0.00	0.00	1
2.9		5660.00	5660.00	5660.00	0.00	0.00	1
5.6		9990.00	9990.00	9990.00	0.00	0.00	1
11		17180.00	17180.00	17180.00	0.00	0.00	1
21		30500.00	30500.00	30500.00	0.00	0.00	1
44		51600.00	51600.00	51600.00	0.00	0.00	1
DMW Control	DO %	102.00	102.00	102.00	0.00	0.00	1
Diluent Control		102.10	102.10	102.10	0.00	0.00	1
2.9		100.50	100.50	100.50	0.00	0.00	1
5.6		101.20	101.20	101.20	0.00	0.00	1
11		102.00	102.00	102.00	0.00	0.00	1
21		103.10	103.10	103.10	0.00	0.00	1
44		105.70	105.70	105.70	0.00	0.00	1

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Statistical Printouts for the Acute Test with *Hydra viridissima*

Hydra Population Growth Test-Growth Rate

Start Date:	13/03/2012 15:00	Test ID:	PR0840/01	Sample ID:	SULPHATE
End Date:	17/03/2012 15:00	Lab ID:		Sample Type:	CP-Chemical product
Sample Date:		Protocol:		Test Species:	HV-Hydra viridissima
Comments:	Prepared in sample 5259 'MRM Diluent'				

Conc-g/L	1	2	3	4
DMW Control	0.3785	0.3883	0.3577	0.4069
Diluent Control	0.2245	0.2821	0.3164	0.2336
0.33	0.2151	0.2336	0.1733	0.2590
0.66	0.2424	0.2245	0.2590	0.2336
1.3	0.2245	0.2336	0.1231	0.1617
2.6	0.0000	0.0000	0.0000	0.0000
5.2	0.0000	0.0000	0.0000	0.0000
11	0.0000	0.0000	0.0000	0.0000

			Transform: Untransformed					1-Tailed			Isotonic	
Conc-g/L	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Mean	N-Mean
DMW Control	0.3829	1.4494	0.3829	0.3577	0.4069	5.350	4					
Diluent Control	0.2641	1.0000	0.2641	0.2245	0.3164	16.302	4	*			0.2641	1.0000
0.33	0.2202	0.8338	0.2202	0.1733	0.2590	16.400	4	1.585	2.290	0.0634	0.2300	0.8709
0.66	0.2399	0.9080	0.2399	0.2245	0.2590	6.133	4	0.877	2.290	0.0634	0.2300	0.8709
*1.3	0.1857	0.7030	0.1857	0.1231	0.2336	28.308	4	2.832	2.290	0.0634	0.1857	0.7030
2.6	0.0000	0.0000	0.0000	0.0000	0.0000	0.000	4				0.0000	0.0000
5.2	0.0000	0.0000	0.0000	0.0000	0.0000	0.000	4				0.0000	0.0000
11	0.0000	0.0000	0.0000	0.0000	0.0000	0.000	4				0.0000	0.0000

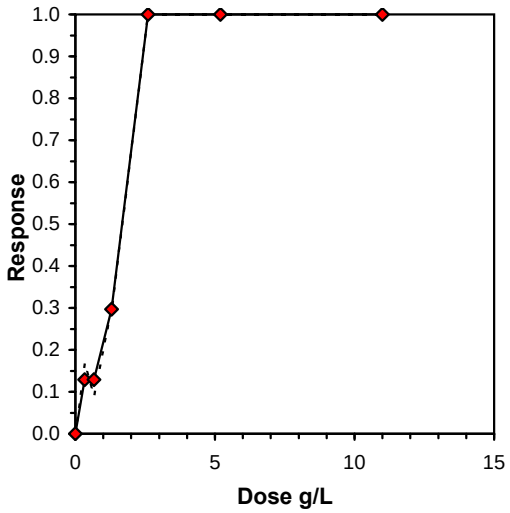
Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.05)	0.966424	0.887	-0.12969	-0.96872
Bartlett's Test indicates equal variances (p = 0.32)	3.54033	11.34487		
The control means are significantly different (p = 2.50E-03)	4.9789	2.446912		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	0.66	1.3	0.926283		0.063435	0.24015	0.004393	0.001535	0.081139	3, 12
Treatments vs Diluent Control										

Linear Interpolation (200 Resamples)

Point	g/L	SD	95% CL(Exp)		Skew
IC05*	0.1278	0.2383	0.0311	1.2341	1.7354
IC10*	0.2556	0.3187	0.0623	1.6722	0.9980
IC15	0.7397	0.3645	0.0000	1.7203	0.2589
IC20	0.9303	0.3219	0.0000	1.7233	-0.4348
IC25	1.1210	0.2492	0.4388	1.7263	-0.5249
IC40	1.4905	0.1493	0.9239	1.8568	-0.4867
IC50	1.6755	0.1257	1.1984	1.9807	-0.5702

