BAE SYSTEMS

Toxicity Reduction Evaluation
For
Industrial Wastewater Treatment System (Bioplant), Radford Army Ammunition Plant

March 2022

Revision 0

Revision Table

Revision No.	Date	Reason for Revision	Author
0	March 2022	Initial document	S. Andrews

Acronyms and Abbreviations

Bioplant	Biological Wastewater Treatment Plant
BMI	Biological Monitoring, Inc.
BOD	Biological Oxygen Demand
C. dubia or Cd	*Ceriodaphnia dubia*
COA	Certificate of Analysis
Coastal	Coastal Bioanalysts, Inc.
COD	Chemical Oxygen Demand
DMR	Discharge Monitoring Report
EDTA	Ethylenediaminetetraacetic Acid
EQ basin	Equalization basin
HLB SPE	Hydrophilic-Lipophilic-Balanced Solid Phase Extraction
I&I	Inflow and Infiltration
LC50	Lethal concentration 50%
MC	Methyl Centralite
NG	Nitroglycerin
NGDS	Northrup Grumman Defense Systems
NOV	Notice of Violation
P. promelas or Pp	*Pimephales promelas*
RBC	Rotating Biological Contactors
RFAAP	Radford Army Ammunition Plant
SPE	Solid Phase Extraction
TC	Total Carbon
TIE	Toxicity Identification Evaluation
TKN	Total Kjeldahl Nitrogen
TRE	Toxicity Reduction Evaluation
TU_a	Toxicity Units (acute)
VDEQ	Virginia Department of Environmental Quality
VPDES	Virginia Pollution Discharge Elimination System
WET	Whole Effluent Toxicity

Table of Contents

Background 6
History of Permit Excursions at Outfall 029 6
Information and Data Gathering 7
Review of Effluent Toxicity Data 7
Industrial Wastewater Sewer Design and Operation 9
Maintenance Activities 9
Distribution System 9
Facility Performance Evaluation 9
Bioplant Operation Evaluations 9
Exploratory Bioplant Sampling and Analyses 9
Process Evaluation of Bioplant 10
Nutrient Evaluation of Bioplant 10
Nitroglycerin Adsorption 10
Solids Within the EQ Basins 10
Coagulation/Polyaluminum Chloride (PAC) 10
Microbial Treatment (EQ Basins and RBCs) 10
Overview of the Importance of Microbial Treatment 11
Microscopic Evaluations 11
Seeding 11
Phosphoric acid 11
Source Identification/Reduction 11
Inflow and Infiltration 11
Solvents (Ethanol, Acetone, Ether) 12
NG 12
Graphite 15
Toxicity Identification Evaluation 15
Evaluation of 1st Quarter 2021 TIE Testing 16
Evaluation of 2nd Quarter 2021 TIE Testing 17
Evaluation of 3rd Quarter 2021 TIE Testing 17
Evaluation of 4th Quarter 2021 TIE Testing 18
Suspected Toxicants Investigations 18
Methyl Centralite 19
Sources of Ionic Constituents 19
Toxicity Control Implementation 19
Continuing Updates 20
Sources Cited 21

Appendices

Appendix A. Timeline of Outfall 029 Permit Excursions

Appendix B. Laboratory COA (Reports) for Outfall 029 Acute WET toxicity Testing

- 2021 01 05 WET CD 029
- 2021 04 29 WET CD 029 Coastal
- 2021 04 29 WET CD 029 Pace
- 2021 08 24 WET CD PP 029
- 2021 11 16 WET CD Coastal
- 2021 11 16 WET CD Biological Monitoring

Appendix C. Data Profile for Lab Results, DMR Monitoring, Operational Data

Appendix D. Noncompliance COA (Reports) for Outfall 029 Toxicity Exploratory Testing

- 2022 02 01 CLE CD PP BMI
- 2022 02 01 CLE CD PP Coastal
- 2022 02 22 CLE CD PP BMI
- 2022 02 22 CLE CD PP Coastal
- 2022 02 22 CLE CD PP San Diego

Appendix E Operations and Maintenance Manual for Outfall 029 – Biological Wastewater Treatment Plant

Appendix F. Bioplant Collection System

Appendix G. Process Evaluation of Bioplant Fall 2021

Appendix H. Nutrient Evaluation of Bioplant Fall 2021

Appendix I. Nitroglycerin Adsorption Testing Fall 2021

Appendix J. Graphite Testing 2021 and 2022.

Appendix K. Toxicity Identification Evaluations (TIE) Manipulation Results

Appendix L. TIE Reports

- Outfall 029 TIE results Q1 2021
- Outfall 029 TIE results Q2 2021
- Outfall 029 TIE results Q2 2021 more testing
- Outfall 029 TIE results Q3 2021
- Outfall 029 TIE results Q4 2021

Appendix M. Investigative Reports

- 2.11.21 BAE NG Screening CD WET test
- 12.7.21 CLE 029 tox and NG degradation analysis
- 10.22.21 MC testing

Background

The Radford Army Ammunition Plant (RFAAP) operates under a Virginia Pollution Discharge Elimination System (VPDES) (Permit Number VA0000248) issued by the Virginia Department of Environmental Quality (VDEQ). Wastewater is treated at the Biological Wastewater Treatment Plant (Bioplant) before being discharged to the New River at Outfall 029. The receiving industrial sewer lines are sourced from various areas within the plant including nitrocellulose, nitroglycerin (NG), acids, solvents, research activities, and various tenants The treatment train of the Bioplant consists of two equalization basins, rotating biological contactors (RBCs), and secondary clarification.

History of Permit Excursions at Outfall 029

Recently, the Bioplant has experienced a sequence of failing acute Whole Effluent Toxicity (WET) tests from 2020 to present date. The VPDES permit[1] for the facility dictates that acute WET testing shall occur at Outfall 029 on a quarterly basis, with TUa (acute Toxicity Units) limit of 1.0. Results are reported on the Discharge Monitoring Report (DMR). The acute tests are 48-hour static tests using *Ceriodaphnia dubia* (Cd). Once a year, tests are conducted using both Cd and *Pimephales promelas* (Pp). The test, which results in the lowest LC50 (i.e. highest TUa) is reported on the DMR. Appendix A outlines a timeline of permit excursions and Notice of Violations (NOVs) for Outfall 029 starting in January 2021. Appendix B contains the Laboratory Certification of Analysis (COA) for compliance toxicity analyses received in 2021. Table 1 outlines acute WET test results at Outfall 029.

Table 1. Historical TUa results for Outfall 029 from past six (6) years. Cd = *Ceriodaphnia dubia*, Pp = *Pimephales promelas*.

Date of Toxicity Sampling	DMR Reported TU_a	Species
1/12/2016	< 1	Cd
4/12/2016	< 1	Cd
7/12/2016	< 1	Cd
10/4/2016	< 1	Cd
1/10/2017	< 1	Cd
4/4/2017	< 1	Cd
8/8/2017	< 1	Cd
10/3/2017	< 1	Cd
1/9/2018	< 1	Cd
4/3/2018	< 1	Cd
7/17/2018	< 1	Cd
10/2/2018	< 1	Cd
1/8/2019	< 1	Cd
4/2/2019	< 1	Cd
7/18/2019	< 1	Cd
10/1/2019	< 1	Cd
1/7/2020	< 1	Cd
4/7/2020	3.74	Cd
8/11/2020	< 1	Cd
10/13/2020	< 1	Cd
1/5/2021	4.05	Cd
4/29/2021	5.275 (average)	Cd
8/24/2021	1	Cd

8/24/2021	3.13	Pp
11/16/2021	17.085 (average)	Cd

Failing WET tests prompted the facility to begin the process of conducting a toxicity reduction evaluation (TRE) to evaluate sources of effluent toxicity. A TRE is defined as "a site specific study conducted in a stepwise process designed to identify the causative agents of effluent toxicity, isolate the sources of toxicity, evaluate the effectiveness of toxicity control options, and then confirm the reduction in effluent toxicity"[2]. Historically in Virginia, a TRE plan would be have been required to be submitted in the situation that a permittee failed to pass acceptable toxicity criteria or permit limits. However, DEQ currently opts to not be directly involved in the TRE process, allowing the burden of reduction and elimination of toxicity to fall on the permittee[3].

Information and Data Gathering

The primary data sources utilized to collection information during the TRE include the following:

- Bioplant Daily Logsheet:
    - Consists of Operator input data at Bioplant to track operational/monitoring/measuring data.
    - Data is recorded on a shift, hourly, and daily basis.
- Discharge Monitoring Reports (DMR):
    - Submitted via online eDMR portal.
    - Parameter values are tracked in spreadsheet, "Monthly eDMR Outfall Tracker." Outfall 029 has a dedicated tab in this spreadsheet.
- Other spreadsheets, reports, records from exploratory sampling:
    - As the investigation progressed, other exploratory sampling and subsequent data analyses occurred both within the treatment system of the Bioplant and within the entire collection system. The following sections and data within the Appendices explain such documents.

Appendix C (Data Profile) contains a cross-referenced list of measured parameters aligning with toxicity sampling. Note that compliance and noncompliance (exploratory) samples are designated.

A cross-functional working group was initiated during March 2021 and has been meeting on a weekly basis since that time. The team members participating in the cross-functional working group include Safety Health Environmental (SHE) Manager, Utilities Operator in Charge, Utilities Process Engineer, Production Area Process Engineers, Environmental Manager, Environmental Water Compliance Specialist, Environmental Specialists, Maintenance Supervisor, and local Army personnel. This meeting is an opportunity to discuss corrective actions, evaluate data/information, and plan next steps. Goals/objectives of the Wastewater Permit Excursion Working Group include the following:

- Share information and updates to help understand the possible sources and issues within the treatment systems.
- Review past corrective actions and implement new actions to address wastewater permit excursions.
- Discuss limitations and barriers to achieving our goals to better sustain wastewater treatment.
- Make recommendations that can be elevated to higher entities to help us achieve our goals.

Review of Effluent Toxicity Data

Al review of every laboratory certificate of analysis (COA) report occurs upon receipt from the subcontractor laboratory. Laboratory COAs from 2021 are contained in Appendix B. When reports were received after sampling events, there were no issues identified within the quality parameters reported by the laboratories that would warrant discrediting or flagging the data reported.

The Division of Consolidated Laboratory Services maintains an online database of accredited commercial laboratories that is searchable by parameters. Certifications for both subcontractor laboratories used to analyze compliance samples can be found in Table 2.

Table 2. Verification of laboratory certification for subcontract laboratories performing toxicity testing for RFAAP.

Lab Name	VELAP ID	Certificate No.	Method	Analyte
Biological Monitoring Inc. (BMI)	460015	11321	EPA 1000 (FW CHRONIC 7D S, G)	*Pimephales promelas*
			EPA 1002 (FW CHRONIC 3-BROOD S, R)	*Ceriodaphnia dubia*
			EPA 2000 (FW 48H LC50)	*Pimephales promelas*
			EPA 2002 (FW 48H LC50)	*Ceriodaphnia dubia*
Coastal Bioanalysts, Inc. (Coastal)	460030	11375	EPA 1000 (FW CHRONIC 7D S, G)	*Pimephales promelas*
			EPA 1002 (FW CHRONIC 3-BROOD S, R)	*Ceriodaphnia dubia*
			EPA 2000 (FW 48H LC50)	*Pimephales promelas*
			EPA 2002 (FW 48H LC50)	*Ceriodaphnia dubia*

RFAAP has historically used Pace Laboratories in Beaver, West Virginia to analyze compliance sampling that includes toxicity samples. Because of persistent and unacceptable performance issues, a new laboratory (Enthalpy Analytical) was contracted beginning in March 2021 with an overlap of approximately a month with both laboratories analyzing samples for RFAAP. Enthalpy uses Coastal Bioanalysts, Inc. (Coastal) as a lower tiered subcontractor for their toxicity sampling.

Split sampling of the 4th quarter 2021 and 1st quarter 2022 samples occurred to explore the possibility of laboratory discrepancies. Toxicity results and laboratory measured parameters (measured upon receipt of sample) are listed Appendix C (Data Profile). Comparison of results from split samples helped the cross-functional team evaluate the performance of each laboratory.

Evaluation of split sampling results indicated that Coastal reported higher TU_a results compared to Biological Monitoring Inc. (BMI). As a confirmatory step, a three-way analysis was conducted February 22, 2022 on noncompliance samples from two waste streams at RFAAP. The third laboratory contracted was Enthalpy Analytical San Diego. Care was taken to ensure homogeneity of samples during pour-ups to reduce potential variability. RFAAP also dictated that all three laboratories run the same dilution series and begin testing on the same day. These steps helped to minimize possible effects from sample storage and allow us to compare WET test results in good faith. After analyzing the results from the three-way split (Appendix C and reports (Appendix D), it was determined that Coastal results are biased high for TU_a. From the laboratory measured parameters, Coastal also reported unusually high values for conductivity (Appendix C).

The results from the February 22, 2022 three-way split were not received in time to make a definitive conclusion about switching the dedicated subcontract laboratory, therefore the 1st quarter 2022 compliance sample (collected March 15, 2022) was split between both Coastal and BMI. A three-way split was attempted earlier in the month (February 1, 2022), however a major ice storm in the mid-west prevented the 3rd sample from arriving in San Diego within the allotted hold time, resulting in the samples only being analyzed by Coastal and BMI. Information gathered from all split sampling events is being compiled for a justification to use BMI as the primary lab to evaluate future toxicity samples.

Industrial Wastewater Sewer Design and Operation

Details about the processes and operation of the Bioplant can be found in the Appendix E (Operations and Maintenance Manual for Outfall 029 – Biological Wastewater Treatment Plant). There have not been any major design or operational changes/upgrades that would be identified as a causal factor for toxicity issues. This an aging facility and maintenance repairs and upgrades are happening on a continuous basis. However, there were several major maintenance improvements that were made in 2021, described in the section below. None of these improvements or upgrades directly correlated to an elimination of failed toxicity tests.

Maintenance Activities

There were several important maintenance activates that were completed in 2021 for various components of the Bioplant. The age of the facility presents challenges for completing repairs and occasionally specific parts are manufactured onsite in order to complete a repair. Below are the impactful maintenance activities completed in 2021:

- RBCs: various RBC's located both inside and outside needed repairs and replacements, including shaft repairs, gear box repairs, gear reducer repairs, small drive sprocket repairs, electrical re-wiring with new conduit, and repairs to concrete platform.
- Recirculation pump: the P-91 recirculation pump in the EQ basin was replaced.
- Baffled effluent weirs on the gravity thickener: onsite fabrication was required to reproduce weirs, new weirs were installed.
- Variable Frequency Drive (VFD): new drives installed on recirculation pumps to increase recirculation efficiency.

Distribution System

Appendix F contains a flow diagram of the collection system from all production areas that ultimately discharge to the Bioplant. The monitoring stations are indicated by yellow boxes with the station identification number. Most monitoring stations record TC (total carbon), pH, and flow with data being continuously logged. Lift stations are noted by blue boxes.

Facility Performance Evaluation

During the ongoing investigation in 2021, efforts for understanding toxicity were divided into two categories: Bioplant operation evaluation and influent source identification/reduction. The overall challenge for the TRE over the course of 2021 and early 2022 has been the continued evidence that there is not one sole event or toxicant that is causing the failed toxicity tests at Outfall 029. It is important to record and track the changes that have occurred to evaluate and improve the performance of the Bioplant. Additionally, the identification of influent constituents and further control of inputs to the Bioplant is of equal importance for this TRE.

Bioplant Operation Evaluations

Extensive evaluations of Bioplant functionality occurred in the second half of 2021, utilizing additional expertise from a wastewater engineer outside of the facility. Additional sampling was planned to aid in further evaluating functionality of the Bioplant. The exploratory sampling, in conjunction with in-depth evaluations of each Bioplant function, allowed RFAAP to make important decisions in 2021 to optimize treatment performance.

Exploratory Bioplant Sampling and Analyses

Multiple sampling plans and evaluations occurred in late 2021 to better understand the treatment system within the Bioplant. Sampling locations and events varied depending on the sampling plan. Data can be found in subsequent Appendices.

Process Evaluation of Bioplant

Process evaluation sampling involved measuring COD, available Phosphorus, and Total Kjeldahl Nitrogen (TKN) throughout the plant (Appendix G) over the course of several weeks. The conclusions from this sampling effort determined that there is a lack of available orthophosphate. This is crucial for sustaining healthy microbial populations

- Solution: Additions of phosphoric acid, according to a recommended dosage, was added to the EQ basins. For the past several years, fertilizer has been added to the system. However, fertilizer also has the potential to add excess ammonia to the system and limited the amount of orthophosphate.

Nutrient Evaluation of Bioplant

A microbial nutrient evaluation was performed at the beginning and end treatment at the Bioplant to determine if there are deficiencies for microbial populations across the entire treatment train (Appendix H) The most important nutrients, vital to supporting microbial communities, were present with the system. However, micronutrients may either be lacking or below detection limit of the analyses performed. If phosphoric acid additions do not result in enhanced microbial treatment, then Iron, Zinc, and Copper levels will be further evaluated with lower detection limits.

Nitroglycerin Adsorption

Nitroglycerin (NG) adsorption to particulates was assessed at multiple upstream stations and within the Bioplant treatment train (Appendix I). It was concluded that NG is not immediately sorbing onto particulates (i.e. graphite) within the system.

Solids Within the EQ Basins

The Bioplant contains two covered concrete Equalization Basins (labeled East EQ Basin and West EQ Basin) with a volume of approximately 3.6 million gallons each. Solid levels are controlled through the operation of recirculation pumps. There was a large volume of solids that had settled over time in the East basin. As part of a major corrective action, subcontractors were engaged to perform a full removal of solids from the East basin. This work was completed at the beginning of January 2022 and the basin was placed back in service January 28, 2022. This improvement also supports the microbial health of the EQ basin by allowing for increased retention time.

Coagulation/Polyaluminum Chloride (PAC)

The source of PAC was investigated to see if there were any changes around the time of failed toxicity tests. No changes in the vendor/supplier were observed. Increased TSS values have not been a major issue and results of TIE testing conducted in 2021 did not reveal metals or other toxicants that would be settled out during coagulation as a causal factor for failed toxicity

Microbial Treatment (EQ Basins and RBCs)

Growth and microbial treatment is achieved in both the EQ basins and the RBCs. Microbial communities are supported in the EQ basins by aeration, phosphorus additions, and seeding/nutrient additions. RBCs operate as an aerobic attached-growth biological treatment process used to remove organic matter from the wastewater. The RBCs consist of a series of closely spaced circular disks of high-density polyethylene with carbon black added for ultraviolet resistance. The approximately twelve-foot diameter disks are slowly rotated through the wastewater, allowing the biological growth on the disks to come into contact with the organic matter in the wastewater and oxygen in the atmosphere.

The EQ basins were not designed to be biological reactors[4]. However, there is evidence that the majority of treatment and removal of organic constituents occurs within the EQ basins. Microbial communities are fed and maintained by the materials that are input. This is an issue when inputs vary broadly and sporadically due to the fluctuations of propellant manufacturing of many different products and the their subsequent waste streams at RFAAP. Achieving stability will always be a challenge when there are a multitude of products produced at RFAAP. The best way to counteract the

effects of these sporadic inputs are by having the most robust microbial population possible. However, the EQ basins were not designed to be biological reactors[4].

Overview of the Importance of Microbial Treatment

Because of the design of the Bioplant, review of microbial health was a major focus of improvement efforts. With proper microbial communities, nutrient support, and retention time, constituents that should undergo microbial degradation through the treatment process include solvents (ethanol, acetone, ether), Nitroglycerin, and other various compounds and chemicals present in the wastewater as the result of many different propellant production activities.

Microscopic Evaluations

In the past, observations of the microorganisms occurred but were ceased many years ago with changing personnel. A microscope was received by the facility during Fall 2021 to resume observations. Samples are collected from the Bioplant EQ basins and the RBCs on a routine basis and immediately viewed on slides for organism counts.

Seeding

Beginning nearly a decade ago, micronutrients (Microsolve 118 and Microclear M100) are added to the EQ basins on a routine basis. Exact microbial communities within Microsolv products is proprietary. Other microbial retailers also have formulations that are used in industrial wastewater treatment. Novozymes was contracted to provide additional proprietary seeding material (Bioremove COD), given the solvent-laden wastewater streams at the Bioplant. Seeding with this material began in September 2021. Later, in December 2021, an additional product was added to the seeding dosage. This product is called MB2 and was recommended to try to enhance NG treatment. A third Novozymes product, MB MN, was added beginning in January 2022 to add micronutrients to the system. The effectiveness review of these products is continuing into 2022.

Phosphoric acid

After exploratory sampling that occurred in Fall 2021, it was determined that the Bioplant system lacked available orthophosphate which is crucial to supporting microbial communities. The recommendation was made to switch from inputting bagged fertilizer to liquid phosphoric acid. A trial dosage of phosphoric acid began in February 2022. This was deemed an effective method for provided additional phosphorus inputs to support microbial health. Phosphoric acid is added at the influent pump station and flows into the EQ basins.

Source Identification/Reduction

In conjunction with the evaluations and improvements made within the Bioplant treatment system, influent sources and specific chemical parameters were also researched, identified, and brought under more systematic control.

Inflow and Infiltration

Stormwater (inflow) and groundwater (infiltration), known as I&I in the wastewater industry, can have a major influencing on wastewater treatment systems. Storm events can cause increased flows to the Bioplant as well as a hydraulic overloading, that can cause a disruption in treatment for the microbial communities in the EQ basins and RBCs. Multiple efforts were completed in 2021 to address I&I pulses to the Bioplant.

There were several major water break repairs that occurred during 2021 that were in close proximity to the intake to lift station 906-8. Prior to the repairs, the lift station pumps were running continuously for a period of approximately 3 months. After the repairs, the cycling of the pumps at this lift station returned to normal. The exact flow rates at this lift station are not measured, but are estimated to be substantial.

In early 2021, there were major repairs of the guttering system that occurred in the area of the facility that feeds Station 12. Several buildings and areas were identified with gutters that

inadvertently diverted rain into the trench system connected to the industrial sewer system. Once repairs were completed, rain was properly diverted to gutters and downspouts, leading to the stormwater system. This improvement was also not measurable, but thought to have had a substantial effect on decreasing I&I entering the Bioplant during rain events.

Solvents (Ethanol, Acetone, Ether)

Solvent-based production of energetic material occurs at RFAAP. The entire collection system and the monitoring stations within the Bioplant monitor are designed to monitor and check the solvent levels through TC (Total Carbon) monitors. Historically, the only pretreatment limits that exist for the collection have been TC limits for two areas of the plant that are known to pulse potentially high amounts of solvent-laden wastewater to the Bioplant.

Removal of organic material, including solvents, occurs within the EQ basins by microbial activity. By observing the data, it is clear that when the microbial community is suppressed, there is detected levels of ethanol, acetone, and/or ether at the clarifier. When microbial treatment is optimized, these constituents are non-detect at the clarifier. These solvents will have a direct effect on the BOD and COD values monitored at Outfall 029 for the DMR, see Appendix C.

Although monitored pulses of solvents occur as part of the varied manufacturing schedule, there were two very large peaks that occurred in February 2022 (Figure 1). An investigation commenced into finding the sources of these pulses.. Multiple leaks of alcohol were draining into the pit system (under operational control) within one of the production buildings. Another pump/trench system in the back of the same building was correlated with these pulses based on operator interviews. Historically, the pump has not been under operational control and is switched on/off as needed by the operators. These deficiencies were immediately corrected and more operational control gained through the use of lock/key, procedure changes, and re-training of area operators. Now both the pit system and the back pump must be sampled for TC by Bioplant operators and will be allowed/disallowed to pump to the Bioplant based on the TC results.

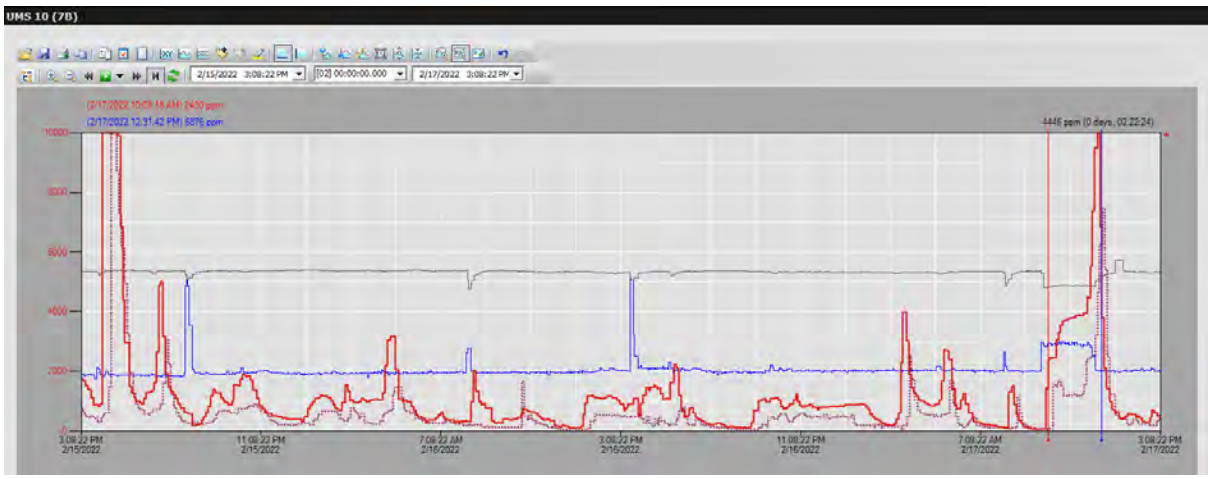


Figure 1. Monitoring data from station 7b measured from 2/15/2022 to 2/18/2022. The red line indicates TC (ppm) and the blue line indicates flow in gallons per minute.

More stringent TC limits were also deployed beginning in January 2022 for an onsite tenant, Northrup Grumman Defense Systems (NGDS). This tenant has a solvent still recovery process that discharges to the Bioplant if it is not recirculated. Before discharging, NGDS must have a Bioplant operator analyze a sample for TC and the sample must be below the allowable limit. This allowable limit was further reduced in January 2022.

NG

Early in the investigation, amounts of Nitroglycerin (NG) measured throughout the Bioplant have been considered as possible toxicant relating to failing toxicity tests, however there is not a direct correlation between pulses of NG and failed toxicity tests.

Nitroglycerin was identified as possibly creating treatment issues at low solids levels by previous research at the Bioplant[4]. NG has a 48-hour LC_{50} for *Ceriodaphnia dubia* at 17.83 mg/L[5]. Initial data reviews and reduction efforts focused on NG as a possible toxicant causing the failed toxicity tests. However, NG is not the sole factor causing failed toxicity tests (Appendix C). There were sampling occasions with higher NG measured in the clarifier but no failed toxicity (sample dates 8/24/2021 and 1/11/2019).

The exact interactions of NG within the Bioplant treatment train are not fully understood. Although NG can be microbially degraded, the fate of NG within the EQ basins could take several paths. The NG that enters the EQ basin could be sorbed onto solids (although exploratory sampling suggested that this does not occur immediately(Appendix I)), vaporized in a carrier solvent, or degraded into NG degradation products[4].

Figure 2 shows that total summation of NG that is both entering the Bioplant (RawC) and detected in the clarifier (CLE). NG levels steadily increased in 2021 in the raw influent. There was also a shift that occurred during 4th quarter 2020 and 1st quarter 2021 in which there was more NG detected in the clarifier than what was entering the Bioplant. This would support the idea of NG sorbing/desorbing from solids within the treatment system.

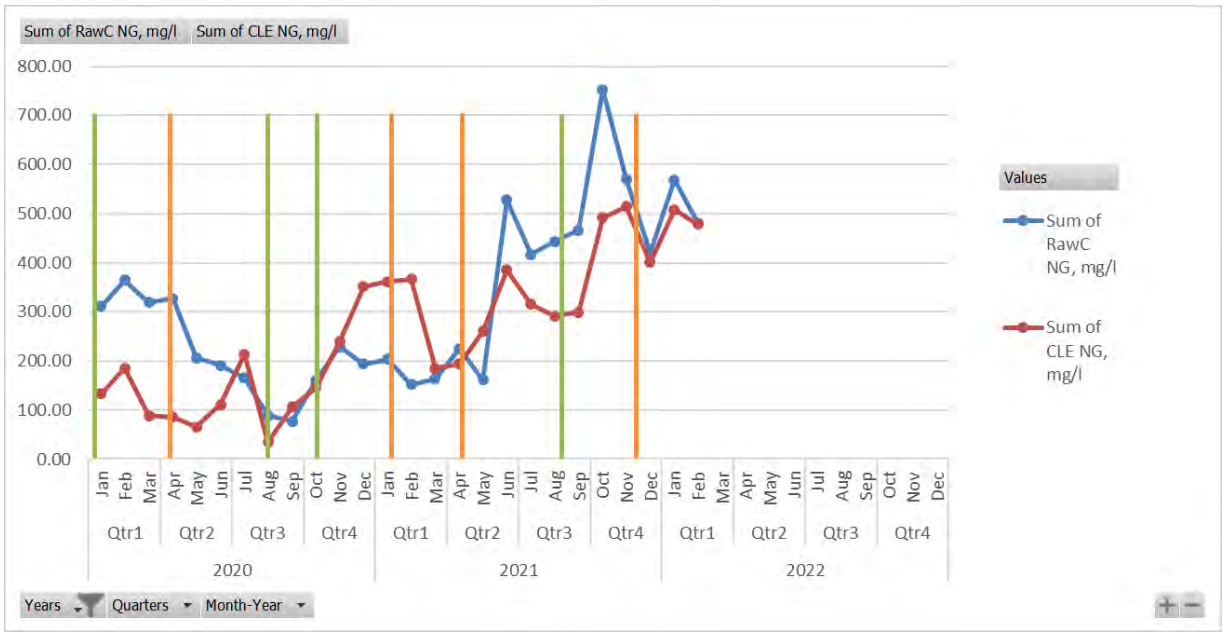


Figure 2. Monthly summation data calculated from daily NG values measured from Bioplant influent (RawC) and Bioplant clarifier (CLE). Green lines indicate when a non-toxic, passing acute WET test was measured (for *C. dubia*). Orange lines indicate when a failed acute WET test was measured.

Currently, NG is not being readily removed from within the Bioplant system. Historical data of NG monthly sums illustrates a shift in treatment starting January 2019 (Figure 3). From 2015 to January 2019, NG was below detection limits within the clarifier Effluent. The reason for the shift has not been identified, but is under investigation. The validity of the lab results, collection methods, equipment, etc. have been questioned and explored multiple times, but there does not seem to an ancillary reason for this shift.