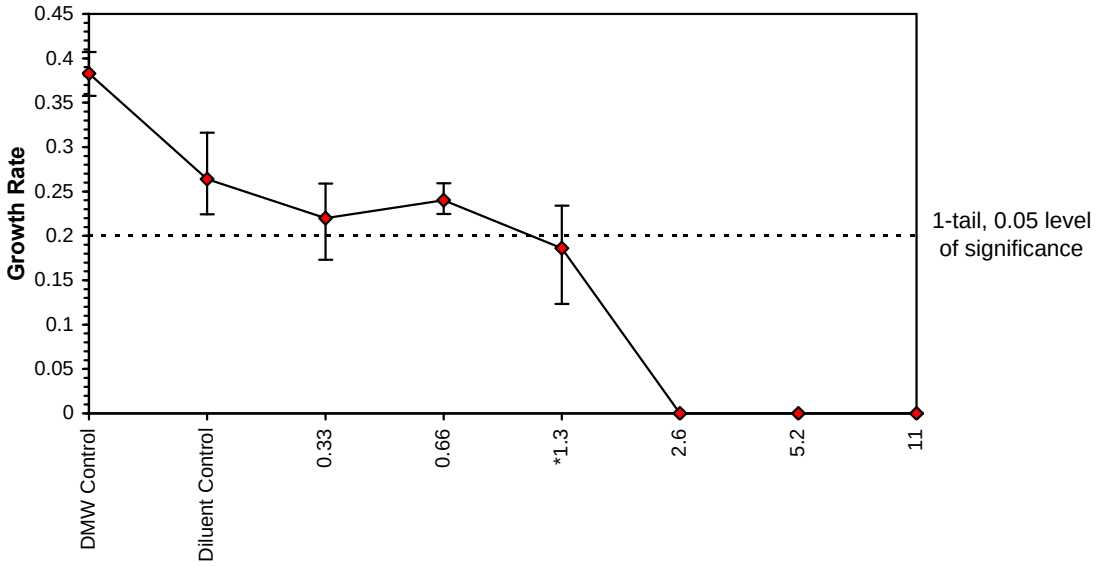
* indicates IC estimate less than the lowest concentration



Hydra Population Growth Test-Growth Rate

Start Date:	13/03/2012 15:00	Test ID:	PR0840/01	Sample ID:	SULPHATE
End Date:	17/03/2012 15:00	Lab ID:		Sample Type:	CP-Chemical product
Sample Date:		Protocol:		Test Species:	HV-Hydra viridissima
Comments:	Prepared in sample 5259 'MRM Diluent'				

Dose-Response Plot



Hydra Population Growth Test-Growth Rate

Start Date:	13/03/2012 15:00	Test ID:	PR0840/01	Sample ID:	SULPHATE
End Date:	17/03/2012 15:00	Lab ID:		Sample Type:	CP-Chemical product
Sample Date:		Protocol:		Test Species:	HV-Hydra viridissima
Comments:	Prepared in sample 5259 'MRM Diluent'				

Auxiliary Data Summary

Conc-g/L	Parameter	Mean	Min	Max	SD	CV%	N
DMW Control	Growth Rate	0.38	0.36	0.41	0.02	37.38	4
Diluent Control		0.26	0.22	0.32	0.04	78.56	4
0.33		0.22	0.17	0.26	0.04	86.29	4
0.66		0.24	0.22	0.26	0.01	50.57	4
1.3		0.19	0.12	0.23	0.05	123.46	4
2.6		0.00	0.00	0.00	0.00		4
5.2		0.00	0.00	0.00	0.00		4
11		0.00	0.00	0.00	0.00		4
DMW Control	Conductivity	24.10	24.10	24.10	0.00	0.00	1
Diluent Control		509.00	509.00	509.00	0.00	0.00	1
0.33		1120.00	1120.00	1120.00	0.00	0.00	1
0.66		1747.00	1747.00	1747.00	0.00	0.00	1
1.3		2960.00	2960.00	2960.00	0.00	0.00	1
2.6		5300.00	5300.00	5300.00	0.00	0.00	1
5.2		9550.00	9550.00	9550.00	0.00	0.00	1
11		17200.00	17200.00	17200.00	0.00	0.00	1
DMW Control	pH	7.70	7.70	7.70	0.00	0.00	1
Diluent Control		8.30	8.30	8.30	0.00	0.00	1
0.33		8.50	8.50	8.50	0.00	0.00	1
0.66		8.50	8.50	8.50	0.00	0.00	1
1.3		8.50	8.50	8.50	0.00	0.00	1
2.6		8.50	8.50	8.50	0.00	0.00	1
5.2		8.50	8.50	8.50	0.00	0.00	1
11		8.40	8.40	8.40	0.00	0.00	1
DMW Control	DO, % sat	99.90	99.90	99.90	0.00	0.00	1
Diluent Control		103.70	103.70	103.70	0.00	0.00	1
0.33		104.90	104.90	104.90	0.00	0.00	1
0.66		104.60	104.60	104.60	0.00	0.00	1
1.3		104.70	104.70	104.70	0.00	0.00	1
2.6		103.60	103.60	103.60	0.00	0.00	1
5.2		103.90	103.90	103.90	0.00	0.00	1
11		104.10	104.10	104.10	0.00	0.00	1