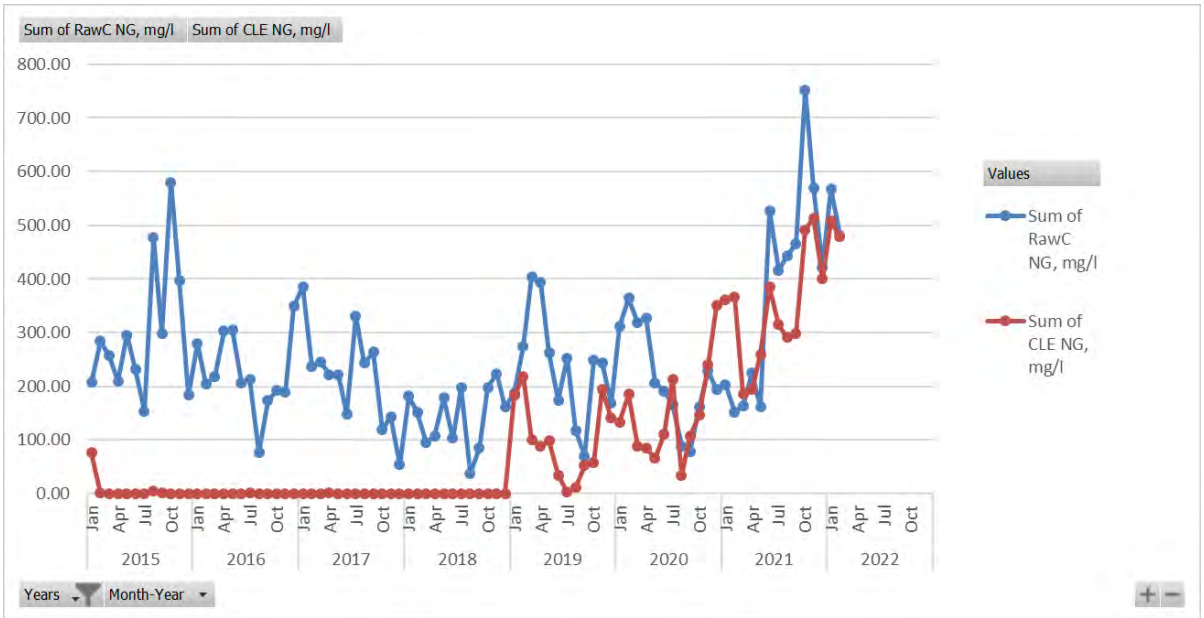


Figure 3. Historical monthly summation data calculated from daily NG values measured from Bioplant influent (RawC) and Bioplant clarifier (CLE).

Early in 2021, an effort was begun to understand the sources of NG entering the Bioplant. There is an industrial sewer line that runs underneath the New River bridge. Production wastewater is collected from all areas located on the Horseshoe bend area of the plant into one lift station before being transported across the bridge. It was determined that the wastewater from the NG production area was the major source of NG-laden wastewater. In the first quarter of 2021, it was thought that a clean-out of EQ tanks located in the pretreatment system for NG-2 would reduce NG entering the waste stream. The results of pre- and post-cleanout samples indicated that this did not reduce NG entering the waste stream.

Table 3. Sampling results from NG and toxicity testing at NG-2 pretreatment areas.

Sample Point	Pre-clean out NG mg/L	Pre-clean out Toxicity (TUa)	Post-clean out NG mg/L	Post-clean out Toxicity (TUa)
906-11 – EQ tanks at NG (cleaned out 3/26/21)	52 (production shutdown)	23.62	75.9 (production running AA2)	24.1
9410 – acid pretreatment	446	No sample	313.20	No sample

In February 2021, a basic compound screening test was performed by Pace Laboratory on solutions created using RFAAP NG standards at low levels. This information would help the facility better understand if NG was the source of toxicity at low levels, see report in Appendix M. The LC_{50} for *Ceriodaphnia dubia* is 17.83 mg/L[5], but the daily NG levels detected in at the clarifier throughout 2020 and 2021 typically range from 2.0 to 15.0 ppm. Therefore, the NG screening tests used concentrations of 0.5, 1.0, 2.5, 5.0, and 10.0 ppm. The results were that the solutions "passed" the screening compared to a control. One *C. dubia* death (out of five test organisms) was observed in the 10.0 ppm solution. NG can still have a negative effect at ranges from 10.0 ppm to 20.0 ppm that could lead to failed toxicity tests. Testing performed later in 2021, examined NG values for the day of sampling, and concluded that *C. dubia* deaths in the sample were likely not solely from the effects of NG (Appendix C). The numbers of death expected at the levels of NG should be much lower. This corroborates the conclusion that there is not one sole toxicant responsible for the recent failed toxicity tests at the Bioplant.

During TIE testing that occurred in 4th quarter 2021, an aliquot of sample was analyzed at a speciality laboratory for NG and degradation products. The results can be found in the report located in Appendix M and the table below. The toxicity of specific NG degradation products is unknown at this time. The subcontracted agreed to attempt exploratory, compound testing for degradation products. However, acquiring standards for NG degradation products was not feasible. However, testing confirmed that there were NG degradation products present within the Bioplant treatment system in the later part of 2021.

Table 4. Results for aqueous analysis of Nitroglycerin and degradation products for the sample collected from Bioplant clarifier (CLE) on 12/7/22.

Target Analyte	Units	Replicate 1	Replicate 2	Replicate 3
1-Mononitroglycerin	mg/L	0.98	0.98	0.99
2-Mononitroglycerin	mg/L	1.15	1.15	1.16
1,2-Dinitroglycerin	mg/L	7.4	74	7.4
1,3-Dinitroglycerin	mg/L	3.8	3.8	3.8
Nitroglycerin*	mg/L	22	22	22

*On the same date, RFAAP Main Lab measured 19.6 mg/L NG on the same sample.

Source reduction explorations are still ongoing for the NG production area.

Graphite

Graphite has previously been identified as having an impact on treatment efficiency at the Bioplant[4].. In addition to settling in pipes, straining pumps, and taking up space within basins (and effectively reducing retention time), graphite can have an impact on microbial treatment within the Bioplant. Graphite coats surfaces within the system, including the RBCs, and can inhibit biofilm attachment and growth. The coating limits movement of oxygen and nutrients through the biofilm, effectively smothering the microbial community. Graphite can also adhere to suspended microbial populations, causing settling and reducing contact with nutrients.

Due to the impact that graphite has on efficiency of the Bioplant, the cross-functional team is evaluating setting limits on the quantity of graphite allowed to be discharged from various production areas. A month-long sampling campaign was designed to evaluate if graphite concentrations could be estimated by other parameters that are easier to measure, such as TC or TSS (Appendix J). Graphite concentrations were variable, depending on the production schedule. Similar to the Cherry and Boardman study[4], TC does not have a good correlation with graphite concentrations. Moderate correlations were found in relations to TSS, depending on the production schedule of the areas that utilize graphite.

Toxicity Identification Evaluation

USEPA has developed Toxicity Identification Evaluation (TIE) procedures to use as tools for TRE studies. These TIE manuals describe procedures for characterization, identification, and confirmation of effluent toxicants[2].

TIE manipulations can involve a wide range of tests to determine the general classification of a contaminant (organic, divalent cation, etc.). Toxicity evaluations can be performed on any of the test organisms, and we have had TIE tests completed with both of our VPDES permitted reference organisms (*C. dubia* and *P. promelas*). The subcontracted laboratories have cited the EPA's Method for Phase I Toxicity Characteristics Procedures for the various TIE tests that were completed in 2021[6].

The results of the TIE tests performed in 2021 and 2022 are summarized in the spreadsheet found in Appendix K. The laboratory reports can be found in Appendix L. The following descriptions summarize the manipulations performed:

- Initial – These are the results of the original WET test.
- Baseline – Because time has passed since the initial toxicity test, a new toxicity test is performed in order to evaluate any changes that may have occurred since the original test. Due to the timing of the tests, results of TIE manipulations are referenced back to these numbers.
- SPE Column – Solid Phase Extraction Column. This column has material that will sorb many hydrophilic organic compounds and other filterable toxicants.
- HLB SPE Column – Hydrophilic-Lipophilic-Balanced Solid Phase Extraction column. This type of column extraction is suspected to adsorb Nitroglycerin and more soluble degradation products.
- EDTA – Ethylenediaminetetraacetic Acid can be added to the sample in varying concentrations in attempts to 'remove' certain metals that may be present in the sample (EDTA complexes to divalent cationic metals such as copper, cadmium, nickel, mercury, and lead). EDTA is typically added at least 2 hours prior to testing to allow time for it to react.
- Sodium Thiosulfate – Sodium Thiosulfate can be added to the sample in varying concentrations in attempts to 'remove' some metals and many oxidants.
- Aeration – Samples are aerated for 60 minutes using carbon-filtered air.
- Filtration – Samples are filtered through glass fiber filters (GFFs) with 1 µm pore size. What passes through the filters (dissolved compounds and any particles smaller than 1 µm) is evaluated with a toxicity test.
- pH adjustments – pH 7 tests involve bubbling CO2 gas through the sample. 'Hi pH' conditions (pH of 9.0) are created by adding sodium hydroxide to the sample. 'pH 11' conditions are also created by the addition of sodium hydroxide. 'pH 3' adjustments are made by additions of hydrochloric acid to the sample.
- HDPE Cube Container, Glass, or PVC – Due to the differing sorption properties of glass vs. plastic, different container materials were evaluated to see if contaminants would sorb to the container over a period of time.

Evaluation of 1st Quarter 2021 TIE Testing

A Toxicity Identification Evaluation (TIE) study was conducted on the effluent of Outfall 029 collected on 1/26/2021 by Pace Analytical (Beaver, West Virginia). A baseline test was conducted to identify initial toxicity, followed by three focused tests in an effort to eliminate the major toxic components to yield a passing toxicity test. This would help to identify the broad constituents that may be the cause of the toxicity issues. The three focused tests were as follows:

- EDTA test to detect toxicity from certain cationic metals,
- Sodium Thiosulfate test designed to detect toxicity from metals and some oxidants including chlorine, bromine, iodine, ozone, and chlorine dioxide,
- Post C18 Solid Phase Extraction test designed to detect toxicity from non-polar organics, some metals, and surfactants.

These tests were selected after conversations with the Pace Laboratory, to target the reduction of toxicity by reducing total metals and/or NG. Unfortunately, none of these manipulations reduced toxicity. The Pace report did note the detection of aluminum.

Evaluation of 2nd Quarter 2021 TIE Testing

In May of 2021, Coastal Bioanalysts, Inc. performed TIE testing on samples collected 4/29/21. The TIE procedures used were selected based on the continued suspicion that NG may be present in trace amounts and chemical analyses performed by Pace Analytical in January 2021. Results suggested that toxicity due to aluminum and NG were not likely. The report also suggested some additional testing that may shed light on potential sources of toxicity. BAE Systems moved forward with the suggested analyses. The focused tests were as follows:

- Baseline – Sample toxicity increased slightly after being stored for 7 days in original HDPE cube container. This would point to a more stable compound, not a volatile compound, causing toxicity.
- Filtration – No toxicity reduction.
- SPE column extraction – No toxicity reduction.
- pH 7 adjustment – This test was suggested based on the presence of aluminum from the Pace report from January 2021. Aluminum toxicity can be influenced by pH and hardness. Because this test did not reduce toxicity, effects from aluminum is unlikely.
- Three days additional storage in either HDPE cube container, Glass, or PVC – No toxicity reduction and no difference based on the storage container. Some toxicants can adsorb onto the plastic of bottles. The lack of sorption by the PVC trial suggests that NG and NG degradation products are not the source of toxicity, as those products tend to adsorb to PVC and would have been removed from the sample.

Coastal Bioanalysts, Inc. suggested additional testing and BAE Systems moved forward with the suggested analyses that occurred with the original sample collected 4/29/21.

- Baseline "2" – Test occurred 27 days after collection. Sample toxicity ***decreased significantly*** after being stored for 27 days in original HDPE cube container. This result contradicts the result from the first round of testing in which toxicity increased slightly after 7 days of storage. Decrease in toxicity could be the result of a breakdown or off-gassing of the original toxicant. The contradiction of results could be demonstrating the existence of multiple toxicants.
- SPE HLB column – Did not decrease toxicity, indicates toxicity was not likely due to organic compounds
- UV-irradiation – Did not decrease toxicity, indicates toxicity was not likely due to filamentous algae or bacteria.
- Mock sample – A "mock" sample is created by estimating major cations and anions and had ***significantly reduced*** toxicity compared to the 029 effluent. However, given the measured conductivity of the sample versus the estimated conductivity from the ion analyses, only 66% of the total ions present were accounted for in the mock solution (K^+, Na^+, Mg^{2+}, Ca^{2+}, Cl^{2-}, SO_4^{2-} and HCO_3^-).

Evaluation of 3rd Quarter 2021 TIE Testing

During the 2021 third quarter toxicity analyses, Outfall 029 failed toxicity for *Pimephales promelas* with a value of 3.13 TU_a while toxicity testing using *Ceriodaphnia dubia* passed with a value <1.00 TU_a. Please note per the facility's VPDES permit requirements, a test for both species must occur once a year at Outfall 029. Upon failure, RFAAP immediately engaged Coastal Bioanalysts, Inc to perform TIE testing on the effluent using *P. promelas* with the following tests:

1. Baseline – Did not decrease toxicity (contradicts 2nd quarter TIE testing).
2. Aeration – Did not decrease toxicity
3. Filtration – Did not decrease toxicity
4. EDTA chelation test – Did not decrease toxicity
5. pH 7 test – only slightly increased toxicity
6. pH 9 adjusted – Did not decrease toxicity

7. HLB SPE – ***Reduced toxicity significantly.***
8. Thiosulfate reduction test – Did not decrease toxicity
9. pH 3 adjusted – slightly decreased toxicity, but was not statistically significant
10. pH 3 aeration – slightly decreased toxicity, but was not statistically significant
11. pH 3 filtration – Did not decrease toxicity
12. pH 3 HLB SPE - ***Reduced toxicity significantly.***
13. pH 11 adjusted – Did not decrease toxicity
14. pH 11 aeration – Did not decrease toxicity
15. pH 11 filtration – Did not decrease toxicity
16. pH 11 HLB SPE - ***Reduced toxicity significantly.***

The HLB SPE columns removed toxicity completely at pH 3, pH 11, and ambient pH. This was the first manipulation that achieved drastic toxicity reduction since RFAAP began exploratory testing in January 2021. Therefore, we knew that the toxicant in this sample was likely an organic compound, and not an easily filterable toxicant (because the physical filtration did not reduce toxicity). It must be noted that these manipulations were tested using *P. promelas*. All previous TIE tests in 2021 were conducted using *C. dubia*.

The extracted contents from the columns were submitted to the laboratory to analyze for semi-volatile compounds (SVOC) using GCMS (Method SW-8270) with a library search. The compound identified in all three (pH 3, pH 11, and ambient pH) columns was 1,3-Dimethyl-1,3-diphenylurea, also known as Methyl centralite. Methyl centralite is used as a coating agent at RFAAP for only one particular propellant product. RFAAP began an investigation into this possible toxicant. bis(2-Ethylhexyl) phthalate was also reported from the library search, but can be a common laboratory contaminant.

Evaluation of 4th Quarter 2021 TIE Testing

It was suspected that Coastal was providing WET results that were biased high compared to other subcontracted labs. The suspicion was mostly centered around testing of a separate wastewater stream (acidic) and separate Outfall (007) located at RFAAP. Because of these suspicions, the 4th quarter 2021 compliance sample was split between two laboratories. When the reports were received, Coastal reported a higher TU_a for Outfall 029. But with no obvious deficiencies in their report or analyses, we used their result in a calculated average to report on the DMR.

Based on the previous results from 3rd quarter, Coastal suggested trying to find a laboratory to analyze NG degradation products and performing a subsequent WET test with multiple dilutions. Nitroglycerin and degradation products would not have been detected in the library scan. Although the onsite RFAAP Main Lab analyzes NG, the presence or amount of NG degradation products within the Bioplant system are not fully understood. Coastal also suggested reanalyzing with both *C. dubia* and *P. promelas* to attempt to gain more understanding regarding the differences in response of the two species.

- *C. dubia* baseline – This test was run 16 days after sample collection after storage in an HDPE cube container. Although the initial test was very toxic (23.98 TU_a, LC_{50} 4.17), the toxicity ***greatly increased*** during the storage time to 69.93 TU_a (LC_{50} 1.43). This contradicts the results from the 2nd quarter 2021 TIE test when a storage time of 27 days decreased toxicity.
- *P. promelas* baseline – This test was run 16 days after sample collection after storage in an HDPE cube container. When tested with this species, toxicity was greatly reduced at 3.30 TU_a (LC_{50} 30.3). This contradicts the result from 2nd quarter 2021 TIE testing when toxicity was greater with *P. promelas* compared to *C. dubia*.

Suspected Toxicants Investigations

The data from the TIE manipulations was not able to provide conclusive evidence for a specific toxicant, except for the TIE testing conducted in the 3rd quarter of 2021. This testing showed a significant decrease in toxicity when the effluent was filtered through an HLP SPE column. The

column material was extracted and the elutant run through a library scan in an attempts to identify organic constituents in the elutant that could be toxic. The scan had detections of Methyl Centralite (MC) and bis(2-Ethylhexyl) phthalate. The phthalate can be a common lab contaminant derived from plastic. Phthalates as a group have not been eliminated from investigation consideration because some production areas utilize phthalates. Phthalates that are part of the SVOC suite (EPA Method SW-846 8270) have been below detection limits during previous evaluation. Further exploration of this group of contaminants will be considered after other avenues have been exhausted.

Methyl Centralite

There is a lack of information on MC in the current literature and toxicity studies are not available for this compound (MC is not included on EPA's ECOTOX website). BMI laboratory was contracted to determine an LC_{50} for MC during late 2021. The report from this testing can be found in Appendix M. The LC_{50} for *C. dubia* was determined to be 297 mg/L and *P. promelas* was determined to be 277 mg/L. It should be noted that MC is not very soluble in water, but could be more readily mobilized in the presence of solvents. MC was mixed with strong alcohol and alcohol were also tested during this initiative. Because the source of MC entering the industrial wastewater system was traced back to a particular coating activity, the discharge from two separate production areas (sweetie barrel discharge and water dry discharge) associated with this activity were tested. Table 5 lists the LC_{50} for each source that resulted from this exploratory testing. The only source that was identified as having acute toxicity was the water dry discharge sample. The next exploratory steps will focus on what constituents in this waste stream are causing toxicity. The production of this product and others at the facility use potassium nitrate, potassium sulfate, and potassium perchlorate. It is possible that these constituents, through chemical reactions occurring within the wastewater system, are producing the ions that were essentially "missing" from the mock sampling TIE testing. Further research and evaluation are needed to explore this possibility.

Table 5. Results from acute toxicity compound testing conducted in October 2021.

Material tested for acute toxicity	Organism	LC_{50} (mg/L)	Confidence Intervals (mg/L)
Sweetie Barrel Discharge	*C. dubia*	2608	2106-3230
	P. promelas	4910	4058-5941
Methyl Centralite	*C. dubia*	297	254-348
	P. promelas	277	236-324
Methyl Centralite with 0.2% Strong Alcohol	*C. dubia*	330	301-362
	P. promelas	218	189-251
Strong Alcohol	*C. dubia*	> 10000	NA
	P. promelas	> 10000	NA
Water Dry Discharge	*C. dubia*	16.60%	14.5-19.0%

Sources of Ionic Constituents

The mock sample composing lab stock solutions that tried to recreate the ratio of commonly measured ions did not prove to be toxic.The "missing" 33% of ions that were not accounted for in the test could possibly contribute to failed toxicity results. Additional exploratory sampling and product source investigation will be ongoing in 2022.

Toxicity Control Implementation

Evidence from the data review and TIE testing revealed that there is not one sole toxicant responsible for failed toxicity tests. Therefore, a holistic approach has been utilized to both control constituents

entering the Bioplant and to bolster the treatment capabilities of the existing systems within the Bioplant. When viewing all the compliance and monitoring data for particular sampling events, it is evident that multiple constituents increased over the course of 2021. Because microbial treatment breaks down a multitude of chemicals and constituents, decreased microbial treatment would result in increased levels of multiple constituents and parameters.

At the conclusion of 2021, after reviewing the results of the all TIE testing, it is evident that failing toxicity is not due to one toxicant or constituent. This is most evident in the contradicting results with baseline testing and the same manipulations across different quarters. Specifically, the HLB SPE manipulation had no effect in 2nd quarter 2021 TIE testing, but was the only manipulation in 3rd quarter 2021 TIE testing that decreased toxicity. The most drastic differences can be seen with the August 2021 and the November 2021 testing. Another major contradiction in results is the difference in toxicity testing across the two different species, *C. dubia* and *P. promelas*. In August 2021, *C. dubia* passed toxicity with *P. promelas* failing. In November 2021 sample, C. dubia failed toxicity with an extremely low LC_{50} value and *P. promelas*, although it also failed, had a much higher LC_{50} value.

Based on the TIE testing and exploratory sampling, it was also concluded that the microbial community within the Bioplant system could be preferentially breaking down and degrading certain compounds. Solvents (ethanol, ether) are more simple compounds and would be preferentially consumed by microbes. If pulses of large amounts of solvents enter the EQ basin, these compounds would be broken down by microbes first. The larger, more complex aqueous/suspended compounds would not be treated, or treated to a lesser extent, and flow through the system. For this reason, more stringent upstream controls on solvents entering the Bioplant were implemented in early 2022. These controls, along with controls on graphite entering the system, should create a more balanced community for the wastewater microbes to break down all constituents and compounds. This will have a downstream effect of preventing these compounds from flowing through the system and causing failed toxicity tests.

Continuing Updates

As required quarterly toxicity testing continues at Outfall 029, we will continue to both monitor and respond to toxicity test results.

Sources Cited

[1] Authorization to Discharge under the Virginia Pollutant Discharge Elimination System and the Virginia State Water Control Law. Permit No. VA0000248. Effective Date: June 10, 2015.

[2] EPA 833-B-99-002, Toxicity Reduction Evaluation Guidance for Municipal Wastewater Treatment Plants, August 1999.

[3] Implementation Guidance for the Toxics Management Program. Office of Water Permit Programs, Division of Water Program Coordination, Department of Environmental Quality. Revised August 24, 2000.

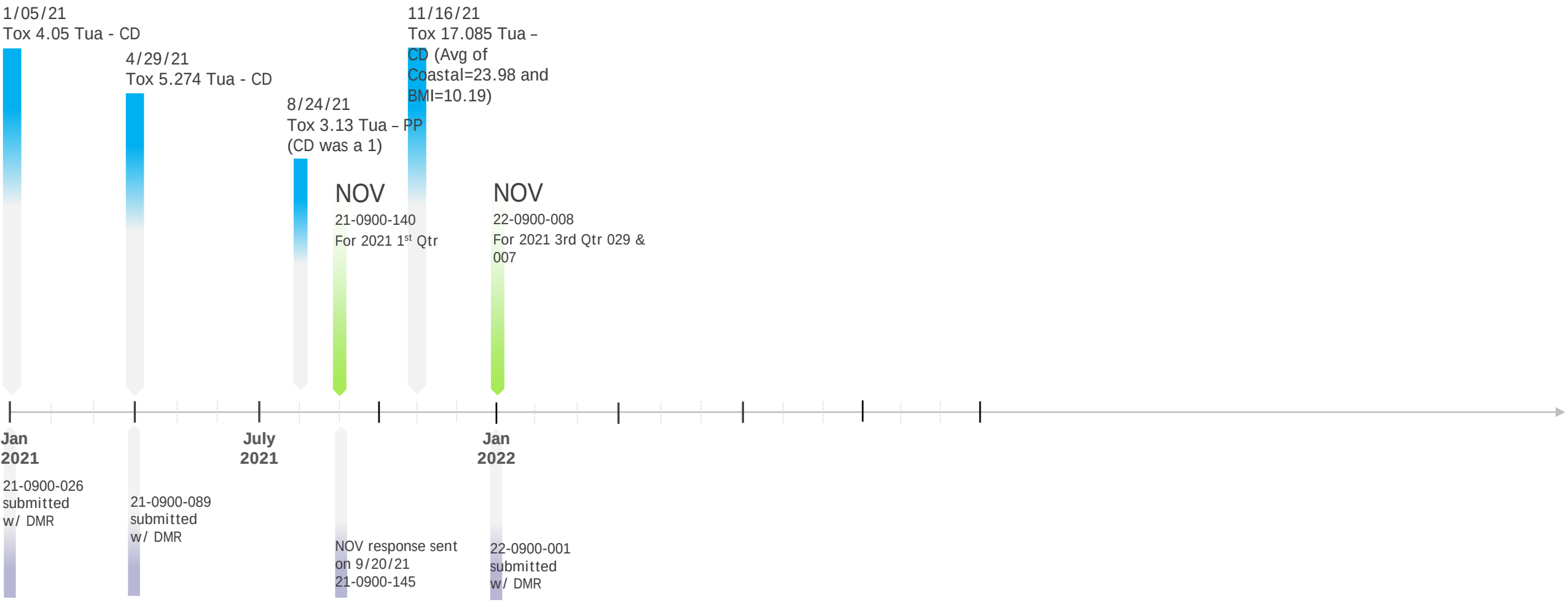
[4] Cherry, D & G. Boardman. 2010. Evaluation of Industrial Wastewater Treatment Facility (Bioplant) at the Radford Army Ammunition Plant, Virginia. Department of Biological Sciences and Department of Civil and Environmental Engineering, Virginia Tech, Blacksburg, VA 24061.

[5] Burton, D.T, S.D. Turley, G.T. Peters. 1993. Toxicity of Nitroguanidine, Nitroglycerin, Hexahydro-1,3,5-Trinitro-1,3,5-Triazine (RDX), and 2,4,6-Trinitrotoluene (TNT) to selected freshwater aquatic organisms. University of Maryland System, Wye Research and Education Center. US Army Medical Research and Development Command.

[6] Environmental Protection Agency. February 1991. Methods for Aquatic Toxicity Identification Evaluations: Phase I Toxicity Characterization Procedures, 2nd ed. EPA/600/6-91/003.

029 Excursions Timeline

Last updated: 1/12/2022
Author: SA



ACUTE TOXICITY BIOASSAY REPORT

BAE SYSTEMS

PACE JOB #: 7355894

CLIENT SAMPLE ID: OUTFALL 029

TEST ORGANISM: CERIODAPHNIA DUBIA

NPDES PERMIT #: VA0000248

Pace Analytical Services received a sample on 01-06-21
for the analyses presented in the following report

ACUTE TOXICITY BIOASSAY REPORT

Pace Job #: 7355894

Conducted For:

BAE Systems
Radford Army Ammunition Plant
P.O. Box 1
State Route 114
Radford, VA 24143

Conducted By:

Pace Analytical Services
225 Industrial Park Road
P.O. Box 286
Beaver, WV 25813

Pace Analytical Services
225 Industrial Park Road
P O Box 286
Beaver WV 25813
TEL: (304) 255-2500
Website: www.pacelabs.com

Executive Summary

BAE Systems submitted a sample for an acute Whole Effluent Toxicity (WET) test to be conducted. The client sample ID was Outfall 029 and the Pace job number was 7355894. The NPDES permit number was VA0000248. The sample was collected on 01-05-21 and was delivered to the laboratory on 01-06-21. The acute toxicity test was initiated on 01-06-21 and utilized *Ceriodaphnia dubia* as the test species. The test was terminated after a 48-hour exposure period on 01-08-21.

The *Ceriodaphnia dubia* test results were as follows: The Lethal Concentration to 50% of the test organisms (LC50) was calculated to be 24.72 % effluent. This data corresponds to a Toxicity Unit-acute (TUa) of 4.05. In essence, this effluent was noticeably toxic with regards to the survival of the *Ceriodaphnia dubia*.

Please feel free to contact myself, or Ed Kirk, Director-Biological Division, should you have any comments or questions, or if we can be of any further assistance. We truly appreciate your business!

Sincerely,

Michael Lester
Bioassay Lab Manager
Pace Analytical Services

PACE ANALYTICAL
SAMPLE INFORMATION

Client: BAE Systems

Address: Radford Army Ammunition Plant
P.O. Box 1
State Route 114
Radford, VA 24143

Pace Job #: 7355894

Pace Sample ID: 7355894-001

Client Sample ID: Outfall 029

VPDES Permit #: VA0000248

Receiving Water Body Name: New River

Sample Type: 24-Hour Composite
Collected From: **Date**: 01-05-21 **Time**: 0000
Collected To: **Date**: 01-05-21 **Time**: 2359

Bioassay Tests Performed: 48-Hr Static Acute Non-Renewal

Test Procedure: EPA Methods Manual 821-R-02-012; October 2002
ENV-SOP-BEAV-TOX-ACUTE-REV.01

Test Method: *Ceriodaphnia dubia* 2002.0

Measured Effect: Death or erratic behavior

Test Organisms: *Ceriodaphnia dubia* **Age**: < 24 Hrs

Last Reference Test Date: 12-03-20

Reference Toxicant Used and Results: KCL, acceptable results

Dilution Water Used: Moderately Hard Synthetic Freshwater

Test Beginning: **Date**: 01-06-21 **Time**: 1305

Test Ending: **Date**: 01-08-21 **Time**: 1230

PACE ANALYTICAL
TEST RESULTS

Pace Sample ID: 7355894-001
Client Sample ID: Outfall 029

Client Name: BAE Systems
VPDES Permit #: VA0000248

Ceriodaphnia dubia

Statistical Test Method	LC-50	TUA	95% Confidence Limits	Qualifier Data
Probit	24.72	4.05	19.69 and 31.02	

19 of 20 test organisms died in the 100.0 % effluent. 18 of 20 test organisms died in the 50.0 %; 12 of 20 died in the 25.0 %, and 2 of 20 died in the 12.5 % test concentrations. All test organisms survived in the 6.25 % test concentration and in the control.

Key:
TUA - Toxicity Units - Acute
LC50 - Lethal Concentration to 50% of population

Qualifiers:
P - Initial pH falls outside the range of 6.0 - 9.0
H - 36 Hour Hold Time Exceeded
T - Initial Temperature exceeded 0 - 6º Range

DATE 01/12/21

APPROVED Michael Lester
Michael Lester
Bioassay Lab Manager

PACE ANALYTICAL
TOXICITY TEST CONDITIONS

Client Name: BAE Systems

Pace Sample ID: 7355894-001
Client Sample ID: Outfall 029
VPDES Permit #: VA0000248

Test Species: *Ceriodaphnia dubia*
Organism Source: In-house Cultures

Exposure Chamber
- Container Type: Tripour disp.
- Total vessel capacity: 50 ml
- Test solution volume: 30 ml
- Water depth: Constant X
  - Cyclic ___

Aeration During Test
- None: X
- Slow: ____
- Moderate: ____
- Vigorous: ___
- Time aeration began: _____

Feeding Schedule
- Not fed: ___
- Fed daily: ___
- Fed prior to test: X

Aeration Prior To Test Initiation
- Moderate: ____
- Minutes: 10

Photoperiod
- 16Hr/8Hr: X
- Other (specify): _____

Place Test Conducted
- Environmental Chamber: X

Vessel type and volume used to deliver effluent and diluent to test chambers: 500 ml volumetric flask, a 250 ml graduated cylinder, and a micro-pipette

Material(s) used to place test organisms into test chambers: Large bore pipets

Condition of surviving organisms at end of test: Healthy

Comments:_____

Concentration (%)	Diluent (mls)	Effluent (mls)	Total (mls)
Control	500	0	500
6.25	468.75	31.25	500
12.5	437.5	62.5	500
25.0	375	125	500
50.0	250	250	500
100.0	0	500	500

Pace Sample ID: 7355894-001
Client Sample ID: Outfall 029

Client Name: BAE Systems
VPDES Permit #: VA0000248

Percent Survival of Test Organisms at Test Termination

Ceriodaphnia dubia

Concentration	% Survival
Control	100.0%
6.25	100.0%
12.5	90.0%
25.0	40.0%
50.0	10.0%
100.0	5.0%

Note: 48 Hr. % Survival Results

Pace Sample ID: 7355894-001

Attachment 1

Acute Cumulative Data Summary Sheet

Facility: BAE Systems

VPDES Permit #: VA0000248

Outfall #: 029

Test Date	Vertebrate	Invertebrate	LC50	TUA
04-16-19		X	>100.0	<1.0
07-21-19		X	>100.0	<1.0
10-04-19		X	>100.0	<1.0
01-10-20		X	>100.0	<1.0
04-10-20		X	26.72	3.74
08-12-20		X	>100.0	<1.0
10-16-20		X	>100.0	<1.0
01-08-21*		X	24.72	4.05

Notes: * Results are submitted with this report.

Pace Sample ID: 7355894-001

Attachment 2

Facility:	BAE Systems	**VPDES Permit #:**	VA0000248
Outfall #:	029	**Receiving Stream:**	New River
Test Period:	3rd Quarter		

Summary of Test Conditions

Test Start:	01-06-21	**Time:**	1305
Test End:	01-08-21	**Time:**	1230
Test Type:	48-Hr. Static Acute Non-Renewal		

Test organisms: *Ceriodaphnia dubia* **Age:** < 24 Hours

Test chamber size: 50 ml **Volume:** 30 ml

Diluent: Moderately Hard Synthetic Freshwater

Pace Sample ID: 7355894-001
Client Sample ID: Outfall 029

Client Name: BAE Systems
VPDES Permit #: VA0000248

Attachment 2 (Continued)

Range of Values Measured During Test

	Parameter		Effluent	Diluent
1.	Chlorine (mg/l)	initial	0.00	0.00
		adjusted	NA	NA
2.	pH	initial	8.43 - 8.81	8.11 - 8.31
		adjusted	NA	NA
3.	Alkalinity (mg/l as CACO3)		279	63.3
4.	Hardness (mg/l as CACO3)		105	93.8
5.	Conductivity (umhos/cm)		744 - 786	345 - 361
6.	D.O. (mg/l)		7.8 - 7.8	7.2 - 7.8
7.	Methods used for adjustment			
		Chlorine	NA	
		pH	NA	

Pace Sample ID: 7355894-001
Client Sample ID: Outfall 029

Client Name: BAE Systems
VPDES Permit #: VA0000248

Attachment 2 (Continued)

Test Results Acute

1. Test Acceptability

Control survival %		100.0 %
2. Methods of statistical analyses		Probit
3. Statistical Results	LC50	24.72
	TUA	4.05

Key:
LC50 - Lethal Concentration to 50% of population
TUA - Toxicity Units Acute

Pace Sample ID: 7355894-001

Attachment 3

Toxicity Test Conditions And Results

Sample Description

Facility: BAE Systems

VPDES Permit #: VA0000248

Outfall #: 029

Sample Collected From: **Date:** 01-05-21 **Time:** 0000

Sample Collected To: **Date:** 01-05-21 **Time:** 2359

Sample Type: 24-Hr. Composite

Collector: BAE Systems **Affiliation:** BAE Systems

Delivery: Pace courier

Test Conditions

Type: 48-Hr. Static Acute Non-Renewal

Start Date: 01-06-21 **Time:** 1305

End Date: 01-08-21 **Time:** 1230

Organism: *Ceriodaphnia dubia* **Age:** < 24 Hours

Chamber size: 50 ml **Volume**: 30 ml

Concentrations: Control, 6.25%, 12.5%, 25.0%, 50.0%, and 100.0%

Number Replicates: 4

Organisms Per Replicate: 5

Feeding Prior to Test: YAT and Selenastrum

Feeding During Test: None

Photo Period: 16 hrs. light/8 hrs. darkness

Pace Sample ID: 7355894-001 Client Name: BAE Systems
Client Sample ID: Outfall 029 VPDES Permit #: VA0000248

Attachment 3 (Continued)

Equipment

pH meter Oakton pH 700 Series

DO meter HACH HQ40d

Conductivity meter Hanna Edge

Temperature meter Oakton pH 700 Series

Chlorine Meter Hanna HI96781

Comments:

Pace Sample ID: 7355894-001 Client Name: BAE Systems
Client Sample ID: Outfall 029 VPDES Permit #: VA0000248

Attachment 4

Reftox Data

Ceriodaphnia dubia

LC50 = 0.66 g/l
NOAEC = 0.50 g/l

Reference toxicant test conducted on 12-03-20

Note: Potassium chloride was used as the reference toxicant KCL –Potassium Chloride, GFS

PACE TOXICITY TEST DATA

Client: BAE Systems	**Test Beginning**:	**Date**: 01-06-21	**Time**: 1305
Client Sample ID: Outfall 029	**Test Ending**:	**Date**: 01-08-21	**Time**: 1230
Pace Sample ID: 7355894-001	**Dilution Water**: Moderately Hard Synthetic Freshwater		
NPDES Permit #: VA0000248	**Test Organism**: *Ceriodaphnia dubia*		**Age**:<24 Hrs
Bioassay Test: 48-Hr. Static Acute Non-Renewal	**Isolation Date**: 01-05-21	**Time**: 0855	
Sample Collection Data	**# Replicates**: 4	**# Organisms/Rep**: 5	
Sample Volume: 2 Gallon **Sample Type**: Composite	**Effluent**		**Dilution Water**
Collected From: **Date**: 01-05-21 **Time**: 0000	**Alkalinity** 279 mg/L	**Chlorine** 0.00	**Alkalinity** 63.8 mg/L
Collected To: **Date**: 01-05-21 **Time**: 2359	**Hardness** 105 mg/L	**Dechlorinated** NA	**Hardness** 93.8 mg/L

Test Concentration (%)	Number of Live Organisms			Dissolved Oxygen (mg/l)			pH (SU)			Conductivity (umhos)			Test Temperature (°C)		
	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs
Control A	5	5	5	7.3	7.8	7.2	8.11	8.31	8.30	345		361	24.8	22.4	23.9
Control B	5	5	5												
Control C	5	5	5												
Control D	5	5	5												
6.25 A	5	5	5	7.5	7.9	7.6	8.18	8.38	8.39	374		392	24.7	23.0	24.2
6.25 B	5	5	5												
6.25 C	5	5	5												
6.25 D	5	5	5												
12.5 A	5	5	5	7.6	7.9	7.7	8.23	8.40	8.45	399		411	24.3	23.0	24.4
12.5 B	5	5	5												
12.5 C	5	5	4												
12.5 D	5	4	4												
25.0 A	5	4	4	7.6	7.9	7.7	8.30	8.51	8.56	446		469	24.2	23.8	23.8
25.0 B	5	2	2												
25.0 C	5	2	2												
25.0 D	5	1	0												
50.0 A	5	3	1	7.7	7.9	7.8	8.38	8.64	8.75	547		594	24.1	23.9	23.9
50.0 B	5	2	0												
50.0 C	5	3	1												
50.0 D	5	0	0												
100.0 A	5	1	0	7.8	7.8	7.8	8.43	8.71	8.81	744		786	24.6	23.6	23.8
100.0 B	5	1	0												
100.0 C	5	3	1												
100.0 D	5	0	0												
Initials	DL	TG	DL												
Time	1305	1320	1230												
Comments:															

Daphnid Acute Test-48 Hour

Start Date:	1/6/2021 13:05	Test ID:	7355894cd	Sample ID:	Outfall 029
End Date:	1/8/2021 12:30	Lab ID:	PACE-WV01040	Sample Type:	DMR-Discharge Monitoring Report
Sample Date:	1/5/2021 23:59	Protocol:	EPAAW02-EPA/821/R-02-01	Test Species:	CD-Ceriodaphnia dubia
Comments:					

Conc-%	1	2	3	4
Hard Synthetic	1.0000	1.0000	1.0000	1.0000
6.25	1.0000	1.0000	1.0000	1.0000
12.5	1.0000	1.0000	0.8000	0.8000
25	0.8000	0.4000	0.4000	0.0000
50	0.2000	0.0000	0.2000	0.0000
100	0.0000	0.0000	0.2000	0.0000

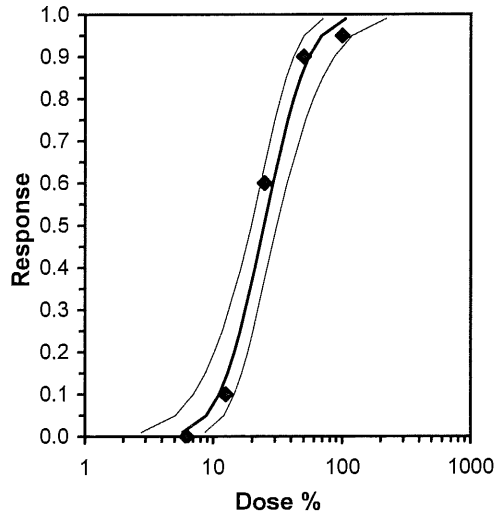
			Transform: Arcsin Square Root					Number	Total
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
Hard Synthetic	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	0	20
6.25	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	0	20
12.5	0.9000	0.9000	1.2262	1.1071	1.3453	11.212	4	2	20
25	0.4000	0.4000	0.6755	0.2255	1.1071	53.304	4	12	20
50	0.1000	0.1000	0.3446	0.2255	0.4636	39.900	4	18	20
100	0.0500	0.0500	0.2850	0.2255	0.4636	41.771	4	19	20

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.05)	0.86279	0.916	-0.0736	4.44942
Equality of variance cannot be confirmed				

Maximum Likelihood-Probit

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	3.68876	0.60483	2.50329	4.87423	0	3.61407	7.81473	0.30627	1.39297	0.27109	4
Intercept	-0.1384	0.86088	-1.8257	1.54898							
TSCR											

Point	Probits	%	95% Fiducial Limits	
EC01	2.674	5.78517	2.77266	8.63747
EC05	3.355	8.85249	5.10188	12.1229
EC10	3.718	11.1059	7.02287	14.6046
EC15	3.964	12.9421	8.67979	16.6227
EC20	4.158	14.6156	10.2386	18.4824
EC25	4.326	16.2228	11.7619	20.3039
EC40	4.747	21.1006	16.39	26.1886
EC50	5.000	24.7158	19.6889	31.0207
EC60	5.253	28.9505	23.3249	37.2595
EC75	5.674	37.6552	30.0902	51.9121
EC80	5.842	41.7959	33.0572	59.6323
EC85	6.036	47.2004	36.757	70.3392
EC90	6.282	55.0042	41.8378	86.9312
EC95	6.645	69.0056	50.4041	119.659
EC99	7.326	105.593	70.7462	220.172



CHAIN OF CUSTODY RECORD

REIC

Research Environmental & Industrial Consultants, Inc.
MAIN LABORATORY & CORPORATE HEADQUARTERS:

P.O. Box 286 * 225 Industrial Park Road, Beaver, WV 25813
800-999-0105 * 304-255-2500 * www.reiclabs.com

MID-OHIO VALLEY Service Center
101 17th Street
Ashland, KY 41101
606-393-5027

SHENANDOAH Service Center
1557 Commerce Rd, Ste. 201
Verona, VA 24482
540-248-0183

ROANOKE Service Center
3029-C Peters Creek Rd
Roanoke, VA 24019
540-777-1276

V5-1109

REIC use ONLY — Client ID: _____ Date: _____ Sheet: ___

Client Name: BAE Systems/ RFAAP — P.O. #: RFAC-071219-01-SJM
Contact Person: Sheree Andrews — Phone #: 540-639-7215
Email Address: sheree.andrews@baesystems.com — Cell Phone #: 540-717-4092
Address: Route 114, P.O. Box 1 — City: Radford — State: VA — Zip: 24143
Billing Address (If Different): _____
City: _____ State: _____ Zip: _____
Site ID & State: _____ Sampler: _____
NPDES Permit #: VA 0000248 — Outfall #: 029
Receiving Stream: New River
From Where and How Sample was Collected: Outfall 029 Composite sampler
Rain Event: _____ Flow: _____

SAMPLE ID	NUMBER & TYPE OF CONTAINERS	COLLECTION DATE AND TIME FROM Date	FROM Time	TO Date	TO Time	SAMPLE COMP / GRAB	Test Type	Test Species
029 Q1 Tox	2 cubes	1/5/21	0000	1/5/21	2359	Comp	◉ Acute	☒ Ceriodaphnia dubia
[redacted]							○ Chronic	☐ Daphnia magna
							○ Screen	☐ Daphnia pulex

☐ Pimephales promelas (Fathead Minnow)

All analytical requests are subject to REIC's Standard Terms and Conditions.

Field Readings	Comments	REIC USE ONLY	
Temperature: 4°C		Temperature:	°C
pH: No Meter	#1 0.9 73Tm88	pH:	SU
Conductivity: No Meter	#2 1.4	Conductivity:	µmhos/cm
DO: No Meter		DO:	mg/L
Chlorine: NA		Chlorine:	mg/L
Is the Sample: ○ Chlorinated ○ Dechlorinated		Sample Appearance:	
Dechlorination Method: NA		Sample Odor:	
Should REIC Dechlorinate Sample: ○ YES ◉ NO		Date Sample Received:	
Date: 1.6.21 Time: 0800		Sample Storage During Shipment:	
Sample Appearance: Clear		Method of Shipment to REIC:	
Sample Odor: NONE		Time: Initials:	

1	Denise Vaughn — Relinquished By (Signature):	1.6.21 / 0915 — Date / Time	2 Relinquished By (Signature): 1-6-21 1230 Date / Time
	Received By (Signature):	1-6-21 0915 — Date / Time:	Received By (Signature): 010621 1230 Date / Time

TOXICITY TEST DATA SHEET

INITIAL READINGS

Pace Job # 7355894-001

Client Name BAE

Client Sample ID Outfall 029

Sample Type Composite

Date Received 01-06-21

Sampling From		Sampling To	
Date 01-05-21	Time 0000	Date 01-05-21	Time 2359

Dissolved Oxygen 10.2

pH 8.22

Conductivity 768

Temperature 1.4

Chlorine HANNA HI 96781 Reagent Lot # 409A 000

Chlorine HACH Model CN66/66F/66T Reagent Lot # ——

Appearance Clear

Odor Slight

Shipment Method Pace Courier

Sample Storage During Shipment On Ice In Cooler

Sample Storage Upon Arrival Bio WC 2

Date 01-06-21 Time 1250 Initials dl

PACE TOXICITY TEST DATA

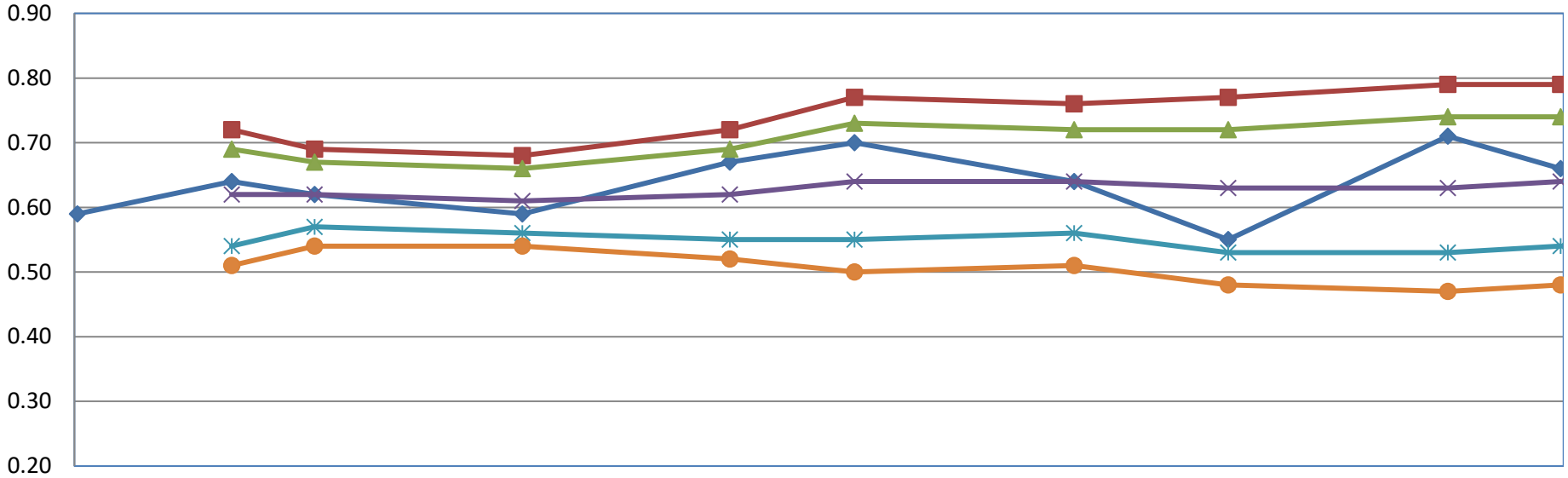
Client: BAE Systems OSG	Test Beginning:	Date: 01-06-21	Time: 1305
Client Sample ID: Surfton OSG	Test Ending:	Date: 01-08-21	Time: 1230
Pace Sample ID: 7355894-001	Dilution Water: Moderately Hard Synthetic Fresh		
NPDES Permit #: VA 0000248	Test Organism: Ceriodaphnia dubia		Age: < 24hrs
Bioassay Test: 48 Hr Static Acute Non-Renewal	Isolation Date: 01-05-21		Time: 0855
Sample Collection Data	# Replicates: 4	# Organisms/Rep: 5	

			Effluent			Dilution Water
Sample Volume: 2 gallon	Sample Type: Composite					
Collected From: Date: 01-05-21	Time: 0000		Alkalinity 279	Chlorine 0.00	Alkalinity	63.3
Collected To: Date: 01-05-21	Time: 2359		Hardness 105	Dechlorinated NA	Hardness	93.8

Test Concentration (%)	Number of Live Organisms			Dissolved Oxygen (mg/l)			pH (SU)			Conductivity (umhos)			Test Temperature (°C)		
	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs
Control A	5	5	5	7.3	7.8	7.2	8.11	8.31	8.30	345		361	24.8	22.4	23.9
Control B	5	5	5												
Control C	5	5	5												
Control D	5	5	5												
6.25 A	5	5	5	7.5	7.9	7.6	8.18	8.38	8.39	374		392	24.7	23.0	24.2
B	5	5	5												
C	5	5	5												
D	5	5	5												
12.5 A	5	5	5	7.6	7.9	7.7	8.23	8.40	8.45	399		411	24.3	23.0	24.4
B	5	~~4~~ 5	5												
C	5	5	4												
D	5	4	4												
25.0 A	5	4	4	7.6	7.9	7.7	8.30	8.51	8.56	446		469	24.2	23.8	23.8
B	5	2	3												
C	5	2	3												
D	5	1	0												
50.0 A	5	3	1	7.7	7.9	7.8	8.38	8.64	8.75	547		594	24.1	23.9	23.9
B	5	2	0												
C	5	3	1												
D	5	0	0												
100.0 A	5	1	0	7.8	7.8	7.8	8.43	8.71	8.81	744		786	24.6	23.6	23.8
B	5	1	0												
C	5	3	1												
D	5	0	0												
Initials	dl	[illegible]	dl												
Time	1305	~~1261~~ 1320	1230												
Comments:		[illegible] 01-07-2021													

[illegible] 1-11-21

Acute Reftox Data - 48 Hour (LC50) - Ceriodaphnia dubia



	03/28 (2020)	04/23 (2020)	05/07 (2020)	06/11 (2020)	07/16 (2020)	08/06 (2020)	09/12 (2020)	10/08 (2020)	11/14 (2020)	12/03 (2020)
LC50	0.59	0.64	0.62	0.59	0.67	0.70	0.64	0.55	0.71	0.66
MaxL		0.72	0.69	0.68	0.72	0.77	0.76	0.77	0.79	0.79
UCL		0.69	0.67	0.66	0.69	0.73	0.72	0.72	0.74	0.74
MEAN		0.62	0.62	0.61	0.62	0.64	0.64	0.63	0.63	0.64
LCL		0.54	0.57	0.56	0.55	0.55	0.56	0.53	0.53	0.54
MinL		0.51	0.54	0.54	0.52	0.50	0.51	0.48	0.47	0.48

	STDEV	MaxL	UCL	MEAN	LCL	MinL
Current:	**0.051**	**0.79**	**0.74**	**0.64**	**0.54**	**0.48**

LC50 = Lethal Concentrations to 50% of population	
STDEV = Standard Deviation	Standard Deviation of LC50
MaxL = Maximum Limit	MEAN + STDV x 3
UCL - Upper Control Limit	MEAN + STDV x 2
MEAN = Average	Average of LC50
LCL = Lower Control Limit	MEAN - STDV x 2
MinL = Minimum Limit	MEAN - STDV x 3

Coefficient of Variance (%) = STDEV x 100 / MEAN

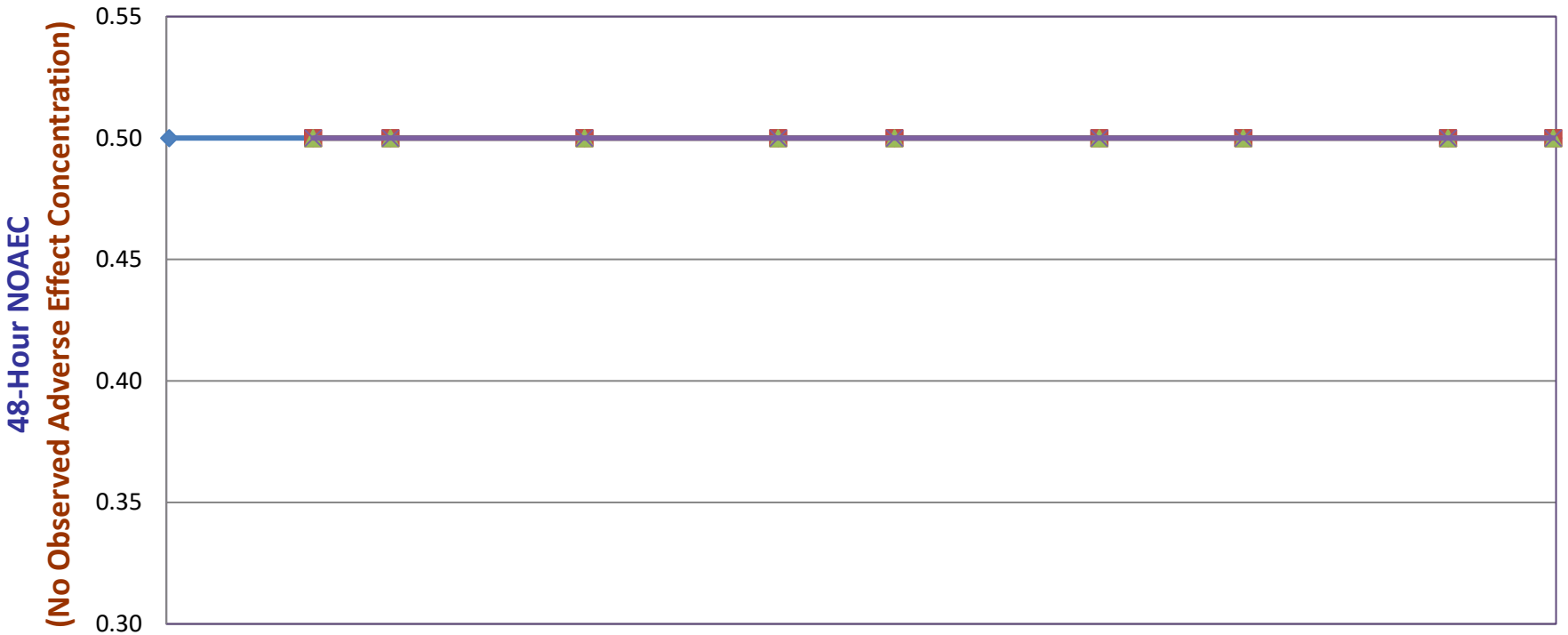
7.97

Note: Test performed @ 25°C

Potassium Chloride (KCl)-Toxicant

LC50 - g/l

Acute Reftox Data (48-Hour NOAEC) - Ceriodaphnia dubia



	03/28 (2020)	04/23 (2020)	05/07 (2020)	06/11 (2020)	07/16 (2020)	08/06 (2020)	09/12 (2020)	10/08 (2020)	11/14 (2020)	12/03 (2020)
NOAEC	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
UCL		0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
MEAN		0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
LCL		0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50

	STDEV	UCL	MEAN	LCL
Current:	**0.000**	**0.50**	**0.50**	**0.50**
NOAEC = No Observed Adverse Effect Concentration				
STDEV = Standard Deviation		Standard Deviation of LC50		
UCL - Upper Control Limit		MEAN + STDV x 2		
MEAN = Average		Average of LC50		
LCL = Lower Control Limit		MEAN - STDV x 2		

Coefficient of Variance (%) = STDEV x 100 / MEAN

0.00

Note: Test performed @ 25°C

Potassium Chloride (KCl)-Toxicant

LC50 - g/l

ENTHALPY ANALYTICAL
formerly Air, Water & Soil Laboratories

1941 Reymet Road ● Richmond, Virginia 23237 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Laboratory Order ID 21D1297

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford, VA 24141	Date Received:	April 30, 2021 13:31
		Date Issued:	May 6, 2021 13:02
		Project Number:	[none]
Submitted To:	Sheree Andrews	Purchase Order:	RFAC-032621-01-RLL
Client Site I.D.:	029 2nd Quarter Toxicity		

Enclosed are the results of analyses for samples received by the laboratory on 04/30/2021 13:31. If you have any questions concerning this report, please feel free to contact the laboratory.

Sincerely,

Ted Soyars

Ted Soyars
Technical Director

End Notes:

The test results listed in this report relate only to the samples submitted to the laboratory and as received by the Laboratory.

Unless otherwise noted, the test results for solid materials are calculated on a wet weight basis. Analyses for pH, dissolved oxygen, temperature, residual chlorine and sulfite that are performed in the laboratory do not meet NELAC requirements due to extremely short holding times. These analyses should be performed in the field. The results of field analyses performed by the Sampler included in the Certificate of Analysis are done so at the client's request and are not included in the laboratory's fields of certification nor have they been audited for adherence to a reference method or procedure.

The signature on the final report certifies that these results conform to all applicable NELAC standards unless otherwise specified. For a complete list of the Laboratory's NELAC certified parameters please contact customer service.

This report shall not be reproduced except in full without the expressed and written approval of an authorized representative of Air Water & Soil Laboratories, Inc.

NELAP ACCREDITED TNI LABORATORY

ENTHALPY ANALYTICAL
formerly Air, Water & Soil Laboratories

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued:	May 06, 2021 13:02
		Project Number:	[none]
		Purchase Order:	RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	029 2nd Quarter Toxicity		

ANALYTICAL REPORT FOR SAMPLES

Laboratory Order ID 21D1297

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
029 Tox	21D1297-01	Waste Water	04/29/2021 00:00 to 04/29/2021 23:59	04/30/2021 13:31

Analysis for Toxicity was subcontracted to Coastal Bioanalysts. The subcontracted results are attached at the end of this Certificate of Analysis.

ENTHALPY ANALYTICAL
formerly Air, Water & Soil Laboratories

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued:	May 06, 2021 13:02
		Project Number:	[none]
		Purchase Order:	RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	029 2nd Quarter Toxicity		

Laboratory Order ID: 21D1297

Analytical Results

Sample I.D. 029 Tox **Laboratory Sample ID:** 21D1297-01

Composite Start-End Date/Time: 04/29/2021 00:00 - 04/29/2021 23:59

Field Residual Cl: **Field pH:**

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Subcontracted Analysis									
Acute Toxicity CD	01	EPA	Attached		--	1	05/06/21 12:43	05/06/21 12:43	N/A

Analytical Summary

Sample ID	Preparation Factors Initial / Final	Method	Batch ID	Sequence ID	Calibration ID
Subcontracted Analysis		**Preparation Method:**	***** DEFAULT PREP *****		
21D1297-01	1.00 mL / 1.00 mL	EPA	BEE0187		

ENTHALPY ANALYTICAL
formerly Air, Water & Soil Laboratories

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued:	May 06, 2021 13:02
		Project Number:	[none]
		Purchase Order:	RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	029 2nd Quarter Toxicity		

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual

ENTHALPY ANALYTICAL
formerly Air, Water & Soil Laboratories

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued:	May 06, 2021 13:02
		Project Number:	[none]
		Purchase Order:	RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	029 2nd Quarter Toxicity		

Certified Analyses included in this Report

Analyte	Certifications

Code	Description	Laboratory ID	Expires
MdDOE	Maryland DE Drinking Water	341	12/31/2021
NC	North Carolina DENR	495	12/31/2021
NCDEQ	North Carolina DEQ	495	12/31/2021
NCDOH	North Carolina Department of Health	51714	07/31/2021
NJDEP	NELAC-New Jersey DEP	VA015	06/30/2021
PADEP	NELAC-Pennsylvania Certificate #006	68-03503	10/31/2021
VELAP	NELAC-Virginia Certificate #11064	460021	06/14/2021
WVDEP	West Virginia DEP	350	06/30/2021

ENTHALPY ANALYTICAL
formerly Air, Water & Soil Laboratories

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued:	May 06, 2021 13:02
		Project Number:	[none]
		Purchase Order:	RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	029 2nd Quarter Toxicity		

Summary of Data Qualifiers

Attached	Attached
RPD	Relative Percent Difference
Qual	Qualifers
-RE	Denotes sample was re-analyzed
D.F.	Dilution Factor. Please also see the Preparation Factor in the Analysis Summary section.
TIC	Tentatively Identified Compounds are compounds that are identified by comparing the analyte mass spectral pattern with the NIST spectral library. A TIC spectral match is reported when the pattern is at least 75% consistent with the published pattern. Compound concentrations are estimated and are calculated using an internal standard response factor of 1.
PCBs, Total	Total PCBs are defined as the sum of detected Aroclors 1016, 1221, 1232, 1248, 1254, 1260, 1262, and 1268.

ENTHALPY ANALYTICAL
formerly *Air, Water & Soil Laboratories*

1941 REYMET ROAD
RICHMOND, VIRGINIA 23237
(804) 358-8295 PHONE
(804)358-8297 FAX

Chain of Custody
Effective: Nov 15, 2018

CHAIN OF CUSTODY

COMPANY NAME: BAE Systems, Inc. - RFAAP	INVOICE TO: Accounts Payable	PROJECT NAME: 029 2nd Quarter Toxicity
CONTACT: Sheree Andrews	INVOICE CONTACT:	SITE NAME:
ADDRESS: Route 114 Radford, Va 24141	INVOICE ADDRESS:	PROJECT NUMBER:
PHONE #: 1-540-717-4092	INVOICE PHONE #:	P.O. #:
FAX #: EMAIL: Sheree.andrews@baesystems.com		Pretreatment Program:
Is sample for compliance reporting? YES	Regulatory State: Va / Is sample from a chlorinated supply? YES NO	PWS I.D. #:
SAMPLER NAME (PRINT): Denise Vaughn	SAMPLER SIGNATURE: Denise Vaughn	Turn Around Time: Circle 10 5 Days or _Day(s)

Matrix Codes: WW=Waste Water/Storm Water GW=Ground Water DW=Drinking Water S=Soil/Solids OR=Organic A=Air WP=Wipe OT=Other_____

CLIENT SAMPLE I.D.	Grab	Composite	Field Filtered (Dissolved Metals)	Composite Start Date	Composite Start Time	Grab Date or Composite Stop Date	Grab Time or Composite Stop Time	Time Preserved 4.30.21	Matrix (See Codes)	Number of Containers	ANALYSIS / (PRESERVATIVE): Acute Toxicity - Ceriodaphnia dubia								COMMENTS: Preservative Codes: N=Nitric Acid C=Hydrochloric Acid S=Sulfuric Acid H=Sodium Hydroxide A=Ascorbic Acid Z=Zinc Acetate T=Sodium Thiosulfate M=Methanol; PLEASE NOTE PRESERVATIVE(S), INTERFERENCE CHECKS or PUMP RATE (L/min)
1) 029 Tox		X		4.29.21	0000	4.29.21	2359	0915	WW	2	X								
2)																			
3)																			
4)																			
5)																			
6)																			
7)																			
8)																			
9)																			
10)																			

RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME
Denise Vaughn	4.30.21 / 0941		4/30/21 0941
RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME
	4/30/21 1331		
RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME

QC Data Package
Level III ☐
Level IV ☐

LAB USE ONLY Therm ID: 271 COOLER TEMP 0.8 °C
Custody Seals used and intact? (Y / N) Received on ice? (Y / N)

BAE Systems, Inc. 21D1297
Toxicity
Recd: 04/30/2021 Due: 05/07/2021

v130325002

ENTHALPY ANALYTICAL
formerly Air, Water & Soil Laboratories

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued:	May 06, 2021 13:02
		Project Number:	[none]
		Purchase Order:	RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	029 2nd Quarter Toxicity		

Sample Conditions Checklist

Samples Received at:	**0.80°C**
How were samples received?	AWS Courier
Were Custody Seals used? If so, were they received intact?	No
Are the custody papers filled out completely and correctly?	Yes
Do all bottle labels agree with custody papers?	Yes
Is the temperature blank or representative sample within acceptable limits or received on ice, and recently taken?	Yes
Are all samples within holding time for requested laboratory tests?	Yes
Is a sufficient amount of sample provided to perform the tests included?	Yes
Are all samples in appropriate containers for the analyses requested?	Yes
Were volatile organic containers received?	No
Are all volatile organic and TOX containers free of headspace?	NA
Is a trip blank provided for each VOC sample set? VOC sample sets include EPA8011, EPA504, EPA8260, EPA624, EPA8015 GRO, EPA8021, EPA524, and RSK-175.	NA
Are all samples received appropriately preserved? Note that metals containers do not require field preservation but lab preservation may delay analysis.	Yes

Samples logged on 15 Day TAT. THM 30 April 2021/14.23

Client: Enthalpy Analytical/Air, Water and Soil Laboratories
Project ID: AWSL2101
Client Sample ID: BAE-Radford Army Ammunition Plant Outfall 029
Permit No.: VA0000248
Sample Period: 4/29/21

Coastal Bioanalysts, Inc.

Report of Analysis: Whole Effluent Toxicity (WET)

Submitted To:	**Prepared By:**
Katrina Cooke Senior Project Manager Enthalpy Analytical/Air, Water and Soil Laboratories 1941 Reymet Road, Richmond, VA 23237	Coastal Bioanalysts, Inc. 6400 Enterprise Court Gloucester, VA 23061 (804) 694-8285 www.coastalbio.com Contact: Peter F. De Lisle, Technical Director

Acute Test Results*				
Species-Test Method	**Test Period**	**NOAEC**	**48-h LC50**	**T.U.$_{Ac}$**
C. dubia EPA 2002.0	5/1/21-5/3/21	N/A	21.5	**4.65**

Details regarding test conduct and data analysis provided in attached bench sheets and printouts as applicable.
For each test method record the T.U.$_{Ac}$ value (bold) on the DMR.

Acute Test QA/QC	**Reference Toxicant: KCl**	**Units: mg/l**	**Test Organism Source: CBI Stock Cultures**		
Species-Method (Ref. Test Date)	**Data Source**	**% Control Survival**	**48-h LC50**	**95% C.L./A.L. For LC50**	**RTT in Control?**
C. dubia 2002.0	RTT	100	527	490-566	Yes
(4/8/21-4/10/21)	CC	100	535	468-601	

Note: RTT = Reference Toxicant Test, CC = Control Chart.

The results of analysis contained within this report relate only to the sample as received in the laboratory. This report shall not be reproduced except in full without written approval from the laboratory. Unless noted below, these test results meet all requirements of NELAP.

APPROVED: Peter F. De Lisle

Digitally signed by Peter F. De Lisle
DN: cn=Peter F. De Lisle, o=Coastal Bioanalysts, Inc., ou=Toxicology, email=pfd@coastalbio.com, c=US
Date: 2021.05.06 12:34:10 -04'00'

Peter F. De Lisle, Ph.D.
Technical Director

Deviations from, additions to, or exclusions from the test method, non-standard conditions or data qualifiers and, as appropriate, a statement of compliance/non-compliance: **NONE**

Please leave feedback regarding our services at: http://coastalbio.com/survey

VELAP# 460030
EPA# VA01116

NELAP ACCREDITED LABORATORY

Coastal Bioanalysts, Inc.

GLOSSARY OF TERMS AND ABBREVIATIONS

A.L. (Acceptance Limits): The results of a given reference toxicant test are compared to the control chart mean value ± 2 standard deviations. These limits approximate the 95% probability limits for the "true" reference toxicant value.

Chronic Value (ChrV): The geometric mean of the NOEC and LOEC. Units are same as test concentration units.

C.L. (Confidence Limits): These are the probability limits, based on the data set and statistical model employed, that the "true value" lies within the limits specified. Typically limits are based on 95% or 99% probabilities.

Control chart: A cumulative summary chart of results from QC tests with reference toxicants. The results of a given reference toxicant test are compared to the control chart mean value and 95% Acceptance Limits (A.L.) (mean ± 2 standard deviations).

IC25: The concentration of sample or chemical, calculated from the data set using statistical models, causing a 25% reduction in test organism growth, reproduction, etc. The lower the IC25, the more toxic the chemical or sample. Units are same as test concentration units.

LC50: The concentration of sample or chemical, calculated from the data set using statistical models, causing a 50% reduction in test organism survival. The lower the LC50, the more toxic the chemical or sample. Units are same as test concentration units. Note: The LC50 value must always be associated with the duration of exposure. Thus 48-h LC50, 96-h LC50, etc. are calculated.

LOEC: Lowest-observable-effect-concentration. The lowest concentration of sample or chemical in a chronic test dilution series in which the test organisms exhibit a statistically significant reduction in any of the test end points (e.g. growth, survival, reproduction) compared to control organisms. Units are same as test concentration units.

PMSD: Percent Minimum Significant Difference: The minimum difference which can exist between a test treatment and the controls in a particular test and be statistically significant; a measure of test sensitivity. The lower the PMSD the more sensitive the test.

N/A: Not applicable.

N/D: Not determined or measured.

NOAEC: No-observable-acute-effect-concentration. The highest concentration of sample or chemical in an acute test dilution series in which the test organisms exhibit no statistically significant reduction in the test end point (e.g. survival) compared to control organisms. Units are same as test concentration units.

NOEC: No-observable-effect-concentration. The highest concentration of sample or chemical in a chronic test dilution series in which the test organisms exhibit no statistically significant reduction in any of the test end points (e.g. growth, survival, reproduction) compared to control organisms. Some regulatory definitions also require that the NOEC be less than the LOEC. Units are same as test concentration units.

Q.L.: Quantitation Limit. Level, concentration, or quantity of a target variable (analyte) that can be reported at a specified degree of confidence.

T.U.: Toxic units. Expresses the relative toxicity of an effluent in such a manner that the larger the toxic unit value the more toxic the effluent. $T.U._{Ac} = 100/LC50$. $T.U._{Chr} = 100/NOEC$. A dimensionless unit.

VELAP# 460030
EPA# VA01116

C. dubia daily biological measurements (EPA 2002.0) Template version ACD-STAT-5trt-061113

TRTMNT (% Effl)	Rep	#Live Day 0	#Live Day 1	#Live Day 2	Final Mean % Live		
C	A	5	4	4	95.0		
	B	5	5	5			
Lab	C	5	5	5			
Control	D	5	5	5			
#1	A	5	5	5	100.0		
6.25	B	5	5	5			
% Effl	C	5	5	5			
	D	5	5	5			
# 2	A	5	5	5	90.0		
12.5	B	5	5	5			
% Effl	C	5	4	4			
	D	5	4	4			
# 3	A	5	5	5	35.0		
25.0	B	5	5	2			
% Effl	C	5	2	0			
	D	5	2	0			
# 4	A	5	5	0	0.0		
50.0	B	5	5	0			
% Effl	C	5	0	0			
	D	5	0	0			
# 5	A	5	5	0	0.0		
100	B	5	4	0			
% Effl	C	5	0	0		Test Duration:	48h 16m
	D	5	0	0			TAC 48+/-0.5h
INITIALS:		AK	CPV	LT	% CONTROL SURVIVAL:		95.0
DATE & TIME:		5/1/21 10:41	5/2/21 9:29	5/3/21 10:57			TAC = 90%
CHANGES & NOTES (INITIALS, DATE, SPECIFIC CHANGE MADE							

SPECIES:	Ceriodaphnia dubia		
ACCLIMATION WATER:	Mod. Hard Synthetic Freshwater		
FEEDING PRIOR TO TEST:	YCT + Selenastrum capricornutum		
FEEDING DURING TEST:	None -YCT + Selenastrum 2+ h before test		
SOURCE:	CBI Stock cultures		
ACCLIMATION TEMP (o C):	25		
BROOD RELEASE START DATE & TIME:	4/30/21 22:00		
BROOD RELEASE END DATE & TIME:	5/1/21 6:00		
DATE/TIME WATER ADDED:	5/1/21 10:35		
DATE/TIME ANIMALS ADDED:	5/1/21 10:41		
ANIMAL AGE WINDOW:	8h 0m		
MAX AGE AT TEST START:	12h 41m		TAC Max. 24 h
TEST SET UP BY:		AK	
SAMPLE COLLECTION DATE &TIME:	4/29/21 23:59	SAMPLE USED	A
SAMPLE AGE AT TEST START:	34h 42m	TAC Max 36 h	
PEER REVIEW BY (INITIALS/DATE):		PB	5/6/21 11:34

TEST ID: AWSL2101ACD

Ceriodaphnia daily water quality bench sheet (EPA METHOD 2002.0) Template version ACD-STAT-5trt-061113

	TRTMNT	Day 0 Initial	Day 1	Day 2 Final	SUMMARY WATER QUALITY DATA MEAN	S.D.	MIN.	MAX.
pH (S.U.)	C	7.96	7.48	7.89	7.78	0.26	7.48	7.96
	1	7.98	7.59	7.98	7.85	0.23	7.59	7.98
	2	7.98	7.63	8.05	7.89	0.23	7.63	8.05
	3	7.98	7.70	8.09	7.92	0.20	7.70	8.09
	4	7.96	7.74	8.16	7.95	0.21	7.74	8.16
	5	7.93	7.88	8.52	8.11	0.36	7.88	8.52
Temp. (o C)	C	25	25	25	25	0.0	25	25
	1	25	25	25	25	0.0	25	25
	2	25	25	25	25	0.0	25	25
	3	25	25	25	25	0.0	25	25
	4	25	25	25	25	0.0	25	25
	5	25	25	25	25	0.0	25	25
Diss. Oxygen (mg/l)	C	8.2	7.7	8.2	8.0	0.3	7.7	8.2
	1	8.2	7.6	8.1	8.0	0.3	7.6	8.2
	2	8.2	7.5	8.3	8.0	0.4	7.5	8.3
	3	8.1	7.6	8.2	8.0	0.3	7.6	8.2
	4	8.0	7.5	8.3	7.9	0.4	7.5	8.3
	5	8.0	7.5	8.4	8.0	0.5	7.5	8.4
Cond. (uS/cm)	C	306		330	318	17.0	306	330
	1	329			329		329	329
	2	355			355		355	355
	3	405			405		405	405
	4	542			542		542	542
	5	773		830	802	40.3	773	830
Replicate measured		Flask	Surrogate	A				
Initials		AK	CPV	LT				
		TRC (mg/l) in highest conc. at end of test:		N/A				
Changes & Notes (Initials, date, specific change or notes)								

Test chamber:	30 ml plastic cup:	✓					
	Other:						
Test solution vol. (15 ml min):	15 ml:	✓					
	Other (ml):						
Illumination & photoperiod:	50-100 ft-c 16L:8D			Template Number:		3	
Number of replicates/treatment:	4						
Initial number animals/replicate:	5						
Test Aerated?	N/A	Date & Time Air Start:		N/A			

TEST ID	TRT ID:	1	2	3	4	5
AWSL2101ACD	CONC(%):	6.25	12.5	25.0	50.0	100

Acute Ceriodaphnia Test-48 Hr Survival

Start Date:		Test ID:	AWSL2101	Sample ID:	
End Date:		Lab ID:	CBI	Sample Type:	
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	CD-Ceriodaphnia dubia
Comments:	DATA ENTERED BY PB				

Conc-%	1	2	3	4
CONTROL	0.8000	1.0000	1.0000	1.0000
6.25	1.0000	1.0000	1.0000	1.0000
12.5	1.0000	1.0000	0.8000	0.8000
25	1.0000	0.4000	0.0000	0.0000
50	0.0000	0.0000	0.0000	0.0000
100	0.0000	0.0000	0.0000	0.0000

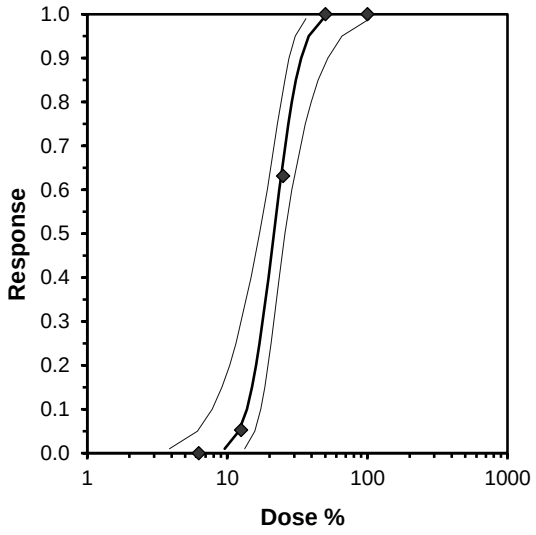
			Transform: Arcsin Square Root					Number	Total
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
CONTROL	0.9500	1.0000	1.2857	1.1071	1.3453	9.261	4	1	20
6.25	1.0000	1.0526	1.3453	1.3453	1.3453	0.000	4	0	20
12.5	0.9000	0.9474	1.2262	1.1071	1.3453	11.212	4	2	20
25	0.3500	0.3684	0.6203	0.2255	1.3453	85.386	4	13	20
50	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4	20	20
100	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 <= 0.01)	0.82543	0.844	1.22885	4.56895
Equality of variance cannot be confirmed				

Maximum Likelihood-Probit

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	6.61214	1.67518	3.32879	9.89549	0.05	0.83	7.81472	0.84	1.33255	0.15124	4
Intercept	-3.81101	2.28474	-8.2891	0.66709							
TSCR	0.02697	0.02553	-0.02307	0.077							

Point	Probits	%	95% Fiducial Limits	
EC01	2.674	9.56578	3.85851	13.2797
EC05	3.355	12.1279	6.1121	15.7403
EC10	3.718	13.7636	7.78308	17.2944
EC15	3.964	14.99	9.13924	18.4737
EC20	4.158	16.0423	10.362	19.5088
EC25	4.326	17.0037	11.517	20.4848
EC40	4.747	19.6895	14.834	23.474
EC50	5.000		17.0305	25.8422
EC60	5.253	23.4891	19.2596	28.8815
EC75	5.674	27.1993	22.8119	35.9897
EC80	5.842	28.8293	24.1561	39.6652
EC85	6.036	30.853	25.696	44.646
EC90	6.282	33.6022	27.6234	52.0927
EC95	6.645	38.134	30.5296	65.9458
EC99	7.326	48.3482	36.3846	103.893



Effluent and Dilution Water Log (Freshwater Tests). FWEFFL061013

											SUMMARY WATER QUALITY DATA				
Initial sample charac-terization	Bottle(1):	A1									MEAN	S.D.	MIN.	MAX.	PARAMETER
	Arrival Temp. (oC, from CoC):	1									1		1	1	Arrival Temp.
	TRC (mg/l)(2):	<DL													
	TRC Corrected(2):														
	Hardness (mg/l):	130									130		130	130	Hardness (mg/l)
	Alkalinity (mg/l):	259									259		259	259	Alkalinity (mg/l)
	NH3-N (mg/l):	<1.0													
	Color/Appearance(3):	C													
	Obvious odor?	NO													
	Date & Time:	4/29/21 16:21													
	Initials:	AK													
Sample prep measure-ments	Test Day:	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7		MEAN	S.D.	MIN.	MAX.	
	Bottle(s):	A1													
	Prep. Temp. (oC):	25									25		25	25	Temp. (oC)
	D.O. (mg/l) After Warming:	8.0													
	Aeration Time (min):	0													
	Adjusted D.O. (mg/l):	8.0									8.0		8.0	8.0	D.O. (mg/l)
	Final pH (S.U.):	7.91									7.91		7.91	7.91	pH (S.U.)
	Conductivity (uS/cm)(4):	771									771		771	771	Cond. (uS/cm)
	Final TRC (mg/l)(5):	N.D.													
	Sample Filtered (60 um)?														
	Date & Time:	5/1/21 10:31													
	Initials:	AK													
Dilution water	Test Day:	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7		MEAN	S.D.	MIN.	MAX.	
	Vat Number:	1													
	Temperature (oC):	25									25		25	25	Temp. (oC)
	Conductivity (uS/cm):	310									310		310	310	Cond. (uS/cm)
	D.O. (mg/l):	8.2									8.2		8.2	8.2	D.O. (mg/l)
	pH (S.U.):	7.83									7.83		7.83	7.83	pH (S.U.)
	Hardness (mg/l):	92									92		92	92	Hardness (mg/l)
	Alkalinity (mg/l):	62									62		62	62	Alkalinity (mg/l)
	Date & Time:	5/1/21 8:30													
	Initials:	AK													
	Changes & Notes (Initials, date, specific change or notes)														
	Peer review Initial/Date:	PB	5/6/21 10:18	DILUTION WATER TYPE:	Mod. Hard Synthetic Freshwater (EPA)	ND=Not Determined/Measured, NA=Not Applicable. 1) Ninth character of lab sample ID on chain of custody AND bottle number in collection series. Together with Project ID constitutes entire sample bottle ID. 2) TRC MDL 0.02 mg/l; QL 0.22 mg/l. Corrected value if Mn, Cr potential positive interference. Corrected using KI and NaAsO2. 3) C-clear, O-opaque, T-turbid, S-solids (Sl-slight, M-moderate, H-heavy), Y-yellow, B-brown, Bl-black, G-green, P-pink, Gr-grey, Or-orange. 4) Measured on first use of sample only. 5) Final TRC measured only if chlorine present in initial characterization.												
PROJECT ID:	AWSL2101	ADDITIONAL EFFLUENT TREATMENT:													

ENTHALPY ANALYTICAL

COASTAL BIOANALYSTS

1941 REYMET ROAD
RICHMOND, VIRGINIA 23237
(804) 358-8295 PHONE
(804)358-8297 FAX

Chain of Custody
Effective: Mar 10, 2021

AWSL2101-A 21-0601 CHAIN OF CUSTODY Q2-ACD PAGE 1 OF

COMPANY NAME: AIR WATER AND SOIL	INVOICE TO: AIR WATER AND SOIL	PROJECT NAME/Quote #: 21D1297
CONTACT: KATRINA COOKE	INVOICE CONTACT: KATHARINE CLARK	SITE NAME: 21D1297
ADDRESS: 1941 REYMET ROAD RICHMOND, VA 23237	INVOICE ADDRESS:	PROJECT NUMBER: 21D1297
PHONE #: 804.358.8295	INVOICE PHONE #:	P.O. #: PO-008557
FAX #: 804.358.8297	EMAIL: support@awslabs.com	Pretreatment Program:

Is sample for compliance reporting? YES NO | Regulatory State: VA | Is sample from a chlorinated supply? YES NO | PWS I.D. #: 15-21

SAMPLER NAME (PRINT): DENISE VAUGHN | SAMPLER SIGNATURE: | Turn Around Time: Circle 10 5 Days or _Day(s)

Matrix Codes: WW=Waste Water/Storm Water GW=Ground Water DW=Drinking Water S=Soil/Solids OR=Organic A=Air WP=Wipe OT=Other_____

CLIENT SAMPLE I.D.	Grab	Composite	Field Filtered (Dissolved Metals)	Composite Start Date	Composite Start Time	Grab Date or Composite Stop Date	Grab Time or Composite Stop Time	Time Preserved 4.30.21	Matrix (See Codes)	Number of Containers	ANALYSIS / (PRESERVATIVE): ACUTE TOX - CERIODAPHNIA DUBIA AND PIMEPHALES							COMMENTS: Preservative Codes: N=Nitric Acid C=Hydrochloric Acid S=Sulfuric Acid H=Sodium Hydroxide A=Ascorbic Acid Z=Zinc Acetate T=Sodium Thiosulfate M=Methanol; PLEASE NOTE PRESERVATIVE(S), INTERFERENCE CHECKS or PUMP RATE (L/min)
1) 21D1297-01 029		X		29 Apr'21	00:00	29 Apr'21	23:59	9.15	WW	2	X	Confirmed Cerio only.						
2)																		
3)																		
4)																		
5)																		
6)																		
7)																		
8)																		
9)																		
10)																		

RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME
LeM	4-30-21 14:27	K Kurkowski	4/30/21 P2227
RELINQUISHED:	DATE / TIME	RECEIVED: A Krueger	DATE / TIME 4/30/21 1615
RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME

QC Data Package: Level III ☐ Level IV ☐

LAB USE ONLY Therm ID: _____ COOLER TEMP _____°C
Custody Seals used and intact? (Y / N) Received on ice? (Y / N)

TV: AK 1°C

Unless otherwise agreed in writing, any and all products and/or services provided by Enthalpy are pursuant to the terms and conditions as set forth at https://enthalpy.com/terms-and-conditions/

Pace Analytical Services, LLC
225 Industrial Park RD
Beaver, WV 25813
(800)999-0105

May 11, 2021

Melissa Lincoln
BAE SYSTEMS, ORDNANCE SYSTEMS INC.
PO BOX 1 / STATE ROUTE 114
RADFORD ARMY AMMUNITION PLANT
Radford, VA 24141

RE: Project: OUTFALL 029-NEW RIVER
Pace Project No.: 7369428

Dear Melissa Lincoln:

Enclosed are the analytical results for sample(s) received by the laboratory on April 30, 2021. The results relate only to the samples included in this report. Results reported herein conform to the applicable TNI/NELAC Standards and the laboratory's Quality Manual, where applicable, unless otherwise noted in the body of the report.

The test results provided in this final report were generated by each of the following laboratories within the Pace Network:

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Todd Crone
todd.crone@pacelabs.com
800-999-0105
Project Manager

Enclosures

cc: Mr. Jody Hawks, BAE SYSTEMS, ORDINANCE SYSTEMS INC.
Mr. William (Andy) Wirt, BAE SYSTEMS, ORDNANCE SYSTEMS INC.

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, LLC.

Pace Analytical Services, LLC
225 Industrial Park RD
Beaver, WV 25813
(800)999-0105

SAMPLE SUMMARY

Project: OUTFALL 029-NEW RIVER
Pace Project No.: 7369428

Lab ID	Sample ID	Matrix	Date Collected	Date Received
7369428001	**029 TOX**	Water	04/29/21 23:59	04/30/21 11:58

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, LLC.

CHAIN OF CUSTODY RECORD

WO# : 7369428

7369428

Research Environmental & Industrial Consultants, Inc.

MAIN LABORATORY & CORPORATE HEADQUARTERS:

P.O. Box 286 * 225 Industrial Park Road, Beaver, WV 25813
800-999-0105 * 304-255-2500 * www.reiclabs.com

MID-OHIO VALLEY Service Center	SHENANDOAH Service Center	ROANOKE Service Center
101 17th Street	1557 Commerce Rd, Ste. 201	3029-C Peters Creek Rd
Ashland, KY 41101	Verona, VA 24482	Roanoke, VA 24019
606-393-5027	540-248-0183	540-777-1276

V5-1109 | REIC use ONLY | Client ID: | Date: | Sheet:

Client Name: BAE Systems/ RFAAP P.O. #: RFAC-071219-01-SJM
Contact Person: Sheree Andrews Phone #: 540-639-7215
Email Address: sheree.andrews@baesystems.com Cell Phone #: 540-717-4092
Address: Route 114, P.O. Box 1 City: Radford State: VA Zip: 24143
Billing Address (If Different):
City: State: Zip:
Site ID & State: Sampler:
NPDES Permit #: VA 0000248 Outfall #: 029
Receiving Stream: New River
From Where and How Sample was Collected: Outfall 029 Composite Sampler
Rain Event: Flow:

SAMPLE ID	NUMBER & TYPE OF CONTAINERS	COLLECTION DATE AND TIME FROM Date	FROM Time	TO Date	TO Time	SAMPLE COMP / GRAB	Test Type	Test Species
029 Tox	2 cubes	4/29/21	0000	4/29/21	2359	Comp	◉ Acute	☐ Pimephales promelas (Fathead Minnow)
							○ Chronic	☒ Ceriodaphnia dubia
							○ Screen	☐ Daphnia magna
								☐ Daphnia pulex

All analytical requests are subject to REIC's Standard Terms and Conditions.

Field Readings	Comments	REIC USE ONLY	
Temperature: 4°C		Temperature:	°C
pH: No Meter		pH:	SU
Conductivity: No Meter	#1) 1.4	Conductivity:	µmhos/cm
DO: No Meter		DO:	mg/L
Chlorine: NA	#2) 1.6	Chlorine:	mg/L
Is the Sample: ○ Chlorinated ○ Dechlorinated		Sample Appearance:	
Dechlorination Method: NA		Sample Odor:	
Should REIC Dechlorinate Sample: ○ YES ◉ NO		Date Sample Received:	
Date: 4.30.21 Time: 0800		Sample Storage During Shipment:	
Sample Appearance: Clear	73TM88	Method of Shipment to REIC:	
Sample Odor: None		Time:	Initials:

1		2	
Denise Vaught Relinquished By (Signature):	4-30-21 0900 Date / Time	Relinquished By (Signature):	4-30-21 1150 Date / Time
Received By (Signature):	4-30-21 0900 Date / Time:	Gary Grubb Received By (Signature):	04-30-2021 1158 Date / Time

ACUTE TOXICITY BIOASSAY REPORT

BAE SYSTEMS

PACE JOB #: 7369428

CLIENT SAMPLE ID: OUTFALL 029

TEST ORGANISM: CERIODAPHNIA DUBIA

NPDES PERMIT #: VA0000248

Pace Analytical Services received a sample on 04-30-21
for the analyses presented in the following report

ACUTE TOXICITY

BIOASSAY REPORT

Pace Job #: 7369428

Conducted For:

BAE Systems
Radford Army Ammunition Plant
P.O. Box 1
State Route 114
Radford, VA 24143

Conducted By:

Pace Analytical Services
225 Industrial Park Road
P.O. Box 286
Beaver, WV 25813

Pace Analytical Services
225 Industrial Park Road
P. O. Box 286
Beaver, WV 25813
TEL: (304) 255-2500
Website: www.pacelabs.com

Executive Summary

BAE Systems submitted a sample for an acute Whole Effluent Toxicity (WET) test to be conducted. The client sample ID was Outfall 029 and the Pace job number was 7369428. The NPDES permit number was VA0000248. The sample was collected on 04-29-21 and was delivered to the laboratory on 04-30-21. The acute toxicity test was initiated on 04-30-21 and utilized *Ceriodaphnia dubia* as the test species. The test was terminated after a 48-hour exposure period on 05-02-21.

The *Ceriodaphnia dubia* test results were as follows: The Lethal Concentration to 50% of the test organisms (LC50) was calculated to be 16.94% effluent. This data corresponds to a Toxicity Unit-acute (TUa) of 5.90. In essence, this effluent was noticeably toxic with regards to the survival of the *Ceriodaphnia dubia*.

Please feel free to contact myself, or Ed Kirk, Director-Biological Division, should you have any comments or questions, or if we can be of any further assistance. We truly appreciate your business!

Sincerely,

Michael Lester
Bioassay Lab Manager
Pace Analytical Services

PACE ANALYTICAL
SAMPLE INFORMATION

Client: BAE Systems

Address: Radford Army Ammunition Plant
P.O. Box 1
State Route 114
Radford, VA 24143

Pace Job #: 7369428

Pace Sample ID: 7369428-001

Client Sample ID: Outfall 029

VPDES Permit #: VA0000248

Receiving Water Body Name: New River

Sample Type: 24-Hour Composite
Collected From: **Date**: 04-29-21 **Time**: 0000
Collected To: **Date**: 04-29-21 **Time**: 2359

Bioassay Tests Performed: 48-Hr Static Acute Non-Renewal

Test Procedure: EPA Methods Manual 821-R-02-012; October 2002
ENV-SOP-BEAV-0179

Test Method: *Ceriodaphnia dubia* 2002.0

Measured Effect: Death or erratic behavior

Test Organisms: *Ceriodaphnia dubia* **Age**: < 24 Hrs

Last Reference Test Date: 04-03-21

Reference Toxicant Used and Results: KCL-Potassium chloride, acceptable results

Dilution Water Used: Moderately Hard Synthetic Freshwater

Test Beginning: **Date**: 04-30-21 **Time**: 1305

Test Ending: **Date**: 05-02-21 **Time**: 1240

PACE ANALYTICAL
TEST RESULTS

Pace Sample ID: 7369428-001 Client Name: BAE Systems
Client Sample ID: Outfall 029 VPDES Permit #: VA0000248

Ceriodaphnia dubia

Statistical Test Method	LC-50	TUA	95% Confidence Limits	Qualifier Data
Probit	16.94	5.90	10.67 and 22.72	

All test organisms died in the 100.0% and 50.0% test concentrations. 12 of 20 test organisms died in the 25.0% test concentration. 10 of 20 test organisms died in the 12.5% test concentration. 3 of 20 test organisms died in the 6.25% test concentration, and 2 of 20 test organisms died in the control.

Key:
TUA - Toxicity Units - Acute
LC50 - Lethal Concentration to 50% of population

Qualifiers:
P - Initial pH falls outside the range of 6.0 - 9.0
H - 36 Hour Hold Time Exceeded
T - Initial Temperature exceeded 0 - 6º Range

DATE 05/10/21 APPROVED Michael Lester

Michael Lester
Bioassay Lab Manager

PACE ANALYTICAL
TOXICITY TEST CONDITIONS

Client Name: BAE Systems

Pace Sample ID: 7369428-001
Client Sample ID: Outfall 029
VPDES Permit #: VA0000248

Test Species: *Ceriodaphnia dubia*
Organism Source: In-house Cultures

Exposure Chamber
- Container Type: Tripour disp.
- Total vessel capacity: 50 ml
- Test solution volume: 30 ml
- Water depth: Constant X
  - Cyclic ___

Aeration During Test
- None: X
- Slow: ____
- Moderate: ____
- Vigorous: ___
- Time aeration began: _____

Feeding Schedule
- Not fed: ___
- Fed daily: ___
- Fed prior to test: X

Aeration Prior To Test Initiation
- Moderate: ____
- Minutes: 14

Photoperiod
- 16Hr/8Hr: X
- Other (specify): _____

Place Test Conducted
- Environmental Chamber: X

Vessel type and volume used to deliver effluent and diluent to test chambers: 500 ml volumetric flask and a 250 ml graduated cylinder

Material(s) used to place test organisms into test chambers: Large bore pipets

Condition of surviving organisms at end of test: Healthy

Comments:_____

Concentration (%)	Diluent (mls)	Effluent (mls)	Total (mls)
Control	500	0	500
6.25	468.75	31.25	500
12.5	437.5	62.5	500
25.0	375	125	500
50.0	250	250	500
100.0	0	500	500

PACE TOXICITY TEST DATA

Client: BAE Systems | **Test Beginning**: **Date**: 04-30-21 **Time**: 1305

Client Sample ID: Outfall 029 | **Test Ending**: **Date**: 05-02-21 **Time**: 1240

Pace Sample ID: 7369428-001 | **Dilution Water**: Moderately Hard Synthetic Freshwater

NPDES Permit #: VA0000248 | **Test Organism**: *Ceriodaphnia dubia* **Age**: <24 Hrs

Bioassay Test: 48 Hr. Static Acute Non-Renewal | **Isolation Date**: 04-29-21 **Time**: 1000

Sample Collection Data | **# Replicates**: 4 **# Organisms/Rep**: 5

Sample Volume: 2 Gallon **Sample Type**: Composite | **Effluent** | **Dilution Water**

Collected From: **Date**: 04-29-21 **Time**: 0000 | **Alkalinity** 214 mg/l **Chlorine** 0.00 mg/l **Alkalinity** 48.2 mg/l

Collected To: **Date**: 04-29-21 **Time**: 2359 | **Hardness** 104 mg/l **Dechlorinated** NA **Hardness** 95.1 mg/l

Test Concentration (%)	Number of Live Organisms			Dissolved Oxygen (mg/l)			pH (SU)			Conductivity (umhos)			Test Temperature (°C)		
	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs
Control A	5	5	5	7.0	7.5	7.4	8.00	7.99	8.06	350		351	25.4	23.0	25.4
Control B	5	5	5												
Control C	5	5	3												
Control D	5	5	5												
6.25% A	5	4	4	7.3	7.7	7.7	8.08	8.07	8.19	380		375	25.9	23.3	25.2
6.25% B	5	5	5												
6.25% C	5	5	4												
6.25% D	5	5	4												
12.5% A	5	4	4	7.3	7.8	7.7	8.14	8.10	8.23	413		422	26.4	23.2	25.9
12.5% B	5	3	2												
12.5% C	5	4	1												
12.5% D	5	3	3												
25.0% A	5	1	1	7.4	7.8	7.8	8.20	8.25	8.36	470		465	26.5	23.4	26.0
25.0% B	5	0	0												
25.0% C	5	4	4												
25.0 % D	5	3	3												
50.0 % A	5	2	0	7.4	7.8	7.7	8.54	8.38	8.48	587		583	26.2	23.6	25.9
50.0% B	5	5	0												
50.0% C	5	3	0												
50.0% D	5	1	0												
100.0% A	5	1	0	7.6	7.7	7.6	8.33	8.53	8.57	828		793	24.2	23.6	25.6
100.0% B	5	1	0												
100.0 % C	5	3	0												
100.0% D	5	0	0												
Initials	TG	DL	DL												
Time	1305	1230	1240												
Comments:															

Pace Sample ID: 7369428-001 Client Name: BAE Systems
Client Sample ID: Outfall 029 VPDES Permit #: VA0000248

Percent Survival of Test Organisms at Test Termination

Ceriodaphnia dubia

Concentration	% Survival
Control	90.0%
6.25%	85.0%
12.5%	50.0%
25.0%	40.0%
50.0%	0.0%
100.0%	0.0%

Note: 48 Hr. % Survival Results

Pace Sample ID: 7369428-001

Attachment 1

Acute Cumulative Data Summary Sheet

Facility: BAE Systems

VPDES Permit #: VA0000248

Outfall #: 029

Test Date	Vertebrate	Invertebrate	LC50	TUA
07-21-19		X	>100.0	<1.0
10-04-19		X	>100.0	<1.0
01-10-20		X	>100.0	<1.0
04-10-20		X	26.72	3.74
08-12-20		X	>100.0	<1.0
10-16-20		X	>100.0	<1.0
01-08-21		X	24.72	4.05
05-02-21*		X	16.94	5.90

Notes: * Results are submitted with this report.

Pace Sample ID: 7369428-001

Attachment 2

Facility:	BAE Systems	**VPDES Permit #:**	VA0000248
Outfall #:	029	**Receiving Stream:**	New River
Test Period:	4th Quarter		

Summary of Test Conditions

Test Start:	04-30-21	**Time:**	1305
Test End:	05-02-21	**Time:**	1240
Test Type:	48 Hr. Static Acute Non-Renewal		

Test organisms: *Ceriodaphnia dubia* **Age:** < 24 Hours

Test chamber size: 50 ml **Volume:** 30 ml

Diluent: Moderately Hard Synthetic Freshwater

Pace Sample ID: 7369428-001
Client Sample ID: Outfall 029

Client Name: BAE Systems
VPDES Permit #: VA0000248

Attachment 2 (Continued)

Range of Values Measured During Test

	Parameter		Effluent	Diluent
1.	Chlorine (mg/l)	initial	0.00	0.00
		adjusted	NA	NA
2.	pH	initial	8.33 - 8.57	7.99 - 8.06
		adjusted	NA	NA
3.	Alkalinity (mg/l as CACO3)		214	48.2
4.	Hardness (mg/l as CACO3)		104	95.1
5.	Conductivity (umhos/cm)		793 - 828	350 - 351
6.	D.O. (mg/l)		7.6 - 7.7	7.0 - 7.5
7.	Methods used for adjustment			
		Chlorine	NA	
		pH	NA	

Pace Sample ID: 7369428-001
Client Sample ID: Outfall 029

Client Name: BAE Systems
VPDES Permit #: VA0000248

Attachment 2 (Continued)

Test Results Acute

1.	Test Acceptability		
	Control survival %		90.0%
2.	Methods of statistical analyses		Probit
3.	Statistical Results	LC50	16.94
		TUA	5.90

Key:
LC50 - Lethal Concentration to 50% of population
TUA - Toxicity Units Acute

Pace Sample ID: 7369428-001

Attachment 3

Toxicity Test Conditions and Results

Sample Description

Facility: BAE Systems

VPDES Permit #: VA0000248

Outfall #: 029

Sample Collected From: **Date:** 04-29-21 **Time:** 0000

Sample Collected To: **Date:** 04-29-21 **Time:** 2359

Sample Type: 24-Hour Composite

Collector: BAE **Affiliation:** BAE Systems

Delivery: Pace courier

Test Conditions

Type: 48 Hr. Static Acute Non-Renewal

Start Date: 04-30-21 **Time:** 1305

End Date: 05-02-21 **Time:** 1240

Organism: *Ceriodaphnia dubia* **Age:** < 24 Hours

Chamber size: 50 ml **Volume**: 30 ml

Concentrations: Control, 6.25%, 12.5%, 25.0%, 50.0%, and 100.0%

Number Replicates: 4

Organisms Per Replicate: 5

Feeding Prior to Test: YAT and Selenastrum

Feeding During Test: None

Photo Period: 16 hrs. light/8 hrs. darkness

Pace Sample ID: 7369428-001 Client Name: BAE Systems
Client Sample ID: Outfall 029 VPDES Permit #: VA0000248

Attachment 3 (Continued)

Instrument Set#1

pH meter Oakton pH 700 Series

DO meter HACH HQ40d

Conductivity meter Hanna Edge

Temperature meter Oakton pH 700 Series

Chlorine Meter Hanna HI96781

Instrument Set#2

pH meter Oakton pH 700 Series

DO meter HACH HQ40d

Conductivity meter Oakton Con 700

Temperature meter Oakton pH 700 Series

Chlorine Meter Hanna HI96781

Comments:

Pace Sample ID: 7369428-001 Client Name: BAE Systems
Client Sample ID: Outfall 029 VPDES Permit #: VA0000248

Attachment 4

Reftox Data

Ceriodaphnia dubia

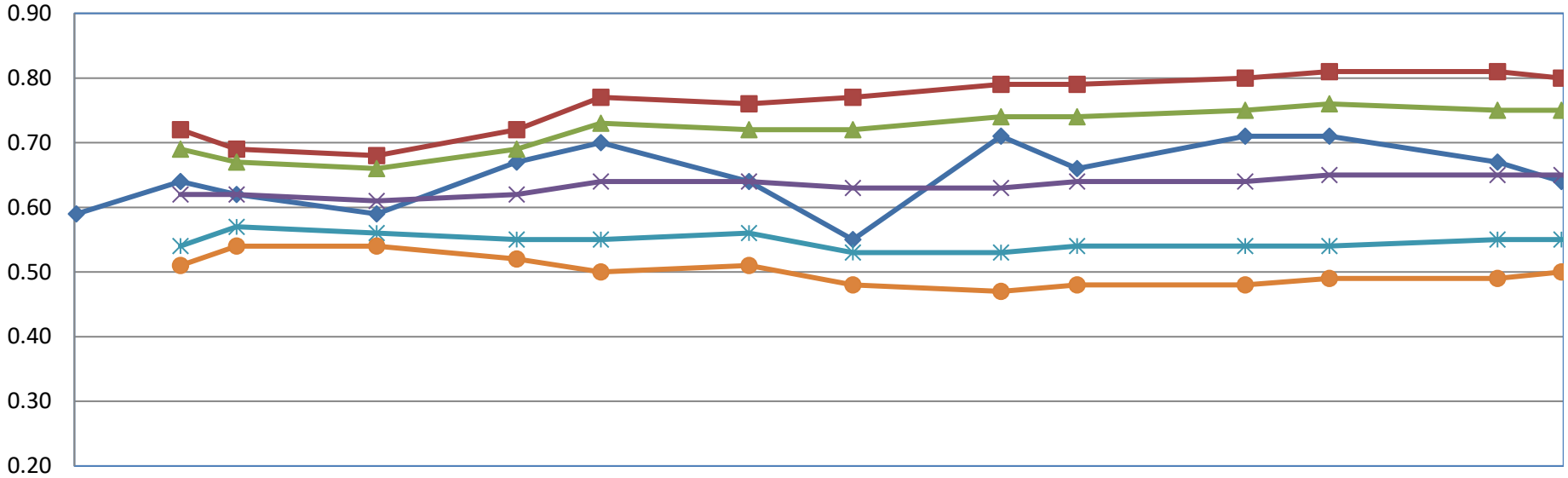
LC50 = 0.64 g/l
NOAEC = 0.50 g/l

Reference toxicant test conducted on 04-03-21

Note: Potassium chloride was used as the reference toxicant KCL – Potassium Chloride, GFS

Key:
LC50- Lethal concentration to 50% of population
NOAEC- No observable adverse effect concentration

Acute Reftox Data - 48 Hour (LC50) - Ceriodaphnia dubia



	03/28 (2020)	04/23 (2020)	05/07 (2020)	06/11 (2020)	07/16 (2020)	08/06 (2020)	09/12 (2020)	10/08 (2020)	11/14 (2020)	12/03 (2020)	01/14 (2021)	02/04 (2021)	03/18 (2021)	04/03 (2021)
LC50	0.59	0.64	0.62	0.59	0.67	0.70	0.64	0.55	0.71	0.66	0.71	0.71	0.67	0.64
MaxL		0.72	0.69	0.68	0.72	0.77	0.76	0.77	0.79	0.79	0.80	0.81	0.81	0.80
UCL		0.69	0.67	0.66	0.69	0.73	0.72	0.72	0.74	0.74	0.75	0.76	0.75	0.75
MEAN		0.62	0.62	0.61	0.62	0.64	0.64	0.63	0.63	0.64	0.64	0.65	0.65	0.65
LCL		0.54	0.57	0.56	0.55	0.55	0.56	0.53	0.53	0.54	0.54	0.54	0.55	0.55
MinL		0.51	0.54	0.54	0.52	0.50	0.51	0.48	0.47	0.48	0.48	0.49	0.49	0.50

	STDEV	MaxL	UCL	MEAN	LCL	MinL
Current:	**0.050**	**0.80**	**0.75**	**0.65**	**0.55**	**0.50**

LC50 = Lethal Concentrations to 50% of population	
STDEV = Standard Deviation	Standard Deviation of LC50
MaxL = Maximum Limit	MEAN + STDV x 3
UCL - Upper Control Limit	MEAN + STDV x 2
MEAN = Average	Average of LC50
LCL = Lower Control Limit	MEAN - STDV x 2
MinL = Minimum Limit	MEAN - STDV x 3

Coefficient of Variance (%) = STDEV x 100 / MEAN

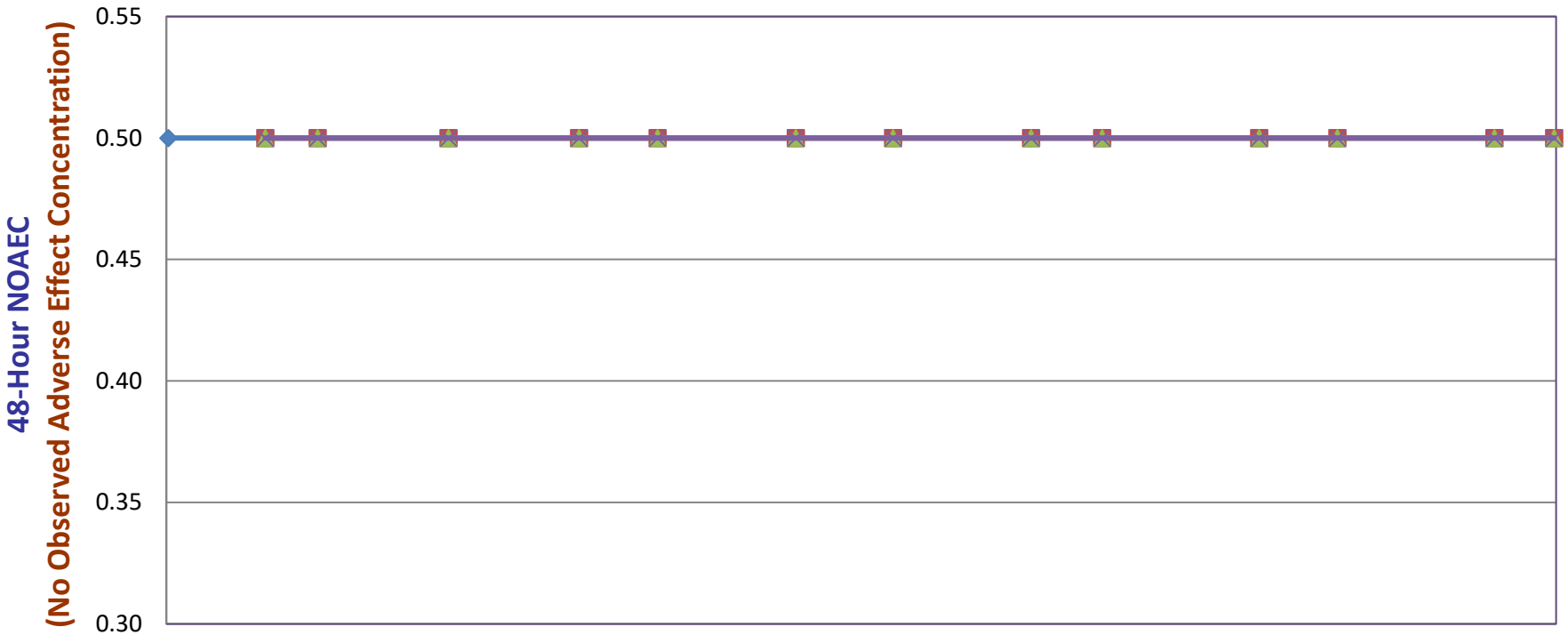
7.70

Note: Test performed @ 25°C

Potassium Chloride (KCl)-Toxicant

LC50 - g/l

Acute Reftox Data (48-Hour NOAEC) - Ceriodaphnia dubia



	03/28 (2020)	04/23 (2020)	05/07 (2020)	06/11 (2020)	07/16 (2020)	08/06 (2020)	09/12 (2020)	10/08 (2020)	11/14 (2020)	12/03 (2020)	01/14 (2021)	02/04 (2021)	03/18 (2021)	04/03 (2021)
NOAEC	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
UCL		0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
MEAN		0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
LCL		0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50

	STDEV	UCL	MEAN	LCL
Current:	**0.000**	**0.50**	**0.50**	**0.50**
NOAEC = No Observed Adverse Effect Concentration				
STDEV = Standard Deviation	Standard Deviation of LC50			
UCL - Upper Control Limit	MEAN + STDV x 2			
MEAN = Average	Average of LC50			
LCL = Lower Control Limit	MEAN - STDV x 2			

Coefficient of Variance (%) = STDEV x 100 / MEAN

0.00

Note: Test performed @ 25°C

Potassium Chloride (KCl)-Toxicant

LC50 - g/l

Daphnid Acute Test-48 Hr Survival

Start Date:	4/30/2021 13:05	Test ID:	7369428cd	Sample ID:	Outfall 029
End Date:	5/2/2021 12:40	Lab ID:	PACE-WV01040	Sample Type:	DMR-Discharge Monitoring Report
Sample Date:	4/29/2021 23:59	Protocol:	EPAAW02-EPA/821/R-02-01	Test Species:	CD-Ceriodaphnia dubia
Comments:					

Conc-%	1	2	3	4
Hard Synthetic	1.0000	1.0000	0.6000	1.0000
6.25	0.8000	1.0000	0.8000	0.8000
12.5	0.8000	0.4000	0.2000	0.6000
25	0.2000	0.0000	0.8000	0.6000
50	0.0000	0.0000	0.0000	0.0000
100	0.0000	0.0000	0.0000	0.0000

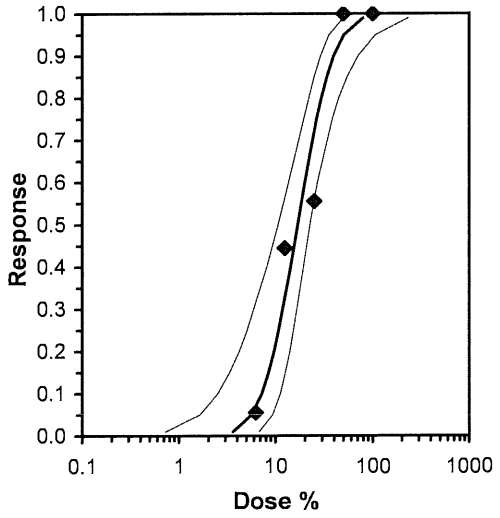
			Transform: Arcsin Square Root					Number	Total
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
Hard Synthetic	0.9000	1.0000	1.2305	0.8861	1.3453	18.660	4	2	20
6.25	0.8500	0.9444	1.1667	1.1071	1.3453	10.206	4	3	20
12.5	0.5000	0.5556	0.7854	0.4636	1.1071	35.048	4	10	20
25	0.4000	0.4444	0.6706	0.2255	1.1071	59.520	4	12	20
50	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4	20	20
100	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)	0.96973	0.887	-0.1801	-0.5174
Bartlett's Test indicates equal variances (p = 0.34)	3.37457	11.3449		

Maximum Likelihood-Probit

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	3.46474	0.8019	1.89302	5.03645	0.1	4.40717	7.81473	0.22072	1.22884	0.28862	5
Intercept	0.74239	1.07511	-1.3648	2.84961							
TSCR	0.10386	0.06294	-0.0195	0.22721							

Point	Probits	%	95% Fiducial Limits	
EC01	2.674	3.60915	0.72662	6.79955
EC05	3.355	5.67674	1.64016	9.42362
EC10	3.718	7.22696	2.52121	11.2602
EC15	3.964	8.50555	3.36066	12.7316
EC20	4.158	9.68121	4.21361	14.0684
EC25	4.326	10.8185	5.10501	15.3595
EC40	4.747	14.3126	8.16699	19.4268
EC50	5.000	16.9371	10.6704	22.7205
EC60	5.253	20.043	13.6839	27.0722
EC75	5.674	26.5163	19.5513	38.3395
EC80	5.842	29.6313	22.0684	44.9288
EC85	6.036	33.727	25.1087	54.7094
EC90	6.282	39.6939	29.1265	71.0808
EC95	6.645	50.5337	35.6261	106.739
EC99	7.326	79.4833	50.4317	235.887



CHAIN OF CUSTODY RECORD

REIC

Research Environmental & Industrial Consultants, Inc.
MAIN LABORATORY & CORPORATE HEADQUARTERS:

P.O. Box 286 * 225 Industrial Park Road, Beaver, WV 25813
800-999-0105 * 304-255-2500 * www.reiclabs.com

MID-OHIO VALLEY Service Center
101 17th Street
Ashland, KY 41101
606-393-5027

SHENANDOAH Service Center
1557 Commerce Rd, Ste. 201
Verona, VA 24482
540-248-0183

ROANOKE Service Center
3029-C Peters Creek Rd
Roanoke, VA 24019
540-777-1276

V5-1109 | REIC use ONLY | Client ID: | Date: | Sheet:

Client Name: BAE Systems/ RFAAP | P.O. #: RFAC-071219-01-SJM
Contact Person: Sheree Andrews | Phone #: 540-639-7215
Email Address: sheree.andrews@baesystems.com | Cell Phone #: 540-717-4092
Address: Route 114, P.O. Box 1 | City: Radford | State: VA | Zip: 24143
Billing Address (If Different):
City: | State: | Zip:
Site ID & State: | Sampler:
NPDES Permit #: VA 0000248 | Outfall #: 029
Receiving Stream: New River
From Where and How Sample was Collected: Outfall 029 Composite Sampler
Rain Event: | Flow:

SAMPLE ID	NUMBER & TYPE OF CONTAINERS	COLLECTION DATE AND TIME FROM Date	FROM Time	TO Date	TO Time	SAMPLE COMP / GRAB	Test Type	Test Species
029 Tox	2 cubes	4/29/21	0000	4/29/21	2359	Comp	◉ Acute	☐ Pimephales promelas (Fathead Minnow)
							○ Chronic	☒ Ceriodaphnia dubia
							○ Screen	☐ Daphnia magna
								☐ Daphnia pulex

All analytical requests are subject to REIC's Standard Terms and Conditions.

Field Readings	Comments	REIC USE ONLY	
Temperature: 4°C		Temperature:	°C
pH: No Meter		pH:	SU
Conductivity: No Meter	#1) 1.4	Conductivity:	µmhos/cm
DO: No Meter		DO:	mg/L
Chlorine: NA	#2) 1.6	Chlorine:	mg/L
Is the Sample: ○ Chlorinated ○ Dechlorinated		Sample Appearance:	
Dechlorination Method: NA		Sample Odor:	
Should REIC Dechlorinate Sample: ○ YES ◉ NO		Date Sample Received:	
Date: 4.30.21 Time: 0800		Sample Storage During Shipment:	
Sample Appearance: Clear	73TM88	Method of Shipment to REIC:	
Sample Odor: None		Time: Initials:	

1 Denise Vaugh Relinquished By (Signature): 4-30-21 0900 Date / Time
Received By (Signature): 4-30-21 0900 Date / Time:

2 Relinquished By (Signature): 4-30-21 1150 Date / Time
Received By (Signature): 04-30-2021 1158 Date / Time

TOXICITY TEST DATA SHEET

INITIAL READINGS

Pace Job # 7369428

Client Name BAE Systems

Client Sample ID 029 Tox

Sample Type Comp

Date Received 04-30-2021

Sampling From		Sampling To	
Date 04-29-2021	Time 0000	Date 04-29-2021	Time 2359

Dissolved Oxygen 9.0

pH 8.21

Conductivity 805

Temperature 1.6

Chlorine HANNA HI 96781 Reagent Lot # W02A 0.00

Chlorine HACH Model CN66/66F/66T Reagent Lot # ——

Appearance Clear

Odor none

Shipment Method courier

Sample Storage During Shipment cooler on ice

Sample Storage Upon Arrival Bio WC #2

Date 04-30-2021 Time 1201 Initials [illegible]

Page 1 of 1

PACE TOXICITY TEST DATA

Client: BAE Systems 029	Test Beginning:	Date: 04-30-2021	Time: 1305
Client Sample ID: Outfall 029	Test Ending:	Date: 05-02-2021	Time: 1240
Pace Sample ID: 7369428-001	Dilution Water: Moderately Hard Synthetic Fresh		
NPDES Permit #: VA0000248	Test Organism: Ceriodaphnia dubia		Age: < 24 hrs
Bioassay Test: 48 Hr Static Acute Non-Renewal	Isolation Date: 04-29-2021		Time: 1000
Sample Collection Data	# Replicates: 4	# Organisms/Rep: 5	

Sample Collection Data			Effluent			Dilution Water
Sample Volume: 1 gallon	Sample Type: Composite					
Collected From: Date: 04-29-21	Time: 0000		Alkalinity 214	Chlorine 0.00		Alkalinity 48.2
Collected To: Date: 04-29-21	Time: 2359		Hardness 164	Dechlorinated NA		Hardness 95.1

Test Concentration (%)	Number of Live Organisms			Dissolved Oxygen (mg/l)			pH (SU)			Conductivity (umhos)			Test Temperature (°C)		
	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs
Control A	5	5	5	7.0	7.5	7.4	8.00	7.99	8.04	350		351	25.4	23.0	25.4
Control B	5	5	5												
Control C	5	5	3												
Control D	5	5	5												
6 A	5	4	4	7.3	7.7	7.7	8.08	8.07	8.14	380		375	25.9	23.3	25.2
B	5	5	5												
C	5	5	4												
D	5	5	4												
12 A	5	4	4	7.3	7.8	7.7	8.14	8.10	8.23	413		422	26.4	23.2	25.9
B	5	3	1												
C	5	4	1												
D	5	3	3												
25 A	5	1	1	7.4	7.8	7.8	8.20	8.25	8.36	470		465	26.5	23.4	26.0
B	5	0	0												
C	5	4	4												
D	5	3	3												
50 A	5	2	0	7.4	7.8	7.7	8.54	8.38	8.44	587		583	26.2	23.6	25.9
B	5	5	0												
C	5	3	0												
D	5	1	0												
100 A	5	1	0	7.6	7.7	7.4	8.33	8.53	8.57	828		793	24.2	23.6	25.4
B	5	1	0												
C	5	3	0												
D	5	0	0												
Initials	JD	AL	AL												
Time	1305	1230	1240												
Comments:															

ENTHALPY ANALYTICAL
formerly Air, Water & Soil Laboratories

1941 Reymet Road ● Richmond, Virginia 23237 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Laboratory Order ID 21H1266

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford, VA 24141	Date Received:	August 25, 2021 13:04
		Date Issued:	September 3, 2021 16:17
		Project Number:	[none]
Submitted To:	Sheree Andrews	Purchase Order:	RFAC-032621-01-RLL
Client Site I.D.:	029 3rd Quarter Toxicity		

Enclosed are the results of analyses for samples received by the laboratory on 08/25/2021 13:04. If you have any questions concerning this report, please feel free to contact the laboratory.

Sincerely,

Ted Soyars

Ted Soyars
Technical Director

End Notes:

The test results listed in this report relate only to the samples submitted to the laboratory and as received by the Laboratory.

Unless otherwise noted, the test results for solid materials are calculated on a wet weight basis. Analyses for pH, dissolved oxygen, temperature, residual chlorine and sulfite that are performed in the laboratory do not meet NELAC requirements due to extremely short holding times. These analyses should be performed in the field. The results of field analyses performed by the Sampler included in the Certificate of Analysis are done so at the client's request and are not included in the laboratory's fields of certification nor have they been audited for adherence to a reference method or procedure.

The signature on the final report certifies that these results conform to all applicable NELAC standards unless otherwise specified. For a complete list of the Laboratory's NELAC certified parameters please contact customer service.

This report shall not be reproduced except in full without the expressed and written approval of an authorized representative of Air Water & Soil Laboratories, Inc.

NELAP ACCREDITED TNI LABORATORY

ENTHALPY ANALYTICAL
formerly Air, Water & Soil Laboratories

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued:	September 03, 2021 16:17
		Project Number:	[none]
		Purchase Order:	RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	029 3rd Quarter Toxicity		

ANALYTICAL REPORT FOR SAMPLES

Laboratory Order ID 21H1266

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
029 Annual Acute - CD & PP	21H1266-01	Waste Water	08/24/2021 00:00 to 08/24/2021 23:59	08/25/2021 13:04

ENTHALPY ANALYTICAL
formerly Air, Water & Soil Laboratories

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued:	September 03, 2021 16:17
		Project Number:	[none]
		Purchase Order:	RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	029 3rd Quarter Toxicity		

Laboratory Order ID: 21H1266

Analytical Results

Sample I.D. 029 Annual Acute - CD & PP **Laboratory Sample ID:** 21H1266-01

Composite Start-End Date/Time: 08/24/2021 00:00 - 08/24/2021 23:59

Field Residual Cl: **Field pH:**

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Subcontracted Analysis									
Acute Toxicity CD	01	EPA	Attached		--	1	09/03/21 15:26	09/03/21 15:28	N/A

Analytical Summary

Sample ID	Preparation Factors Initial / Final	Method	Batch ID	Sequence ID	Calibration ID
Subcontracted Analysis		**Preparation Method:**	***** DEFAULT PREP *****		
21H1266-01	1.00 mL / 1.00 mL	EPA	BEI0153		

ENTHALPY ANALYTICAL
formerly Air, Water & Soil Laboratories

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued:	September 03, 2021 16:17
		Project Number:	[none]
		Purchase Order:	RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	029 3rd Quarter Toxicity		

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual

ENTHALPY ANALYTICAL
formerly Air, Water & Soil Laboratories

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued:	September 03, 2021 16:17
		Project Number:	[none]
		Purchase Order:	RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	029 3rd Quarter Toxicity		

Certified Analyses included in this Report

Analyte	Certifications

Code	Description	Laboratory ID	Expires
MADEP	Massachusetts DEP	M-VA913	06/30/2022
MdDOE	Maryland DE Drinking Water	341	12/31/2021
NC	North Carolina DENR	495	12/31/2021
NCDEQ	North Carolina DEQ	495	12/31/2021
NCDOH	North Carolina Department of Health	51714	07/31/2022
NHDES	NELAP-New Hampshire Certificate #224221	2242	02/25/2022
NJDEP	NELAP-New Jersey DEP	VA015	06/30/2022
NYDOH	New York DOH Drinking Water	12096	04/01/2022
PADEP	NELAP-Pennsylvania Certificate #006	68-03503	10/31/2021
VELAP	NELAP-Virginia Certificate #11539	460021	06/14/2022
WVDEP	West Virginia DEP	350	10/31/2021

ENTHALPY ANALYTICAL
formerly Air, Water & Soil Laboratories

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued:	September 03, 2021 16:17
		Project Number:	[none]
		Purchase Order:	RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	029 3rd Quarter Toxicity		

Summary of Data Qualifiers

Attached	Attached
RPD	Relative Percent Difference
Qual	Qualifers
-RE	Denotes sample was re-analyzed
D.F.	Dilution Factor. Please also see the Preparation Factor in the Analysis Summary section.
TIC	Tentatively Identified Compounds are compounds that are identified by comparing the analyte mass spectral pattern with the NIST spectral library. A TIC spectral match is reported when the pattern is at least 75% consistent with the published pattern. Compound concentrations are estimated and are calculated using an internal standard response factor of 1.
PCBs, Total	Total PCBs are defined as the sum of detected Aroclors 1016, 1221, 1232, 1248, 1254, 1260, 1262, and 1268.

ENTHALPY ANALYTICAL
formerly *Air, Water & Soil Laboratories*

1941 REYMET ROAD
RICHMOND, VIRGINIA 23237
(804) 358-8295 PHONE
(804)358-8297 FAX

Chain of Custody
Effective: Nov 15, 2018

CHAIN OF CUSTODY

COMPANY NAME: BAE Systems, Inc. - RFAAP	INVOICE TO: Accounts Payable	PROJECT NAME: 029 3rd Quarter Toxicity
CONTACT: Sheree Andrews	INVOICE CONTACT:	SITE NAME:
ADDRESS: Route 114 Radford, Va 24141	INVOICE ADDRESS:	PROJECT NUMBER:
PHONE #: 1-540-717-4092	INVOICE PHONE #:	P.O. #:
FAX #: EMAIL: Sheree.andrews@baesystems.com		Pretreatment Program:
Is sample for compliance reporting? YES	Regulatory State: Va / Is sample from a chlorinated supply? YES NO	PWS I.D. #:
SAMPLER NAME (PRINT): Denise Vaughn	SAMPLER SIGNATURE: Denise Vaughn	Turn Around Time: Circle 10 5 Days or _Day(s)

Matrix Codes: WW=Waste Water/Storm Water GW=Ground Water DW=Drinking Water S=Soil/Solids OR=Organic A=Air WP=Wipe OT=Other_____

CLIENT SAMPLE I.D.	Grab	Composite	Field Filtered (Dissolved Metals)	Composite Start Date	Composite Start Time	Grab Date or Composite Stop Date	Grab Time or Composite Stop Time	Time Preserved	Matrix (See Codes)	Number of Containers	ANALYSIS / (PRESERVATIVE): Acute Toxicity - Ceriodaphnia dubia	Acute Toxicity - Pimephales							COMMENTS: Preservative Codes: N=Nitric Acid C=Hydrochloric Acid S=Sulfuric Acid H=Sodium Hydroxide A=Ascorbic Acid Z=Zinc Acetate T=Sodium Thiosulfate M=Methanol — PLEASE NOTE PRESERVATIVE(S), INTERFERENCE CHECKS or PUMP RATE (L/min)
1) 029 Annual Acute-cd&pp		X		8.24.21	0000	8.24.21	2359		WW	2	x	x							
2)																			
3)																			
4)																			
5)																			
6)																			
7)																			
8)																			
9)																			
10)																			

RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME
Denise Vaughn	8.25.21 0839	[signature]	8/25/21 0839
[signature]	8/25/21 1304	[signature]	8/25/21 1304

QC Data Package
Level III ☐
Level IV ☐

LAB USE ONLY Therm ID: 277 COOLER TEMP 12 °C
Custody Seals used and intact? (Y / N) Received on ice? (Y / N)

BAE Systems, Inc. 21H1266
Toxicity
Recd: 08/25/2021 Due: 09/01/2021

v130325002

ENTHALPY ANALYTICAL
formerly Air, Water & Soil Laboratories

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued:	September 03, 2021 16:17
		Project Number:	[none]
		Purchase Order:	RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	029 3rd Quarter Toxicity		

Sample Conditions Checklist

Samples Received at:	**1.20°C**
How were samples received?	AWS Courier
Were Custody Seals used? If so, were they received intact?	No
Are the custody papers filled out completely and correctly?	Yes
Do all bottle labels agree with custody papers?	Yes
Is the temperature blank or representative sample within acceptable limits or received on ice, and recently taken?	Yes
Are all samples within holding time for requested laboratory tests?	Yes
Is a sufficient amount of sample provided to perform the tests included?	Yes
Are all samples in appropriate containers for the analyses requested?	Yes
Were volatile organic containers received?	No
Are all volatile organic and TOX containers free of headspace?	NA
Is a trip blank provided for each VOC sample set? VOC sample sets include EPA8011, EPA504, EPA8260, EPA624, EPA8015 GRO, EPA8021, EPA524, and RSK-175.	NA
Are all samples received appropriately preserved? Note that metals containers do not require field preservation but lab preservation may delay analysis.	Yes

Work order logged on standard 5 Day TAT. THM 25 Aug 2021/10.16

Client: Enthalpy Analytical/Air, Water and Soil Laboratories
Project ID: AWSL2109 acute
Client Sample ID: BAE-Radford Army Ammunition Plant 21H1266-01A
Permit No.: VA0000248 Outfall 029
Sample Period: 8/24/21

Coastal Bioanalysts, Inc.

Report of Analysis: Whole Effluent Toxicity (WET)

Submitted To:	**Prepared By:**
Katrina Cooke Senior Project Manager Enthalpy Analytical/Air, Water and Soil Laboratories 1941 Reymet Road, Richmond, VA 23237	Coastal Bioanalysts, Inc. 6400 Enterprise Court Gloucester, VA 23061 (804) 694-8285 www.coastalbio.com Contact: Peter F. De Lisle, Technical Director

Acute Test Results*				
Species-Test Method	**Test Period**	**NOAEC**	**48-h LC50**	**T.U.$_{Ac}$**
C. dubia EPA 2002.0	8/25/21-8/27/21	N/A	100	**1.00**
P. promelas EPA 2000.0	8/25/21-8/27/21	N/A	31.9	**3.13**

Details regarding test conduct and data analysis provided in attached bench sheets and printouts as applicable.
For each test method record the T.U.$_{Ac}$ value (bold) on the DMR.

Acute Test QA/QC	**Reference Toxicant: KCl**	**Units: mg/l**	**Test Organism Source: CBI Stock Cultures**		
Species-Method (Ref. Test Date)	**Data Source**	**% Control Survival**	**48-h LC50**	**95% C.L./A.L. For LC50**	**RTT in Control?**
C. dubia 2002.0	RTT	100	565	539-593	Yes
(8/3/21-8/5/21)	CC	100	530	465-596	
P. promelas 2000.0	RTT	100	905	823-997	Yes
(8/3/21-8/5/21)	CC	100	1029	865-1193	

Note: RTT = Reference Toxicant Test, CC = Control Chart.

The results of analysis contained within this report relate only to the sample as received in the laboratory. This report shall not be reproduced except in full without written approval from the laboratory. Unless noted below, these test results meet all requirements of NELAP.

APPROVED: Peter F. De Lisle

Digitally signed by Peter F. De Lisle
DN: cn=Peter F. De Lisle, o=Coastal Bioanalysts, Inc., ou=Toxicology, email=pfd@coastalbio.com, c=US
Date: 2021.09.03 12:26:31 -04'00'

Peter F. De Lisle, Ph.D.
Technical Director

Deviations from, additions to, or exclusions from the test method, non-standard conditions or data qualifiers and, as appropriate, a statement of compliance/non-compliance: **NONE**

Please leave feedback regarding our services at: http://coastalbio.com/survey

VELAP# 460030
EPA# VA01116

NELAP ACCREDITED LABORATORY

Coastal Bioanalysts, Inc.

GLOSSARY OF TERMS AND ABBREVIATIONS

A.L. (Acceptance Limits): The results of a given reference toxicant test are compared to the control chart mean value ± 2 standard deviations. These limits approximate the 95% probability limits for the "true" reference toxicant value.

Chronic Value (ChrV): The geometric mean of the NOEC and LOEC. Units are same as test concentration units.

C.L. (Confidence Limits): These are the probability limits, based on the data set and statistical model employed, that the "true value" lies within the limits specified. Typically limits are based on 95% or 99% probabilities.

Control chart: A cumulative summary chart of results from QC tests with reference toxicants. The results of a given reference toxicant test are compared to the control chart mean value and 95% Acceptance Limits (A.L.) (mean ± 2 standard deviations).

IC25: The concentration of sample or chemical, calculated from the data set using statistical models, causing a 25% reduction in test organism growth, reproduction, etc. The lower the IC25, the more toxic the chemical or sample. Units are same as test concentration units.

LC50: The concentration of sample or chemical, calculated from the data set using statistical models, causing a 50% reduction in test organism survival. The lower the LC50, the more toxic the chemical or sample. Units are same as test concentration units. Note: The LC50 value must always be associated with the duration of exposure. Thus 48-h LC50, 96-h LC50, etc. are calculated.

LOEC: Lowest-observable-effect-concentration. The lowest concentration of sample or chemical in a chronic test dilution series in which the test organisms exhibit a statistically significant reduction in any of the test end points (e.g. growth, survival, reproduction) compared to control organisms. Units are same as test concentration units.

PMSD: Percent Minimum Significant Difference: The minimum difference which can exist between a test treatment and the controls in a particular test and be statistically significant; a measure of test sensitivity. The lower the PMSD the more sensitive the test.

N/A: Not applicable.

N/D: Not determined or measured.

NOAEC: No-observable-acute-effect-concentration. The highest concentration of sample or chemical in an acute test dilution series in which the test organisms exhibit no statistically significant reduction in the test end point (e.g. survival) compared to control organisms. Units are same as test concentration units.

NOEC: No-observable-effect-concentration. The highest concentration of sample or chemical in a chronic test dilution series in which the test organisms exhibit no statistically significant reduction in any of the test end points (e.g. growth, survival, reproduction) compared to control organisms. Some regulatory definitions also require that the NOEC be less than the LOEC. Units are same as test concentration units.

Q.L.: Quantitation Limit. Level, concentration, or quantity of a target variable (analyte) that can be reported at a specified degree of confidence.

T.U.: Toxic units. Expresses the relative toxicity of an effluent in such a manner that the larger the toxic unit value the more toxic the effluent. $T.U._{Ac} = 100/LC50$. $T.U._{Chr} = 100/NOEC$. A dimensionless unit.

C. dubia daily biological measurements (EPA 2002.0) Template version ACD-STAT-5trt-061113

TRTMNT (% Effl)	Rep	#Live Day 0	#Live Day 1	#Live Day 2	Final Mean % Live		
C	A	5	5	5	100.0		
	B	5	5	5			
Lab	C	5	5	5			
Control	D	5	5	5			
#1	A	5	5	5	100.0		
6.25	B	5	5	5			
% Effl	C	5	5	5			
	D	5	5	5			
# 2	A	5	5	5	100.0		
12.5	B	5	5	5			
% Effl	C	5	5	5			
	D	5	5	5			
# 3	A	5	5	5	100.0		
25.0	B	5	5	5			
% Effl	C	5	5	5			
	D	5	5	5			
# 4	A	5	5	5	100.0		
50.0	B	5	5	5			
% Effl	C	5	5	5			
	D	5	5	5			
# 5	A	5	4	1	50.0		
100	B	5	5	2			
% Effl	C	5	5	5		Test Duration:	47h 59m
	D	5	5	2			TAC 48+/-0.5h
INITIALS:		AK	CPV	LT	% CONTROL SURVIVAL:		100.0
DATE & TIME:		8/25/21 16:00	8/26/21 8:57	8/27/21 16:00			TAC = 90%
CHANGES & NOTES (INITIALS, DATE, SPECIFIC CHANGE MADE							

SPECIES:	Ceriodaphnia dubia		
ACCLIMATION WATER:	Mod. Hard Synthetic Freshwater		
FEEDING PRIOR TO TEST:	YCT + Selenastrum capricornutum		
FEEDING DURING TEST:	None -YCT + Selenastrum 2+ h before test		
SOURCE:	CBI Stock cultures		
ACCLIMATION TEMP (o C):	25		
BROOD RELEASE START DATE & TIME:	8/24/21 22:00		
BROOD RELEASE END DATE & TIME:	8/25/21 6:00		
DATE/TIME WATER ADDED:	8/25/21 15:49		
DATE/TIME ANIMALS ADDED:	8/25/21 16:00		
ANIMAL AGE WINDOW:	8h 0m		
MAX AGE AT TEST START:	18h 1m		TAC Max. 24 h
TEST SET UP BY:		AK	
SAMPLE COLLECTION DATE &TIME:	8/24/21 23:59	SAMPLE USED	A
SAMPLE AGE AT TEST START:	16h 2m	TAC Max 36 h	
PEER REVIEW BY (INITIALS/DATE):		PB	8/30/21 12:42

TEST ID: AWSL2109ACD

Ceriodaphnia daily water quality bench sheet (EPA METHOD 2002.0) Template version ACD-STAT-5trt-061113

	TRTMNT	Day 0 Initial	Day 1	Day 2 Final	SUMMARY WATER QUALITY DATA MEAN	S.D.	MIN.	MAX.
pH (S.U.)	C	7.85	8.24	7.61	7.90	0.32	7.61	8.24
	1	7.88	8.16	7.67	7.90	0.25	7.67	8.16
	2	7.94	8.12	7.76	7.94	0.18	7.76	8.12
	3	7.99	8.10	7.92	8.00	0.09	7.92	8.10
	4	8.14	8.11	7.96	8.07	0.10	7.96	8.14
	5	8.31	8.23	8.32	8.29	0.05	8.23	8.32
Temp. (o C)	C	25	25	25	25	0.0	25	25
	1	25	25	25	25	0.0	25	25
	2	25	25	25	25	0.0	25	25
	3	25	25	25	25	0.0	25	25
	4	25	25	25	25	0.0	25	25
	5	25	25	25	25	0.0	25	25
Diss. Oxygen (mg/l)	C	8.2	8.0	7.8	8.0	0.2	7.8	8.2
	1	8.2	8.0	7.8	8.0	0.2	7.8	8.2
	2	8.2	8.0	8.0	8.1	0.1	8.0	8.2
	3	8.2	8.0	8.0	8.1	0.1	8.0	8.2
	4	8.2	8.1	8.1	8.1	0.1	8.1	8.2
	5	8.2	8.1	8.2	8.2	0.1	8.1	8.2
Cond. (uS/cm)	C	298		312	305	9.9	298	312
	1	326			326		326	326
	2	354			354		354	354
	3	390			390		390	390
	4	506			506		506	506
	5	728		715	722	9.2	715	728
Replicate measured		Flask	Surrogate	D				
Initials		CPV	CPV	LT				
		TRC (mg/l) in highest conc. at end of test:		N/A				
Changes & Notes (Initials, date, specific change or notes)								

Test chamber:	30 ml plastic cup:	✓					
	Other:						
Test solution vol. (15 ml min):	15 ml:	✓					
	Other (ml):						
Illumination & photoperiod:	50-100 ft-c 16L:8D			Template Number:		4	
Number of replicates/treatment:	4						
Initial number animals/replicate:	5						
Test Aerated?	N/A	Date & Time Air Start:		N/A			

TEST ID	TRT ID:	1	2	3	4	5
AWSL2109ACD	CONC(%):	6.25	12.5	25.0	50.0	100

P. promelas daily biological measurements (EPA 2000.0) Template version APP-STAT-48h-5trt-061113

TRTMNT (%Effl)	Rep	#Live Day 0	#Live Day 1	#Live Day 2	Final Mean % Live		
C	A	10	10	10	100.0		
Lab Control	B	10	10	10			
#1	A	10	10	10	100.0		
6.25	B	10	10	10			
# 2	A	10	10	10	100.0		
12.5	B	10	10	10			
# 3	A	10	10	8	85.0		
25.0	B	10	10	9			
# 4	A	10	4	0	0.0		
50.0	B	10	2	0			
# 5	A	10	0	0	0.0	Test Duration:	48h 1m
100	B	10	0	0			TAC 48+/-0.5h
INITIALS:		AK	CPV	LT	% CONTROL SURVIVAL:		100.0
DATE & TIME:		8/25/21 15:57	8/26/21 8:54	8/27/21 15:57			TAC = 90%
CHANGES & NOTES (INITIALS, DATE, SPECIFIC CHANGE MADE							

SPECIES:	Pimephales promelas		
ACCLIMATION WATER:	Mod. Hard Synthetic Freshwater		
FEEDING PRIOR TO TEST:	Artemia nauplii ad libitum		
FEEDING DURING TEST:	None		
SOURCE:	CBI Stock cultures		
ACCLIMATION TEMP (o C):	25		
HATCH START DATE & TIME:	8/20/21 17:00		
HATCH END DATE & TIME:	8/21/21 9:00		
DATE/TIME WATER ADDED:	8/25/21 15:49		
DATE/TIME ANIMALS ADDED:	8/25/21 15:57		
ANIMAL AGE WINDOW:	16h 0m		TAC Max. 24 h
MAX AGE AT TEST START:	5d		TAC Max. 14 d
TEST SET UP BY:		AK	
SAMPLE COLLECTION DATE & TIME:	8/24/21 23:59	SAMPLE USED	A
SAMPLE AGE AT TEST START:	15h 58m	TAC MAX 36 h	
PEER REVIEW BY (INITIALS/DATE):		PB	8/30/21 12:43

TEST ID: AWSL2109APP

P. promelas daily water quality bench sheet (EPA METHOD 2002.0) Template version APP-STAT-48h-5trt-06113

	TRTMNT	Day 0 Initial	Day 1	Day 2 Final	SUMMARY WATER QUALITY DATA MEAN	S.D.	MIN.	MAX.
pH (S.U.)	C	7.85	8.35	7.62	7.94	0.37	7.62	8.35
	1	7.88	8.18	7.65	7.90	0.27	7.65	8.18
	2	7.94	8.14	7.67	7.92	0.24	7.67	8.14
	3	7.99	8.14	7.72	7.95	0.21	7.72	8.14
	4	8.14	8.16	8.00	8.10	0.09	8.00	8.16
	5	8.31	8.26		8.29	0.04	8.26	8.31
Temp. (o C)	C	25	25	25	25	0.0	25	25
	1	25	25	25	25	0.0	25	25
	2	25	25	25	25	0.0	25	25
	3	25	25	25	25	0.0	25	25
	4	25	25	25	25	0.0	25	25
	5	25	25		25	0.0	25	25
Diss. Oxygen (mg/l)	C	8.2	7.8	7.7	7.9	0.3	7.7	8.2
	1	8.2	7.7	7.7	7.9	0.3	7.7	8.2
	2	8.2	7.8	7.6	7.9	0.3	7.6	8.2
	3	8.2	7.8	7.7	7.9	0.3	7.7	8.2
	4	8.2	7.9	7.6	7.9	0.3	7.6	8.2
	5	8.2	7.8		8.0	0.3	7.8	8.2
Cond. (uS/cm)	C	298		306	302	5.7	298	306
	1	326			326		326	326
	2	354			354		354	354
	3	390			390		390	390
	4	506		527	517	14.8	506	527
	5	728			728		728	728
Replicate measured		B	A	B				
Initials		AK	CPV	LT				
		TRC (mg/l) in highest conc. at end of test:		NA				
Changes & Notes (Initials, date, specific change or notes)								

Test chamber:	400 ml Tri-pour bkr:	✓			
	Other:				
Test solution vol. (200 ml min):	400 ml:	✓			
	Other (ml):				
Illumination & photoperiod:	50-100 ft-c 16L:8D				
Number of replicates/treatment:	2				
Initial number animals/replicate:	10				
Test Aerated?	No	Date & Time Air Start:			

TEST ID	TRT ID:	1	2	3	4	5	D.O. Highest conc. @ aeration:
AWSL2109APP	CONC (%):	6.25	12.5	25.0	50.0	100	Total live highest conc.@ aeration

Acute Fish Test-48 Hr Survival

Start Date:		Test ID:	AWSL2109PP	Sample ID:	INITIAL
End Date:		Lab ID:	CBI	Sample Type:	
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	PP-Pimephales promelas
Comments:	DATA ENTERED BY PB				

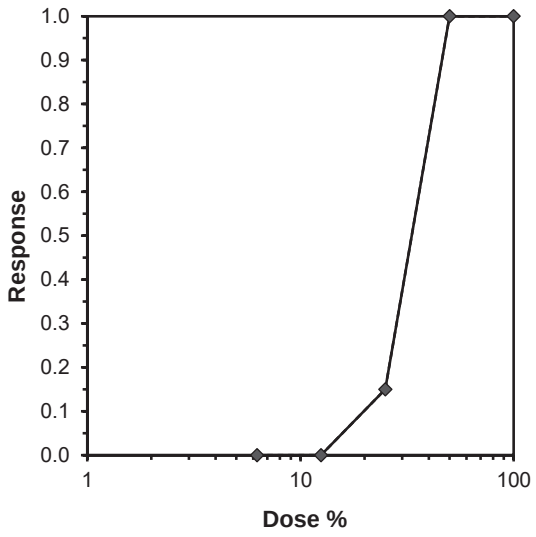
Conc-%	1	2
CONTROL	1.0000	1.0000
6.25	1.0000	1.0000
12.5	1.0000	1.0000
25	0.8000	0.9000
50	0.0000	0.0000
100	0.0000	0.0000

			Transform: Arcsin Square Root					Number	Total
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
CONTROL	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	2	0	20
6.25	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	2	0	20
12.5	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	2	0	20
25	0.8500	0.8500	1.1781	1.1071	1.2490	8.517	2	3	20
50	0.0000	0.0000	0.1588	0.1588	0.1588	0.000	2	20	20
100	0.0000	0.0000	0.1588	0.1588	0.1588	0.000	2	20	20

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Normality of the data set cannot be confirmed				
Equality of variance cannot be confirmed				

Trimmed Spearman-Karber

Trim Level	EC50	95% CL	
0.0%	31.864	28.525	35.594
5.0%	32.562	28.604	37.068
10.0%	33.061	27.944	39.114
20.0%	33.258	30.805	35.905
Auto-0.0%			



Effluent and Dilution Water Log (Freshwater Tests). FWEFFL061013

											SUMMARY WATER QUALITY DATA				
Initial sample charac-terization	Bottle(1):	A1									MEAN	S.D.	MIN.	MAX.	PARAMETER
	Arrival Temp. (oC, from CoC):	1									1		1	1	Arrival Temp.
	TRC (mg/l)(2):	<DL													
	TRC Corrected(2):														
	Hardness (mg/l):	98									98		98	98	Hardness (mg/l)
	Alkalinity (mg/l):	202									202		202	202	Alkalinity (mg/l)
	NH3-N (mg/l):	<1.0													
	Color/Appearance(3):	C													
	Obvious odor?	NO													
	Date & Time:	8/25/21 15:41													
	Initials:	LT													
Sample prep measure-ments	Test Day:	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7		MEAN	S.D.	MIN.	MAX.	
	Bottle(s):	A1-2													
	Prep. Temp. (oC):	25									25		25	25	Temp. (oC)
	D.O. (mg/l) After Warming:	9.2													
	Aeration Time (min):	2													
	Adjusted D.O. (mg/l):	8.2									8.2		8.2	8.2	D.O. (mg/l)
	Final pH (S.U.):	8.24									8.24		8.24	8.24	pH (S.U.)
	Conductivity (uS/cm)(4):	746									746		746	746	Cond. (uS/cm)
	Final TRC (mg/l)(5):	N.D.													
	Sample Filtered (60 um)?														
	Date & Time:	8/25/21 15:47													
	Initials:	CPV													
Dilution water	Test Day:	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7		MEAN	S.D.	MIN.	MAX.	
	Vat Number:	1													
	Temperature (oC):	25									25		25	25	Temp. (oC)
	Conductivity (uS/cm):	299									299		299	299	Cond. (uS/cm)
	D.O. (mg/l):	8.2									8.2		8.2	8.2	D.O. (mg/l)
	pH (S.U.):	7.69									7.69		7.69	7.69	pH (S.U.)
	Hardness (mg/l):	86									86		86	86	Hardness (mg/l)
	Alkalinity (mg/l):	61									61		61	61	Alkalinity (mg/l)
	Date & Time:	8/25/21 9:00													
	Initials:	CPV													
	Changes & Notes (Initials, date, specific change or notes)														
	Peer review Initial/Date:	PB	9/1/21 10:29	DILUTION WATER TYPE:	Mod. Hard Synthetic Freshwater (EPA)										
PROJECT ID:	AWSL2109	ADDITIONAL EFFLUENT TREATMENT:													

ND=Not Determined/Measured, NA=Not Applicable. 1) Ninth character of lab sample ID on chain of custody AND bottle number in collection series. Together with Project ID constitutes entire sample bottle ID. 2) TRC MDL 0.02 mg/l; QL 0.22 mg/l. Corrected value if Mn, Cr potential positive interference. Corrected using KI and NaAsO2. 3) C-clear, O-opaque, T-turbid, S-solids (Sl-slight, M-moderate, H-heavy), Y-yellow, B-brown, Bl-black, G-green, P-pink, Gr-grey, Or-orange. 4) Measured on first use of sample only. 5) Final TRC measured only if chlorine present in initial characterization.

ENTHALPY ANALYTICAL
formerly *Air, Water & Soil Laboratories*

Coastal Bioanalysts
6400 Enterprise Ct
Gloucester, VA 23061

1941 REYMET ROAD
RICHMOND, VIRGINIA 23237
(804) 358-8295 PHONE
(804)358-8297 FAX

Chain of Custody
Form #: D1331
Rev. 1.0
Effective: Feb 14, 2014

AWSL2109-A 21-1228

CHAIN OF CUSTODY

COMPANY NAME: Air, Water & Soil Labs, INC	INVOICE TO: AWS LABS	PROJECT NAME/Quote #: 21H1266
CONTACT: Katrina Cooke	INVOICE CONTACT: Katharine Clark	SITE NAME: 21H1266
ADDRESS:1941 Reymet Rd, Richmond, VA 23237	INVOICE ADDRESS:	PROJECT NUMBER: 21H1266
PHONE #: 804-358-8295	INVOICE PHONE #:	P.O. #:
FAX #:804-358-8297	EMAIL: support@awslabs.com	Pretreatment Program:

Is sample for compliance reporting? (YES) NO VA | Is sample from a chlorinated supply? YES NO | PWS I.D. #:

SAMPLER NAME (PRINT): Denise Vaycho | SAMPLER SIGNATURE: | **Turn Around Time: 21 Days**

Matrix Codes: WW=Waste Water/Storm Water GW=Ground Water DW=Drinking Water S=Soil/Solids OR=Organic A=Air WP=Wipe OT=Other_____

CLIENT SAMPLE I.D.	Grab	Composite	Field Filtered (Dissolved Metals)	Composite Start Date	Composite Start Time	Grab Date or Composite Stop Date	Grab Time or Composite Stop Time	Time Preserved	Matrix (See Codes)	Number of Containers	ANALYSIS / (PRESERVATIVE) Acute Toxicity - Ceriodaphnia Dubia	Acute Toxicity - Pimephales Promelas							COMMENTS
1) 21H1266-01 029 Annual Acute - CD & PP		X		08/24/21	0.00	08/24/21	23.59		WW	2	X	X							
2)																			
3)																			
4)																			
5)																			
6)																			
7)																			
8)																			
9)																			
10)																			

Preservative Codes: N=Nitric Acid C=Hydrochloric Acid S=Sulfuric Acid H=Sodium Hydroxide A=Ascorbic Acid Z=Zinc Acetate T=Sodium Thiosulfate M=Methanol

PLEASE NOTE PRESERVATIVE(S), INTERFERENCE CHECKS or PUMP RATE (L/min)

21H1266-01 A Due: 09/01/2021 18:00
Non-Potable Water-Cubitainer
BAE Systems, I
Collected: 08/24/2021 23:59
029 Annual Acute - CD & PP

Order #: 1G23015
Project: VPDES Weekly
Sample ID: 029 WC
Matrix: NPW Container: Cubitainer
Pres: Cool < 6 °C
AcuteToxicity Sub

Date: 8.24.21
Time: 2359
Taken By: DV
Pour Up
8.25.21

RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME
Sarah Endsley	8/25/21 1400	[illegible]	
RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME
		L. Thomas @CBI	8/25/21 1540
RELINQUISHED:	DATE / TIME	RECEIVED: °1C	DATE / TIME TV-LT

QC Data Package
Level I ☐
Level II ☐
Level III ☐
Level IV ☐

LAB USE ONLY COOLER TEMP °1C °C

21H1266 Coastal Bioanalysts - BAE.xls

1941 Reymet Road ● Richmond, Virginia 23237 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Laboratory Order ID 21K1076

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford, VA 24141	Date Received:	November 17, 2021 13:37
		Date Issued:	November 29, 2021 17:02
		Project Number:	[none]
Submitted To:	Sheree Andrews	Purchase Order:	RFAC-032621-01-RLL
Client Site I.D.:	029 4th Quarter Toxicity		

Enclosed are the results of analyses for samples received by the laboratory on 11/17/2021 13:37. If you have any questions concerning this report, please feel free to contact the laboratory.

Sincerely,

Ted Soyars

Ted Soyars
Technical Director

End Notes:

The test results listed in this report relate only to the samples submitted to the laboratory and as received by the Laboratory.

Unless otherwise noted, the test results for solid materials are calculated on a wet weight basis. Analyses for pH, dissolved oxygen, temperature, residual chlorine and sulfite that are performed in the laboratory do not meet NELAC requirements due to extremely short holding times. These analyses should be performed in the field. The results of field analyses performed by the Sampler included in the Certificate of Analysis are done so at the client's request and are not included in the laboratory's fields of certification nor have they been audited for adherence to a reference method or procedure.

The signature on the final report certifies that these results conform to all applicable NELAC standards unless otherwise specified. For a complete list of the Laboratory's NELAC certified parameters please contact customer service.

This report shall not be reproduced except in full without the expressed and written approval of an authorized representative of Air Water & Soil Laboratories, Inc.

TNI Accredited
VELAP ID 460021

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued:	November 29, 2021 17:02
		Project Number:	[none]
		Purchase Order:	RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	029 4th Quarter Toxicity		

ANALYTICAL REPORT FOR SAMPLES

Laboratory Order ID 21K1076

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
029 Quarterly TOX-Cd	21K1076-01	Waste Water	11/16/2021 00:00 to 11/16/2021 23:59	11/17/2021 13:37

Analysis for Acute Toxicity was subcontracted to Coastal Bioanalyst The subcontracted results are attached at the end of this Certificate of Analysis.

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued:	November 29, 2021 17:02
		Project Number:	[none]
		Purchase Order:	RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	029 4th Quarter Toxicity		

Laboratory Order ID: 21K1076

Analytical Results

Sample I.D. 029 Quarterly TOX-Cd **Laboratory Sample ID:** 21K1076-01

Composite Start-End Date/Time: 11/16/2021 00:00 - 11/16/2021 23:59

Field Residual Cl: **Field pH:**

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Subcontracted Analysis									
Acute Toxicity CD	01	EPA	Attached		--	1	11/29/21 14:13	11/29/21 14:14	N/A

Analytical Summary

Sample ID	Preparation Factors Initial / Final	Method	Batch ID	Sequence ID	Calibration ID
Subcontracted Analysis		**Preparation Method:**	***** DEFAULT PREP *****		
21K1076-01	1.00 mL / 1.00 mL	EPA	BEK1105		

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued:	November 29, 2021 17:02
		Project Number:	[none]
		Purchase Order:	RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	029 4th Quarter Toxicity		

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued:	November 29, 2021 17:02
		Project Number:	[none]
		Purchase Order:	RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	029 4th Quarter Toxicity		

Certified Analyses included in this Report

Analyte **Certifications**

Code	Description	Laboratory ID	Expires
MADEP	Massachusetts DEP	M-VA913	06/30/2022
MdDOE	Maryland DE Drinking Water	341	12/31/2021
NC	North Carolina DENR	495	12/31/2021
NCDEQ	North Carolina DEQ	495	12/31/2021
NCDOH	North Carolina Department of Health	51714	07/31/2022
NHDES	NELAP-New Hampshire Certificate #224221	2242	02/25/2022
NJDEP	NELAP-New Jersey DEP	VA015	06/30/2022
NYDOH	New York DOH Drinking Water	12096	04/01/2022
PADEP	NELAP-Pennsylvania Certificate #007	68-03503	10/31/2022
VELAP	NELAP-Virginia Certificate #11539	460021	06/14/2022
WVDEP	West Virginia DEP	350	12/31/2021

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued:	November 29, 2021 17:02
		Project Number:	[none]
		Purchase Order:	RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	029 4th Quarter Toxicity		

Summary of Data Qualifiers

Attached	Attached
RPD	Relative Percent Difference
Qual	Qualifers
-RE	Denotes sample was re-analyzed
D.F.	Dilution Factor. Please also see the Preparation Factor in the Analysis Summary section.
TIC	Tentatively Identified Compounds are compounds that are identified by comparing the analyte mass spectral pattern with the NIST spectral library. A TIC spectral match is reported when the pattern is at least 75% consistent with the published pattern. Compound concentrations are estimated and are calculated using an internal standard response factor of 1.
PCBs, Total	Total PCBs are defined as the sum of detected Aroclors 1016, 1221, 1232, 1248, 1254, 1260, 1262, and 1268.

ENTHALPY ANALYTICAL
formerly *Air, Water & Soil Laboratories*

1941 REYMET ROAD
RICHMOND, VIRGINIA 23237
(804) 358-8295 PHONE
(804)358-8297 FAX

Chain of Custody
Effective: Nov 15, 2018

CHAIN OF CUSTODY

COMPANY NAME: BAE Systems, Inc. - RFAAP	INVOICE TO: Accounts Payable	PROJECT NAME: 029 4th Quarter Toxicity
CONTACT: Sheree Andrews	INVOICE CONTACT:	SITE NAME:
ADDRESS: Route 114 Radford, Va 24141	INVOICE ADDRESS:	PROJECT NUMBER:
PHONE #: 1-540-717-4092	INVOICE PHONE #:	P.O. #:
FAX #: EMAIL: Sheree.andrews@baesystems.com		Pretreatment Program:

Is sample for compliance reporting? YES | Regulatory State: Va | Is sample from a chlorinated supply? YES NO | PWS I.D. #:

SAMPLER NAME (PRINT): Matt Alberts SAMPLER SIGNATURE: Matt Alberts | Turn Around Time: Circle 10 5 Days or _Day(s)

Matrix Codes: WW=Waste Water/Storm Water GW=Ground Water DW=Drinking Water S=Soil/Solids OR=Organic A=Air WP=Wipe OT=Other WW

CLIENT SAMPLE I.D.	Grab	Composite	Field Filtered (Dissolved Metals)	Composite Start Date	Composite Start Time	Grab Date or Composite Stop Date	Grab Time or Composite Stop Time	Time Preserved	Matrix (See Codes)	Number of Containers	ANALYSIS / (PRESERVATIVE): Acute Toxicity - Ceriodaphnia dubia								COMMENTS: Preservative Codes: N=Nitric Acid C=Hydrochloric Acid S=Sulfuric Acid H=Sodium Hydroxide A=Ascorbic Acid Z=Zinc Acetate T=Sodium Thiosulfate M=Methanol; PLEASE NOTE PRESERVATIVE(S), INTERFERENCE CHECKS or PUMP RATE (L/min)
1) 029 Quarterly Tox-cd		X		11.16.21	0000	11.16.21	2359		WW		x								
2)																			
3)																			
4)																			
5)																			
6)																			
7)																			
8)																			
9)																			
10)																			

RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME
Matt Alberts	11-17-21/0800	AWS Courier	
RELINQUISHED: Courier	DATE / TIME	RECEIVED:	DATE / TIME 17 NOV 2021 1337
RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME

QC Data Package
Level III ☐
Level IV ☐

LAB USE ONLY Therm ID: 271 COOLER TEMP 0.3 °C
Custody Seals used and intact? (Y (N)) Received on ice? (Y) N)

BAE Systems, Inc. 21K1076
Toxicity
Recd: 11/17/2021 Due: 11/24/2021

v130325002

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued:	November 29, 2021 17:02
		Project Number:	[none]
		Purchase Order:	RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	029 4th Quarter Toxicity		

Sample Conditions Checklist

Samples Received at:	**0.30°C**
How were samples received?	AWS Courier
Were Custody Seals used? If so, were they received intact?	No
Are the custody papers filled out completely and correctly?	Yes
Do all bottle labels agree with custody papers?	Yes
Is the temperature blank or representative sample within acceptable limits or received on ice, and recently taken?	Yes
Are all samples within holding time for requested laboratory tests?	Yes
Is a sufficient amount of sample provided to perform the tests included?	Yes
Are all samples in appropriate containers for the analyses requested?	Yes
Were volatile organic containers received?	No
Are all volatile organic and TOX containers free of headspace?	NA
Is a trip blank provided for each VOC sample set? VOC sample sets include EPA8011, EPA504, EPA8260, EPA624, EPA8015 GRO, EPA8021, EPA524, and RSK-175.	NA
Are all samples received appropriately preserved? Note that metals containers do not require field preservation but lab preservation may delay analysis.	Yes

Work order logged on standard 21 Day TAT. THM 17 Nov 2021/20.05

Client: Enthalpy Analytical/Air, Water and Soil Laboratories
Project ID: AWSL2113
Client Sample ID: BAE-Radford Army Ammunition Plant 21K1076-01
Permit No.: VA0000248 Outfall 029
Sample Period: 11/16/21

Coastal Bioanalysts, Inc.

Report of Analysis: Whole Effluent Toxicity (WET)

Submitted To:	**Prepared By:**
Katrina Cooke Senior Project Manager Enthalpy Analytical/Air, Water and Soil Laboratories 1941 Reymet Road, Richmond, VA 23237	Coastal Bioanalysts, Inc. 6400 Enterprise Court Gloucester, VA 23061 (804) 694-8285 www.coastalbio.com Contact: Peter F. De Lisle, Technical Director

Acute Test Results*				
Species-Test Method	**Test Period**	**NOAEC**	**48-h LC50**	**T.U.$_{Ac}$**
C. dubia EPA 2002.0	11/18/21-11/20/21	N/A	4.17	**23.98**

Details regarding test conduct and data analysis provided in attached bench sheets and printouts as applicable.
For each test method record the T.U.$_{Ac}$ value (bold) on the DMR.

Acute Test QA/QC	**Reference Toxicant: KCl**	**Units: mg/l**	**Test Organism Source: CBI Stock Cultures**		
Species-Method (Ref. Test Date)	**Data Source**	**% Control Survival**	**48-h LC50**	**95% C.L./A.L. For LC50**	**RTT in Control?**
C. dubia 2002.0	RTT	100	434	410-459	Yes
(11/2/21-11/4/21)	CC	100	539	475-602	

Note: RTT = Reference Toxicant Test, CC = Control Chart.

The results of analysis contained within this report relate only to the sample as received in the laboratory. This report shall not be reproduced except in full without written approval from the laboratory. Unless noted below, these test results meet all requirements of NELAP.

APPROVED: Peter F. De Lisle

Digitally signed by Peter F. De Lisle
DN: cn=Peter F. De Lisle, o=Coastal Bioanalysts, Inc., ou=Toxicology, email=pfd@coastalbio.com, c=US
Date: 2021.11.29 12:32:21 -05'00'

Peter F. De Lisle, Ph.D.
Technical Director

Deviations from, additions to, or exclusions from the test method, non-standard conditions or data qualifiers and, as appropriate, a statement of compliance/non-compliance: **NONE**

Please leave feedback regarding our services at: http://coastalbio.com/survey

VELAP# 460030
EPA# VA01116

NELAP ACCREDITED LABORATORY

Coastal Bioanalysts, Inc.

GLOSSARY OF TERMS AND ABBREVIATIONS

A.L. (Acceptance Limits): The results of a given reference toxicant test are compared to the control chart mean value ± 2 standard deviations. These limits approximate the 95% probability limits for the "true" reference toxicant value.

Chronic Value (ChrV): The geometric mean of the NOEC and LOEC. Units are same as test concentration units.

C.L. (Confidence Limits): These are the probability limits, based on the data set and statistical model employed, that the "true value" lies within the limits specified. Typically limits are based on 95% or 99% probabilities.

Control chart: A cumulative summary chart of results from QC tests with reference toxicants. The results of a given reference toxicant test are compared to the control chart mean value and 95% Acceptance Limits (A.L.) (mean ± 2 standard deviations).

IC25: The concentration of sample or chemical, calculated from the data set using statistical models, causing a 25% reduction in test organism growth, reproduction, etc. The lower the IC25, the more toxic the chemical or sample. Units are same as test concentration units.

LC50: The concentration of sample or chemical, calculated from the data set using statistical models, causing a 50% reduction in test organism survival. The lower the LC50, the more toxic the chemical or sample. Units are same as test concentration units. Note: The LC50 value must always be associated with the duration of exposure. Thus 48-h LC50, 96-h LC50, etc. are calculated.

LOEC: Lowest-observable-effect-concentration. The lowest concentration of sample or chemical in a chronic test dilution series in which the test organisms exhibit a statistically significant reduction in any of the test end points (e.g. growth, survival, reproduction) compared to control organisms. Units are same as test concentration units.

PMSD: Percent Minimum Significant Difference: The minimum difference which can exist between a test treatment and the controls in a particular test and be statistically significant; a measure of test sensitivity. The lower the PMSD the more sensitive the test.

N/A: Not applicable.

N/D: Not determined or measured.

NOAEC: No-observable-acute-effect-concentration. The highest concentration of sample or chemical in an acute test dilution series in which the test organisms exhibit no statistically significant reduction in the test end point (e.g. survival) compared to control organisms. Units are same as test concentration units.

NOEC: No-observable-effect-concentration. The highest concentration of sample or chemical in a chronic test dilution series in which the test organisms exhibit no statistically significant reduction in any of the test end points (e.g. growth, survival, reproduction) compared to control organisms. Some regulatory definitions also require that the NOEC be less than the LOEC. Units are same as test concentration units.

Q.L.: Quantitation Limit. Level, concentration, or quantity of a target variable (analyte) that can be reported at a specified degree of confidence.

T.U.: Toxic units. Expresses the relative toxicity of an effluent in such a manner that the larger the toxic unit value the more toxic the effluent. $T.U._{Ac} = 100/LC50$. $T.U._{Chr} = 100/NOEC$. A dimensionless unit.

VELAP# 460030
EPA# VA01116

C. dubia daily biological measurements (EPA 2002.0) Template version ACD-STAT-5trt-061113

TRTMNT (% Effl)	Rep	#Live Day 0	#Live Day 1	#Live Day 2	Final Mean % Live		
C	A	5	5	5	100.0		
	B	5	5	5			
Lab	C	5	5	5			
Control	D	5	5	5			
#1	A	5	5	2	25.0		
6.25	B	5	4	0			
% Effl	C	5	0	0			
	D	5	5	3			
# 2	A	5	0	0	0.0		
12.5	B	5	1	0			
% Effl	C	5	0	0			
	D	5	1	0			
# 3	A	5	0	0	0.0		
25.0	B	5	0	0			
% Effl	C	5	0	0			
	D	5	0	0			
# 4	A	5	0	0	0.0		
50.0	B	5	0	0			
% Effl	C	5	1	0			
	D	5	0	0			
# 5	A	5	0	0	0.0		
100	B	5	2	0			
% Effl	C	5	0	0		Test Duration:	48h 14m
	D	5	1	0			TAC 48+/-0.5h
INITIALS:		AK	LT	CPV	% CONTROL SURVIVAL:		100.0
DATE & TIME:		11/18/21 10:45	11/19/21 7:42	11/20/21 11:00			TAC = 90%
CHANGES & NOTES (INITIALS, DATE, SPECIFIC CHANGE MADE							

	SPECIES:	Ceriodaphnia dubia	
	ACCLIMATION WATER:	Mod. Hard Synthetic Freshwater	
	FEEDING PRIOR TO TEST:	YCT + Selenastrum capricornutum	
	FEEDING DURING TEST:	None -YCT + Selenastrum 2+ h before test	
	SOURCE:	CBI Stock cultures	
	ACCLIMATION TEMP (o C):	25	
	BROOD RELEASE START DATE & TIME:	11/17/21 22:00	
	BROOD RELEASE END DATE & TIME:	11/18/21 6:00	
	DATE/TIME WATER ADDED:	11/18/21 10:40	
	DATE/TIME ANIMALS ADDED:	11/18/21 10:45	
	ANIMAL AGE WINDOW:	8h 0m	
	MAX AGE AT TEST START:	12h 46m	TAC Max. 24 h
	TEST SET UP BY:	AK	
	SAMPLE COLLECTION DATE &TIME:	11/16/21 23:59	SAMPLE USED A
TEST ID:	SAMPLE AGE AT TEST START:	34h 47m	TAC Max 36 h
AWSL2113ACD	PEER REVIEW BY (INITIALS/DATE):	CPV,PB	11/24/21 12:20

Ceriodaphnia daily water quality bench sheet (EPA METHOD 2002.0) Template version ACD-STAT-5trt-061113

	TRTMNT	Day 0 Initial	Day 1	Day 2 Final	SUMMARY WATER QUALITY DATA MEAN	S.D.	MIN.	MAX.
pH (S.U.)	C	8.07	7.96	7.84	7.96	0.12	7.84	8.07
	1	8.06	8.03	7.97	8.02	0.05	7.97	8.06
	2	8.11	8.08	8.09	8.09	0.02	8.08	8.11
	3	8.17	8.08		8.13	0.06	8.08	8.17
	4	8.22	8.17	8.28	8.22	0.06	8.17	8.28
	5	8.36	8.35	8.40	8.37	0.03	8.35	8.40
Temp. (o C)	C	25	25	25	25	0.0	25	25
	1	25	25	25	25	0.0	25	25
	2	25	25	25	25	0.0	25	25
	3	25	25		25	0.0	25	25
	4	25	25	25	25	0.0	25	25
	5	25	25	25	25	0.0	25	25
Diss. Oxygen (mg/l)	C	8.2	8.1	8.0	8.1	0.1	8.0	8.2
	1	8.2	8.1	8.0	8.1	0.1	8.0	8.2
	2	8.2	8.2	7.9	8.1	0.2	7.9	8.2
	3	8.2	8.2		8.2	0.0	8.2	8.2
	4	8.2	8.2	7.9	8.1	0.2	7.9	8.2
	5	8.2	8.3	8.1	8.2	0.1	8.1	8.3
Cond. (uS/cm)	C	296		327	312	21.9	296	327
	1	328			328		328	328
	2	346			346		346	346
	3	408			408		408	408
	4	515			515		515	515
	5	705		669	687	25.5	669	705
Replicate measured		Flask	Surrogate	B				
Initials		AK	LT	CPV				
		TRC (mg/l) in highest conc. at end of test:		N/A				
Changes & Notes (Initials, date, specific change or notes)								

Test chamber:	30 ml plastic cup:	✓			
	Other:				
Test solution vol. (15 ml min):	15 ml:	✓			
	Other (ml):				
Illumination & photoperiod:	50-100 ft-c 16L:8D		Template Number:	11	
Number of replicates/treatment:	4				
Initial number animals/replicate:	5				
Test Aerated?	N/A	Date & Time Air Start:	N/A		

TEST ID	TRT ID:	1	2	3	4	5
AWSL2113ACD	CONC(%):	6.25	12.5	25.0	50.0	100

Acute Ceriodaphnia Test-48 Hr Survival

Start Date:		Test ID:	AWSL2113	Sample ID:	
End Date:		Lab ID:	CBI	Sample Type:	
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	CD-Ceriodaphnia dubia
Comments:	DATA ENTERED BY PB				

Conc-%	1	2	3	4
CONTROL	1.0000	1.0000	1.0000	1.0000
6.25	0.4000	0.0000	0.0000	0.6000
12.5	0.0000	0.0000	0.0000	0.0000
25	0.0000	0.0000	0.0000	0.0000
50	0.0000	0.0000	0.0000	0.0000
100	0.0000	0.0000	0.0000	0.0000

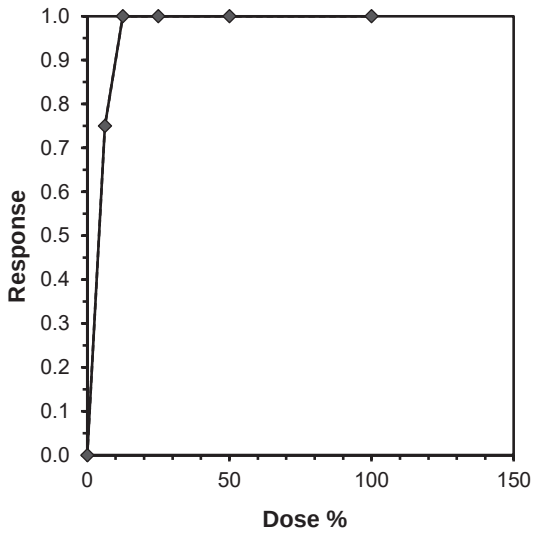
			Transform: Arcsin Square Root					Isotonic	
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Mean	N-Mean
CONTROL	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	1.0000	1.0000
6.25	0.2500	0.2500	0.5055	0.2255	0.8861	65.988	4	0.2500	0.2500
12.5	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4	0.0000	0.0000
25	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4	0.0000	0.0000
50	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4	0.0000	0.0000
100	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 normal distribution (p > 0.01)	0.8902	0.749	0.31151	0.27399
Equality of variance cannot be confirmed				

Linear Interpolation (200 Resamples)

Point	%	SD	95% CL(Exp)		Skew
IC05*	0.4167	0.0828	0.2500	0.7528	1.4336
IC10*	0.8333	0.1655	0.5000	1.5056	1.4336
IC15*	1.2500	0.2483	0.7500	2.2583	1.4336
IC20*	1.6667	0.3311	1.0000	3.0111	1.4336
IC25*	2.0833	0.4138	1.2500	3.7639	1.4336
IC40*	3.3333	0.6621	2.0000	6.0222	1.4336
IC50*	[illegible]	0.8007	2.5000	7.5227	1.2096

*[illegible]



PD

Effluent and Dilution Water Log (Freshwater Tests). FWEFFL061013

											SUMMARY WATER QUALITY DATA				
Initial sample charac-terization	Bottle(1):	A1									MEAN	S.D.	MIN.	MAX.	PARAMETER
	Arrival Temp. (oC, from CoC):	1									1		1	1	Arrival Temp.
	TRC (mg/l)(2):	<DL													
	TRC Corrected(2):														
	Hardness (mg/l):	94									94		94	94	Hardness (mg/l)
	Alkalinity (mg/l):	220									220		220	220	Alkalinity (mg/l)
	NH3-N (mg/l):	<1.0													
	Color/Appearance(3):	C													
	Obvious odor?	NO													
	Date & Time:	11/18/21 9:30													
	Initials:	LT													
Sample prep measure-ments	Test Day:	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7		MEAN	S.D.	MIN.	MAX.	
	Bottle(s):	A1													
	Prep. Temp. (oC):	25									25		25	25	Temp. (oC)
	D.O. (mg/l) After Warming:	9.0													
	Aeration Time (min):	2													
	Adjusted D.O. (mg/l):	8.2									8.2		8.2	8.2	D.O. (mg/l)
	Final pH (S.U.):	8.33									8.33		8.33	8.33	pH (S.U.)
	Conductivity (uS/cm)(4):	698									698		698	698	Cond. (uS/cm)
	Final TRC (mg/l)(5):	N.D.													
	Sample Filtered (60 um)?														
	Date & Time:	11/18/21 10:35													
	Initials:	AK													
Dilution water	Test Day:	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7		MEAN	S.D.	MIN.	MAX.	
	Vat Number:	2													
	Temperature (oC):	25									25		25	25	Temp. (oC)
	Conductivity (uS/cm):	300									300		300	300	Cond. (uS/cm)
	D.O. (mg/l):	8.2									8.2		8.2	8.2	D.O. (mg/l)
	pH (S.U.):	7.70									7.70		7.70	7.70	pH (S.U.)
	Hardness (mg/l):	84									84		84	84	Hardness (mg/l)
	Alkalinity (mg/l):	58									58		58	58	Alkalinity (mg/l)
	Date & Time:	11/18/21 8:00													
	Initials:	LT													
	Changes & Notes (Initials, date, specific change or notes)														
	Peer review Initial/Date:	CPV,PB	11/24/21 12:21	DILUTION WATER TYPE:	Mod. Hard Synthetic Freshwater (EPA)	ND=Not Determined/Measured, NA=Not Applicable. 1) Ninth character of lab sample ID on chain of custody AND bottle number in collection series. Together with Project ID constitutes entire sample bottle ID. 2) TRC MDL 0.02 mg/l; QL 0.22 mg/l. Corrected value if Mn, Cr potential positive interference. Corrected using KI and NaAsO2. 3) C-clear, O-opaque, T-turbid, S-solids (Sl-slight, M-moderate, H-heavy), Y-yellow, B-brown, Bl-black, G-green, P-pink, Gr-grey, Or-orange. 4) Measured on first use of sample only. 5) Final TRC measured only if chlorine present in initial characterization.												
PROJECT ID:	AWSL2113	ADDITIONAL EFFLUENT TREATMENT:													

AWSL2113-A
21-1808

ENTHALPY ANALYTICAL
formerly *Air, Water & Soil Laboratories*

Coastal Bioanalysts
6400 Enterprise Ct
Gloucester, VA 23061

1941 REYMET ROAD
RICHMOND, VIRGINIA 23237
(804) 358-8295 PHONE
(804)358-8297 FAX

Chain of Custody
Form #: D1331
Rev. 1.0
Effective: Feb 14, 2014

CHAIN OF CUSTODY

COMPANY NAME: Air, Water & Soil Labs, INC	INVOICE TO: AWS LABS	PROJECT NAME/Quote #: 21K1076
CONTACT: Katrina Cooke	INVOICE CONTACT: awsap@awslabs.com	SITE NAME: 21K1076
ADDRESS:1941 Reymet Rd, Richmond, VA 23237	INVOICE ADDRESS:	PROJECT NUMBER: 21K1076
PHONE #: 804-358-8295	INVOICE PHONE #:	P.O. #: PO.018803
FAX #:804-358-8297	EMAIL: support@awslabs.com	Pretreatment Program:

Is sample for compliance reporting? (YES) NO VA | Is sample from a chlorinated supply? YES NO | PWS I.D. #:

SAMPLER NAME (PRINT): Matt Alberts SAMPLER SIGNATURE: | **Turn Around Time: 21 Days**

Matrix Codes: WW=Waste Water/Storm Water GW=Ground Water DW=Drinking Water S=Soil/Solids OR=Organic A=Air WP=Wipe OT=Other_____

CLIENT SAMPLE I.D.	Grab	Composite	Field Filtered (Dissolved Metals)	Composite Start Date	Composite Start Time	Grab Date or Composite Stop Date	Grab Time or Composite Stop Time	Time Preserved	Matrix (See Codes)	Number of Containers	ANALYSIS / (PRESERVATIVE) Acute Toxicity - Ceriodaphnia Dubia								COMMENTS
1)		X		11/16/21	00.00	11/16/21	23.59		WW	1	X								
21K1076-01: 029 Quarterly TOX-Cd																			
3)																			
4)																			
5)																			
6)																			
7)																			
8)																			
9)																			
10)																			

Preservative Codes: N=Nitric Acid C=Hydrochloric Acid S=Sulfuric Acid H=Sodium Hydroxide A=Ascorbic Acid Z=Zinc Acetate T=Sodium Thiosulfate M=Methanol

PLEASE NOTE PRESERVATIVE(S), INTERFERENCE CHECKS or PUMP RATE (L/min)

RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME
		L. Thomas	11/18/21 0930
RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME
RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME

QC Data Package
Level I ☐
Level II ☐
Level III ☐
Level IV ☐

LAB USE ONLY

COOLER TEMP 1 °C

TV-LT

21K1076 Coastal Bioanalysts - BAE.xls

Appendix C. Data profile for lab results, DMR monitoring, and Bioplant operational data
ns = not sampled

					Test results from 029 compliance testing (for DMR reporting purposes)															
029 Date of Toxicity Sampling	**TU a result**	**Species**	**Lab**	**Compliance Sample?**	**pH Min**	**pH Max2**	**Flow MGD**	**BOD mg/L**	**TSS mg/L**	**COD mg/L**	**Sulfate mg/L**	**Nitrogen mg/L**	**Influent BOD mg/L**	**Influent TSS mg/L**	**Influent COD mg/L**	**Chromium Avg Loadi**	**Copper Avg Loading**	**Lead Avg Loading**	**Nickel Avg Loading**	**Zinc Avg Loading**
2/22/2022	2.6	Cd	San Diego	N (CLE)																
2/22/2022	2	Pp	San Diego	N (CLE)																
2/22/2022	>4.0	Cd	Coastal	N (CLE)																
2/22/2022	<1.0	Pp	Coastal	N (CLE)																
2/22/2022	1.25	Cd	BMI	N (CLE)																
2/22/2022	1.44	Pp	BMI	N (CLE)	7.6	7.7	1.1461	48.9	60	99.8	ns	28.1	ns	ns	ns	ns	ns	ns	ns	ns
2/1/2022	4.55	Cd	Coastal	N (CLE)																
2/1/2022	1	Pp	Coastal	N (CLE)																
2/1/2022	1	Cd	BMI	N (CLE)																
2/1/2022	1	Pp	BMI	N (CLE)	7.8	7.9	1.114	72.9	3.3	147	ns	19.8	ns	ns	ns	ns	ns	ns	ns	ns
12/7/2021	3.6	Pp	Coastal	N (CLE)	7.5	7.6	1.1216	>58.0	12	157	54.2	6.1	452	2,800	1,970	0	0.02	0.10	0	0
12/7/2021	1.2	Cd	Coastal	N (CLE)																
11/16/2021	10.2	Cd	BMI	Y	7.8	8	0.9183	56.1	14	174	ns	0.9	ns	ns	ns	ns	ns	ns	ns	ns
11/16/2021	23.98	Cd	Coastal	Y																
8/24/2021	1	Cd	Coastal	Y	8	8.1	0.7259	<2.0	1.1	19.8	ns	12.5	ns	ns	ns	ns	ns	ns	ns	ns
8/24/2021	3.13	Pp	Coastal	Y																
4/29/2021	4.65	Cd	Coastal	Y	8	8	0.9	ns	ns	ns	ns	ns	ns	ns	ns	0	0.03	0.17	0	0.05
1/5/2021	4.05	Cd	Pace	Y	7.9	8	1.1707	8.7	5.7	48.5	40	9.8	144	206	1,230	0	0.03	0.13	0	0.03
10/13/2020	1	Cd	Pace	Y	7.8	7.9	0.7853	<2.0	2	12.2	62.7	6.1	262	25	ns	0	0.02	0.12	0	0
8/11/2020	1	Cd	Pace	Y	7.6	7.6	0.9144	<10.6	4	30.3		0.7				0	0.01	0.13	0	0.01
4/7/2020	3.74	Cd	Pace	Y	7.9	8.3	0.9677	6.2	19	29.7	58.6	11.5	441	1,820	3,120	0.01	0.17	0.1	0	0.01
1/7/2020	1	Cd	Pace	Y	7.9	8	0.927	<2.0	2.5	8.8		7.9				0	0.02	0.11	0	0
10/1/2019	1	Cd	Pace	Y	7.9	8	0.9088	<2.0	3	15.7	46.3	1.7	428	2,220	3,310	0	0.02	0.11	0	0.04
7/18/2019	1	Cd	Pace	Y	8	8.1	0.6682									0	0.02	0.1	0	0
4/2/2019	1	Cd	Pace	Y	8	8.2	0.7424	<2.0	3	14	48.2	12.7	380	1,090	2,450	0	0.02	0.1	0	0
1/8/2019	1	Cd	Pace	Y	7.8	8	1.2666	31.3	4	17	27.5	15.5	359	2,330	1,630	0	0.03	0.08	0	0
10/2/2018	1	Cd	Pace	Y	7.9	8	0.9672	<2.0	2	<10.0	65.3	6.5	124	2,280	1,690	0	0.03	0.14	0	0
7/17/2018	1	Cd	Pace	Y	8	8.2	0.921	<2.0	2	<10.0	ns	11.2	ns	ns	ns	0	0	0	0	0
4/3/2018	1	Cd	Pace	Y	7.6	7.8	1.0834	<2.0	8	21	32.6	9.6	133	770	113	0	0	0	0	0
1/9/2018	1	Cd	Pace	Y	7.6	7.8	1.1726	<2.0	2	<10.0	27.1	11.4	174	1,860	58	ns	ns	ns	ns	ns

Appendix C. Data profil
ns = not sampled

	Data from Tox Reports (measured by Tox lab on sample receipt)							Internal Bioplant Monitoring Test Results							
029 Date of Toxicity Sampling	Chlorine from Tox Report	Average pH from Tox Report	Alkalinity from Tox Report	Hardness from Tox Report	Average Cond. From Tox Report	Ammonia (NH3-N) from Tox Report	D.O. from Tox Report2	PAX added (gall/day)	CLE Methyl Centralite mg/L	CLE NG, mg/l	EQE (RBCI) Settled Solids, ml/l	CLE COD, mg/l	CLE Ethanol, mg/l	CLE Acetone, mg/l	CLE Ether, mg/l
2/22/2022	0.04	7.58	19	119	815		8.4	26	0	13.2	210	1150	<2	48	<2
2/22/2022								26	0	13.2	210	1150	<2	48	<2
2/22/2022	0	7.48	21	662	1375	<1.0	8.2	26	0	13.2	210	1150	<2	48	<2
2/22/2022								26	0	13.2	210	1150	<2	48	<2
2/22/2022	0	7.64	500	620	760		5.7	26	0	13.2	210	1150	<2	48	<2
2/22/2022								26	0	13.2	210	1150	<2	48	<2
2/1/2022	0	7.46	15	1382	3640	<1.0	8.1	30	0	15.1	172.5	38	25	6	<2
2/1/2022								30	0	15.1	172.5	38	25	6	<2
2/1/2022	0	7.88	440	620	633	ns	8.4	30	0	15.1	172.5	38	25	6	<2
2/1/2022								30	0	15.1	172.5	38	25	6	<2
12/7/2021								59	0.7	19.6	220	144	<2	3	<2
12/7/2021	0	8.28	245	128	691	<1.0	8.4	59	0.7	19.6	220	144	<2	3	<2
11/16/2021	0	8.3	500	480	724	ns	8.8	19	1.6	15.1	188.75	48	<2	<2	<2
11/16/2021	0	8.36	220	94	705	<1.0	8.2	19	1.6	15.1	188.75	48	<2	<2	<2
8/24/2021	0	8.31	202	98	728	<1.0	8.2	13	0.18	12.1	207.5	16	<2	<2	<2
8/24/2021								13	0.18	12.1	207.5	16	<2	<2	<2
4/29/2021	0	7.93	259	130	773	<1.0	8	22	0	10.9	337.5	0	<2	<2	<2
1/5/2021	0	8.62	279	105	765	ns	7.8	20	0	9.9	211.25	0	<2	<2	<2
10/13/2020	0	8.405	234	96.8	693	ns	7.4	19	0.109	0	408.75	0	<2	<2	<2
8/11/2020	0	8.23	215	109	522	ns	7.6	20	1.93	0.9	215	0	<2	<2	<2
4/7/2020	0	8.45	254	121	768.5	ns	7.35	26	0	2.5	332.5	0	<2	<2	<2
1/7/2020	0	8.435	158	95.3	424.5	ns	7.9	29	0	0.1	275	0	<2	<2	<2
10/1/2019	0	8.435	269	827	677	ns	7.8	13	0	3.1	157.5	0	<2	<2	<2
7/18/2019	0	8.525	337	109	830.5	ns	7.55	15	0	0.3	315	0	<2	<2	<2
4/2/2019	0	8.45	115	233	665	ns	7.8	9	0.068	0	198.75	0	<2	<2	<2
1/8/2019	0	8.22	116	109	460.5	ns	7.55	13	0	12.4	153.75	0	<2	<2	<2
10/2/2018	ND	8.03	174	121	634.5	ns	7	13	0	0	142.5	0	<2	<2	<2
7/17/2018	0	7.785	197	93.9	645	ns	5.7	13	0	0	183.75	0	<2	<2	<2
4/3/2018	0.3	8.04	134	113	493.5	ns	7.35	15	0	0	205	2	<2	<2	<2
1/9/2018	ND	7.77	74.4	84.1	421	ns	7.65	14	0	0	153.75	4	<2	<2	<2

Toxicity Tests
For
BAE Systems

Report # 2713

Submitted To: Dr. Ashley Bandy

Submitted By:

Biological Monitoring, Inc.
1800 Kraft Drive, Suite 104
Blacksburg, VA 24060

Phone: 540-953-2821
Fax: 540-951-1481

Report Date: Feb 15, 2022

Biological Monitoring, Inc. is accredited by The NELAC Institute (TNI 2009, ID:460015). The test results reported herein meet all requirements of TNI. The procedures are deemed compliant with the methods and acceptable for reporting.

Quality Manager

BIOLOGICAL MONITORING, INC
1800 KRAFT DRIVE SUITE 104 BLACKSBURG VIRGINIA 24060
PH:540-953-2821 EMAIL:BMI@BIOMON.COM WWW.BIOMON.COM
TNI ACCREDITED LAB# 460015

Toxicity Testing Data Summary

Client BAE Systems **Permit #** NA **Sample** 029

Test ID	BAE020322-3	**Result**	LC50 > 100, TUa <1	**Pass/Fail**	NA	**Next Step**	NA
Test ID	BAE020322-4	**Result**	LC50 > 100, TUa <1	**Pass/Fail**	NA	**Next Step**	NA

BIOLOGICAL MONITORING, INC
1800 KRAFT DRIVE SUITE 104 BLACKSBURG VIRGINIA 24060
PH:540-953-2821 EMAIL:BMI@BIOMON.COM WWW.BIOMON.COM
TNI ACCREDITED LAB# 460015

Certificate of Analysis

Client	BAE Systems	**Report #**	2713
BMI Project #	4186	**Report Date**	Feb 15, 2022
Permit #	NA	**Sample ID #s**	BAE020322-2
Sample	029	**Test ID #**	BAE020322-3

Test Type	Static Acute			**Organism**	Pimephales promelas
Test Start Date	Feb 3, 2022	**Test Start Time**	1130	**EPA Method #**	2000
Test End Date	Feb 5, 2022	**Test End Time**	1130	**Photoperiod**	16h L/ 8h D

Endpoint	Survival	**Method**	Graphical	**Result**	LC50 > 100
Endpoint	Survival	**Method**	Graphical	**Result**	
Endpoint		**Method**		**Result**	
Endpoint		**Method**		**Result**	
Endpoint		**Method**		**Result**	

Final Result LC50 >100, TUa<1 **Pass/Fail**

BIOLOGICAL MONITORING, INC
1800 KRAFT DRIVE SUITE 104 BLACKSBURG VIRGINIA 24060
PH:540-953-2821 EMAIL:BMI@BIOMON.COM WWW.BIOMON.COM
TNI ACCREDITED LAB# 460015

Certificate of Analysis

Client	BAE Systems	**Report #**	2713
BMI Project #	4186	**Report Date**	Feb 15, 2022
Permit #	NA	**Sample ID #s**	BAE020322-2
Sample	029	**Test ID #**	BAE020322-4

Test Type	Static Acute			**Organism**	Ceriodaphnia dubia
Test Start Date	Feb 3, 2022	**Test Start Time**	1130	**EPA Method #**	2002
Test End Date	Feb 5, 2022	**Test End Time**	1130	**Photoperiod**	16h L/ 8h D

Endpoint	Survival	**Method**	Graphical	**Result**	LC50 >100
Endpoint	Survival	**Method**	Graphical	**Result**	
Endpoint		**Method**		**Result**	
Endpoint		**Method**		**Result**	
Endpoint		**Method**		**Result**	

Final Result LC50 >100, TUa<1 **Pass/Fail**

Acute Toxicity Test
(*Pimephales promelas*)

Experiment I.D.# BAE02DB22-3
Biologist(s): JR VR PR MM SS LJ
Permit # NA
Client: BAE Systems
Effluent toxicant: 029
Sample Type: Grab (Composite)
Sample Chlorine: <0.07
Dilution Water Used MHRW
Feeding Schedule: Not fed
Aeration:
Template #: 4x6 odd

Start of Test Date: 2-3-22 Time: 1330
End of Test Date: 2-5-22 Time: 1330
Test Duration: 48 hours
Test Temperature: 25 +/- 1 deg C
Test Volume: 350 ml
Test Containers Used: 400 ml TriPours
Renewal Frequency: None
Test Organism Age: 4 days
Organism Batch #: BS 02DB22-1
Organisms per concentration: 20
Waterbath/Shelf #: 5

SAMPLE COLLECTION				TEST RENEWAL			
Date(s)		Time(s)					
From:	To:	From:	To:	Date(s)	Time(s)	Test Day	Diluent Batch #:
2-1-22	2-1-22	0000	2359	2-3-22	1330	0	8108

Meters: Instrument Id#: Temp.: 073 pH: 061

DO: 061 Conductivity/Salinity: 061

Conditions of surviving organisms at end of test: Normal

Comments:

Experiment ID: BAED20322-3

Conc: Units	Rep.	Number of Live Organisms			Dissolved Oxygen (mg/L)			pH			Alkalinity mg/L as $CaCO_3$	Hardness mg/L as $CaCO_3$	Conductivity (umhos) or Salinity 0/00			Temperature (C)		
		0	24	48	0	24	48	0	24	48	0	0	0	24	48	0	24	48
%	A	5	5	5	7.90	7.88	7.85	8.10	8.12	8.16	64	90	327	336	342	26	25	25
	B	5	5	5														
0	C	5	5	5														
	D	5	5	5														
	A	5	5	5	8.03	8.00	7.94	8.07	8.10	8.15			442	448	456	26	25	25
25	B	5	5	5														
	C	5	5	5														
	D	5	5	5														
	A	5	5	5	8.07	8.05	8.02	8.02	8.05	8.10			496	508	513	26	25	25
45	B	5	5	5														
	C	5	5	5														
	D	5	5	5														
Recorded By:		KOA	KOA	KOA	KOA	KOA	KOA	KOA	KOA	KOA	KOA	KOA	KOA	KOA	KOA	KOA	KOA	KOA

Experiment ID: BAED210322-3

Conc: Units	Rep.	Number of Live Organisms			Dissolved Oxygen (mg/L)			pH			Alkalinity mg/L as $CaCO_3$	Hardness mg/L as $CaCO_3$	Conductivity (umhos) or Salinity 0/00			Temperature (C)		
		0	24	48	0	24	48	0	24	48	0	0	0	24	48	0	24	48
% 60	A	5	5	5	8.32	8.26	8.20	7.76	7.80	7.86			470	479	483	26	25	25
	B	5	5	5														
	C	5	5	5														
	D	5	5	5														
80	A	5	5	5	8.40	8.30	8.22	7.82	7.84	7.90			603	612	619	26	25	25
	B	5	5	5														
	C	5	5	5														
	D	5	5	5														
100	A	5	5	4	8.38	8.22	8.09	7.88	7.90	7.96	440	620	633	640	653	26	25	25
	B	5	5	5														
	C	5	5	4														
	D	5	5	5														
Recorded By:		KM	KM	KM	KM	KM	KM	KM	KM	KM	KM	KM	KM	KM	KM	KM	KM	KM

Acute Toxicity Test
(*Ceriodaphnia dubia*)

Experiment I.D.# BAE0202322-4
Biologist(s): JR VR PR MM SS LJ KP
Permit # NA
Client: BAE Systems
Effluent toxicant: 029
Sample Type: Composite
Sample Chlorine: <0.02
Dilution Water Used MHRW
Feeding Schedule: Not fed
Aeration: —
Template #: 5x6 Odd

Start of Test Date: 2-3-22 Time: 1130
End of Test Date: 2-5-22 Time: 1130
Test Duration: 48 hours
Test Temperature: 25 +/- 1 deg C
Test Volume: 30 ml
Test Containers Used: 50 ml TriPours
Renewal Frequency: None
Test Organism Age: <24 hours
Organism Batch #: D12722
Organisms per concentration: 20
Waterbath/Shelf #: 8

SAMPLE COLLECTION				TEST RENEWAL			
Date(s)		Time(s)					
From:	To:	From:	To:	Date(s)	Time(s)	Test Day	Diluent Batch #:
2-1-22	2-1-22	0000	2359	2-3-22	1130	0	8108

Meters: Instrument Id#: Temp.: 073 pH: 061

DO: 061 Conductivity/Salinity: 061

Conditions of surviving organisms at end of test: Normal

Comments:

Experiment ID: BAE 020322-4

Conc: Units	Rep.	Number of Live Organisms			Dissolved Oxygen (mg/L)			pH			Alkalinity mg/L as $CaCO_3$	Hardness mg/L as $CaCO_3$	Conductivity (umhos) or Salinity 0/00			Temperature (C)		
		0	24	48	0	24	48	0	24	48	0	0	0	24	48	0	24	48
%	A	5	5	5	7.90	7.85	7.80	8.10	8.12	8.16	64	90	327	338	347	26	26	25
	B	5	5	5														
0	C	5	5	5														
	D	5	5	5														
	A	5	5	5	8.03	8.00	7.92	8.07	8.10	8.15			442	451	459	26	26	25
	B	5	5	5														
25	C	5	5	5														
	D	5	5	5														
	A	5	5	5	8.07	7.99	7.87	8.02	8.03	8.07			496	512	520	26	26	25
	B	5	5	5														
45	C	5	5	5														
	D	5	5	5														
Recorded By:		KDR	KDR	KDR	KDR	KDR	KDR	KDR	KDR	KDR	KDR	KDR	KDR	KDR	KDR	KDR	KDR	KDR

Experiment ID: BAEW0322-4

Conc: Units	Rep.	Number of Live Organisms			Dissolved Oxygen (mg/L)			pH			Alkalinity mg/L as $CaCO_3$	Hardness mg/L as $CaCO_3$	Conductivity (umhos) or Salinity 0/00			Temperature (C)		
		0	24	48	0	24	48	0	24	48	0	0	0	24	48	0	24	48
%	A	5	5	5	8.32	8.28	8.20	7.76	7.78	7.84			470	477	484	26	26	25
60	B	5	5	5														
	C	5	5	5														
	D	5	5	5														
	A	5	5	5	8.40	8.36	8.30	7.82	7.85	7.96			603	610	618	26	26	25
80	B	5	5	5														
	C	5	5	5														
	D	5	5	4														
	A	5	5	5	8.38	8.32	8.26	7.88	7.92	8.00	440	620	633	638	646	26	26	25
100	B	5	5	4														
	C	5	5	5														
	D	5	5	5														
Recorded By:		KDR	KDR	KDR	KDR	KDR	KDR	KDR	KDR	KDR	KDR	KDR	KDR	KDR	KDR	KDR	KDR	KDR

BIOLOGICAL MONITORING, INC.
1800 KRAFT DRIVE SUITE 104 BLACKSBURG VIRGINIA 24060
PH: 540-953-2821 FAX: 540-951-1481 WWW.BIOMON.COM

NELAC ACCREDITED LAB # 460015

Sample Collection – Chain of Custody Form

Lab Sample ID (Lab Use Only): B A F 0 2 0 3 2 2 - 2

General Information

Client: Radford Army Ammunition Plant (RFAAP) Contact Name/Phone #: Matt Alberts: matt.alberts@baesystems.com, 540-639-7762; Ashley Bandy: ashley.bandy@baesystems.com, 540-639-7034

NPDES Permit #: NA, noncompliance samples Outfall Name/#: CLE (029)

Sample Chlorinated? No Dechlorinated? No

Should BMI Dechlorinate Sample? No

Test should be set up and run on Thursday, Feb. 3, 2022 using the following dilutions: 25%, 45%, 60%, 80%, and 100%

Sampling Information

use species C. dubia and P. promelas. SA 2/2/22

☐ Grab Sample Date Time Volume

☒ Composite Sample Type 24 hr. Time — Flow

Composite Start Date 2-1-22 Composite Start Time 00:00

Composite End Date 2-1-22 Composite End Time 23:59

Sub-samples — Frequency — Volume —

Field Measurements

Temp at Collection Point	Temp In Collection Device	pH	Chlorine	Date/Time	Initials
—	—	—	—	—	—

Custody Information

Relinquished By	Date	Time	Received By	Date	Time
Matt Alberts	2-2-22	1555	[illegible]	2-2-22	1600

Matt Alberts — Printed Name/Affiliation
Matt Alberts — Signature
2-2-22 — Date

Sample Check In (Lab Use Only)

Temperature 3.3 pH 8.19 Chlorine <0.02 DO 10.23 Conductivity/Salinity 652

On Ice? ✓ Custody Seal? NA Alkalinity 440 Hardness 620

Visual Description Clear Odor None

Ammonia (NH3-N) 0.08 Initials [illegible] Date/Time 2-3-22/0630

1941 Reymet Road ● Richmond, Virginia 23237 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Laboratory Order ID 22B0065

Client Name:	BAE Systems, Inc. - RFAAP	Date Received:	February 2, 2022 13:35
	Route 114	Date Issued:	February 10, 2022 17:35
	Radford, VA 24141	Project Number:	[none]
Submitted To:	Sheree Andrews	Purchase Order:	RFAC-032621-01-RLL
Client Site I.D.:	3-Way Toxicity Split - Coastal		

Enclosed are the results of analyses for samples received by the laboratory on 02/02/2022 13:35. If you have any questions concerning this report, please feel free to contact the laboratory.

Sincerely,

Ted Soyars

Technical Director

End Notes:

The test results listed in this report relate only to the samples submitted to the laboratory and as received by the Laboratory.

Unless otherwise noted, the test results for solid materials are calculated on a wet weight basis. Analyses for pH, dissolved oxygen, temperature, residual chlorine and sulfite that are performed in the laboratory do not meet NELAC requirements due to extremely short holding times. These analyses should be performed in the field. The results of field analyses performed by the Sampler included in the Certificate of Analysis are done so at the client's request and are not included in the laboratory's fields of certification nor have they been audited for adherence to a reference method or procedure.

The signature on the final report certifies that these results conform to all applicable NELAC standards unless otherwise specified. For a complete list of the Laboratory's NELAC certified parameters please contact customer service.

This report shall not be reproduced except in full without the expressed and written approval of an authorized representative of Air Water & Soil Laboratories, Inc.

TNI Accredited
VELAP ID 460021

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Received: Date Issued: Project Number: Purchase Order:	February 2, 2022 13:35 February 10, 2022 17:35 [none] RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	3-Way Toxicity Split - Coastal		

ANALYTICAL REPORT FOR SAMPLES

Laboratory Order ID 22B0065

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
Crowder Tank (007)	22B0065-01	Waste Water	02/01/2022 08:00 to 02/01/2022 23:59	02/02/2022 13:35
CLE (029)	22B0065-02	Waste Water	02/01/2022 00:00 to 02/01/2022 23:59	02/02/2022 13:35

Analysis for Acute Toxicity was subcontracted to Coastal Bioanalysts, Inc. The subcontracted results are attached at the end of this Certificate of Analysis.

ENTHALPY ANALYTICAL

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Received: Date Issued: Project Number: Purchase Order:	February 2, 2022 13:35 February 10, 2022 17:35 [none] RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	3-Way Toxicity Split - Coastal		

Laboratory Order ID: 22B0065

Analytical Results

Sample I.D. Crowder Tank (007) **Laboratory Sample ID:** 22B0065-01

Composite Start-End Date/Time: 02/01/2022 08:00 - 02/01/2022 23:59

Field Residual Cl: **Field pH:**

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Subcontracted Analysis									
Acute Toxicity PP	01	EPA	Attached		--	1	02/10/22 17:20	02/10/22 17:22	N/A

Analytical Results

Sample I.D. CLE (029) **Laboratory Sample ID:** 22B0065-02

Composite Start-End Date/Time: 02/01/2022 00:00 - 02/01/2022 23:59

Field Residual Cl: **Field pH:**

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Subcontracted Analysis									
Acute Toxicity PP	02	EPA	Attached		--	1	02/10/22 17:20	02/10/22 17:22	N/A

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Received: Date Issued: Project Number: Purchase Order:	February 2, 2022 13:35 February 10, 2022 17:35 [none] RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	3-Way Toxicity Split - Coastal		

Analytical Summary

Sample ID	Preparation Factors Initial / Final	Method	Batch ID	Sequence ID	Calibration ID
Subcontracted Analysis		**Preparation Method:**	**No Prep**		
22B0065-01	1.00 mL / 1.00 mL	EPA	BFB0375		
22B0065-02	1.00 mL / 1.00 mL	EPA	BFB0375		

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Received: Date Issued: Project Number: Purchase Order:	February 2, 2022 13:35 February 10, 2022 17:35 [none] RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	3-Way Toxicity Split - Coastal		

Certified Analyses included in this Report

Analyte **Certifications**

Code	Description	Laboratory ID	Expires
MADEP	Massachusetts DEP	M-VA913	06/30/2022
MdDOE	Maryland DE Drinking Water	341	12/31/2022
NC	North Carolina DENR	495	07/31/2022
NCDEQ	North Carolina DEQ	495	12/31/2022
NCDOH	North Carolina Department of Health	51714	07/31/2022
NHDES	NELAP-New Hampshire Certificate #224221	2242	02/25/2022
NJDEP	NELAP-New Jersey DEP	VA015	06/30/2022
NYDOH	New York DOH Drinking Water	12096	04/01/2022
PADEP	NELAP-Pennsylvania Certificate #007	68-03503	10/31/2022
VELAP	NELAP-Virginia Certificate #11539	460021	06/14/2022
WVDEP	West Virginia DEP	350	02/28/2022

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Received: Date Issued: Project Number: Purchase Order:	February 2, 2022 13:35 February 10, 2022 17:35 [none] RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	3-Way Toxicity Split - Coastal		

Summary of Data Qualifiers

Attached	Attached
RPD	Relative Percent Difference
Qual	Qualifers
-RE	Denotes sample was re-analyzed
D.F.	Dilution Factor. Please also see the Preparation Factor in the Analysis Summary section.
TIC	Tentatively Identified Compounds are compounds that are identified by comparing the analyte mass spectral pattern with the NIST spectral library. A TIC spectral match is reported when the pattern is at least 75% consistent with the published pattern. Compound concentrations are estimated and are calculated using an internal standard response factor of 1.
PCBs, Total	Total PCBs are defined as the sum of detected Aroclors 1016, 1221, 1232, 1248, 1254, 1260, 1262, and 1268.

ENTHALPY ANALYTICAL
formerly *Air, Water & Soil Laboratories*

1941 REYMET ROAD
RICHMOND, VIRGINIA 23237
(804) 358-8295 PHONE
(804)358-8297 FAX

Chain of Custody
Effective: Nov 15, 2018

CHAIN OF CUSTODY

COMPANY NAME: BAE Systems, Inc. - RFAAP	INVOICE TO: Accounts Payable	PROJECT NAME: 3-Way Toxicity Split - Coastal
CONTACT: Ashley Bandy	INVOICE CONTACT:	SITE NAME:
ADDRESS: Route 114 Radford, Va 24141	INVOICE ADDRESS:	PROJECT NUMBER:
PHONE #: 1-540-639-7034	INVOICE PHONE #:	P.O. #:
FAX #: EMAIL: ashley.bandy@baesystems.com		Pretreatment Program:
Is sample for compliance reporting? No	Regulatory State: Va	Is sample from a chlorinated supply? NO / PWS I.D. #:
SAMPLER NAME (PRINT): Denise Vaughn	SAMPLER SIGNATURE: Denise Vaughn	Turn Around Time: Circle 10 5 Days or _Day(s)

Matrix Codes: WW=Waste Water/Storm Water GW=Ground Water DW=Drinking Water S=Soil/Solids OR=Organic A=Air WP=Wipe OT=Other_____

CLIENT SAMPLE I.D.	Grab	Composite	Field Filtered (Dissolved Metals)	Composite Start Date	Composite Start Time	Grab Date or Composite Stop Date	Grab Time or Composite Stop Time	Time Preserved 2.2.22	Matrix (See Codes)	Number of Containers	Acute Toxicity - Ceriodaphnia dubia	Acute Toxicity - Pimephales							COMMENTS
											ANALYSIS / (PRESERVATIVE)								Preservative Codes: N=Nitric Acid C=Hydrochloric Acid S=Sulfuric Acid H=Sodium Hydroxide A=Ascorbic Acid Z=Zinc Acetate T=Sodium Thiosulfate M=Methanol
1) Crowder Tank (007)		X		2.1.22	~~0000~~ 0800 2-2-22 AMB	~~2.1.22~~ 2-2-22 AMB	2359	0730	WW		x	x							15%, 25%, 50%, 75%, 100% Dilutions
2) CLE (029)		x		2.1.22	0000	2.1.22	2359	0800	WW		x	x							25%, 45%, 60%, 80%, 100% Dilutions
3)																			
4)																			
5)																			
6)																			
7)																			
8)																			
9)																			
10)																			

PLEASE NOTE PRESERVATIVE(S), INTERFERENCE CHECKS or PUMP RATE (L/min)

All tests are to be set up and run on Thursday, Feb. 3, 2022

RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME
Denise Vaughn	2.2.22/0830	[signature]	2/2/22 0830
[signature]	2-2-22 1335	JH	2-2-22 1335

QC Data Package
Level III ☐
Level IV ☐

LAB USE ONLY Therm ID: 271 COOLER TEMP 1.7 °C
Custody Seals used and intact? (Y / N) Received on ice? (Y / N)

BAE Systems, Inc. 22B0065
Toxicity
Recd: 02/02/2022 Due: 02/09/2022

v130325002

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Received: Date Issued: Project Number: Purchase Order:	February 2, 2022 13:35 February 10, 2022 17:35 [none] RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	3-Way Toxicity Split - Coastal		

Sample Conditions Checklist

Samples Received at:	**1.70°C**
How were samples received?	AWS Courier
Were Custody Seals used? If so, were they received intact?	No
Are the custody papers filled out completely and correctly?	Yes
Do all bottle labels agree with custody papers?	Yes
Is the temperature blank or representative sample within acceptable limits or received on ice, and recently taken?	Yes
Are all samples within holding time for requested laboratory tests?	Yes
Is a sufficient amount of sample provided to perform the tests included?	Yes
Are all samples in appropriate containers for the analyses requested?	Yes
Were volatile organic containers received?	No
Are all volatile organic and TOX containers free of headspace?	NA
Is a trip blank provided for each VOC sample set? VOC sample sets include EPA8011, EPA504, EPA8260, EPA624, EPA8015 GRO, EPA8021, EPA524, and RSK-175.	NA
Are all samples received appropriately preserved? Note that metals containers do not require field preservation but lab preservation may delay analysis.	Yes

Work Order Comments

Client: Enthalpy Analytical/Air, Water and Soil Laboratories
Project ID: AWSL2201
Client Sample ID: BAE-Radford Army Ammunition Plant 22B0065-01A
Permit No.: VA0000248 Crowder Tank (007)
Sample Period: 2/1/22

Coastal Bioanalysts, Inc.

Report of Analysis: Whole Effluent Toxicity (WET)

Submitted To:	**Prepared By:**
JP Verheul Business Development Manager / Senior Chemist Enthalpy Analytical/Air, Water and Soil Laboratories 1941 Reymet Road, Richmond, VA 23237	Coastal Bioanalysts, Inc. 6400 Enterprise Court Gloucester, VA 23061 (804) 694-8285 www.coastalbio.com Contact: Peter F. De Lisle, Technical Director

Acute Test Results*				
Species-Test Method	**Test Period**	**NOAEC**	**48-h LC50**	**T.U.$_{Ac}$**
C. dubia EPA 2002.0	2/3/22-2/5/22	N/A	22.0	**4.55**
P. promelas EPA 2000.0	2/3/22-2/5/22	N/A	>100	**<1.00**

Details regarding test conduct and data analysis provided in attached bench sheets and printouts as applicable.
For each test method record the T.U.$_{Ac}$ value (bold) on the DMR.

Acute Test QA/QC	**Reference Toxicant: KCl**	**Units: mg/l**	**Test Organism Source: CBI Stock Cultures**		
Species-Method (Ref. Test Date)	**Data Source**	**% Control Survival**	**48-h LC50**	**95% C.L./A.L. For LC50**	**RTT in Control?**
C. dubia 2002.0	RTT	100	499	462-540	Yes
(2/2/22-2/4/22)	CC	100	526	450-602	
P. promelas 2000.0	RTT	100	1016	934-1104	Yes
(2/2/22-2/4/22)	CC	100	1000	832-1168	

Note: RTT = Reference Toxicant Test, CC = Control Chart.

The results of analysis contained within this report relate only to the sample as received in the laboratory. This report shall not be reproduced except in full without written approval from the laboratory. Unless noted below, these test results meet all requirements of NELAP.

APPROVED: Peter F. De Lisle

Digitally signed by Peter F. De Lisle
DN: cn=Peter F. De Lisle, o=Coastal Bioanalysts, Inc., ou=Toxicology, email=pfd@coastalbio.com, c=US
Date: 2022.02.10 14:43:02 -05'00'

Peter F. De Lisle, Ph.D.
Technical Director

Deviations from, additions to, or exclusions from the test method, non-standard conditions or data qualifiers and, as appropriate, a statement of compliance/non-compliance: **Revised 2/10/22 to include revised CoC.**

Please leave feedback regarding our services at: http://coastalbio.com/survey

VELAP# 460030
EPA# VA01116

NELAP ACCREDITED LABORATORY

GLOSSARY OF TERMS AND ABBREVIATIONS

A.L. (Acceptance Limits): The results of a given reference toxicant test are compared to the control chart mean value ± 2 standard deviations. These limits approximate the 95% probability limits for the "true" reference toxicant value.

Chronic Value (ChrV): The geometric mean of the NOEC and LOEC. Units are same as test concentration units.

C.L. (Confidence Limits): These are the probability limits, based on the data set and statistical model employed, that the "true value" lies within the limits specified. Typically limits are based on 95% or 99% probabilities.

Control chart: A cumulative summary chart of results from QC tests with reference toxicants. The results of a given reference toxicant test are compared to the control chart mean value and 95% Acceptance Limits (A.L.) (mean ± 2 standard deviations).

IC25: The concentration of sample or chemical, calculated from the data set using statistical models, causing a 25% reduction in test organism growth, reproduction, etc. The lower the IC25, the more toxic the chemical or sample. Units are same as test concentration units.

LC50: The concentration of sample or chemical, calculated from the data set using statistical models, causing a 50% reduction in test organism survival. The lower the LC50, the more toxic the chemical or sample. Units are same as test concentration units. Note: The LC50 value must always be associated with the duration of exposure. Thus 48-h LC50, 96-h LC50, etc. are calculated.

LOEC: Lowest-observable-effect-concentration. The lowest concentration of sample or chemical in a chronic test dilution series in which the test organisms exhibit a statistically significant reduction in any of the test end points (e.g. growth, survival, reproduction) compared to control organisms. Units are same as test concentration units.

PMSD: Percent Minimum Significant Difference: The minimum difference which can exist between a test treatment and the controls in a particular test and be statistically significant; a measure of test sensitivity. The lower the PMSD the more sensitive the test.

N/A: Not applicable.

N/D: Not determined or measured.

NOAEC: No-observable-acute-effect-concentration. The highest concentration of sample or chemical in an acute test dilution series in which the test organisms exhibit no statistically significant reduction in the test end point (e.g. survival) compared to control organisms. Units are same as test concentration units.

NOEC: No-observable-effect-concentration. The highest concentration of sample or chemical in a chronic test dilution series in which the test organisms exhibit no statistically significant reduction in any of the test end points (e.g. growth, survival, reproduction) compared to control organisms. Some regulatory definitions also require that the NOEC be less than the LOEC. Units are same as test concentration units.

Q.L.: Quantitation Limit. Level, concentration, or quantity of a target variable (analyte) that can be reported at a specified degree of confidence.

T.U.: Toxic units. Expresses the relative toxicity of an effluent in such a manner that the larger the toxic unit value the more toxic the effluent. $T.U._{Ac} = 100/LC50$. $T.U._{Chr} = 100/NOEC$. A dimensionless unit.

C. dubia daily biological measurements (EPA 2002.0) Template version ACD-STAT-5trt-061113

TRTMNT (% Effl)	Rep	#Live Day 0	#Live Day 1	#Live Day 2	Final Mean % Live		
C	A	5	5	5	100.0		
	B	5	5	5			
Lab	C	5	5	5			
Control	D	5	5	5			
#1	A	5	5	5	75.0		
15.0	B	5	5	5			
% Effl	C	5	5	3			
	D	5	5	2			
# 2	A	5	5	4	50.0		
25.0	B	5	5	2			
% Effl	C	5	5	3			
	D	5	5	1			
# 3	A	5	2	0	0.0		
50.0	B	5	0	0			
% Effl	C	5	5	0			
	D	5	2	0			
# 4	A	5	0	0	0.0		
75.0	B	5	0	0			
% Effl	C	5	5	0			
	D	5	2	0			
# 5	A	5	2	0	0.0		
100	B	5	4	0			
% Effl	C	5	5	0		Test Duration:	48h 4m
	D	5	0	0			TAC 48+/-0.5h
INITIALS:		AK	LT	LT	% CONTROL SURVIVAL:		100.0
DATE & TIME:		2/3/22 11:06	2/4/22 9:21	2/5/22 11:10			TAC = 90%
CHANGES & NOTES (INITIALS, DATE, SPECIFIC CHANGE MADE		Toxcalc to be performed with permit-specific dilutions.					

	SPECIES:	Ceriodaphnia dubia	
	ACCLIMATION WATER:	Mod. Hard Synthetic Freshwater	
	FEEDING PRIOR TO TEST:	YCT + Selenastrum capricornutum	
	FEEDING DURING TEST:	None -YCT + Selenastrum 2+ h before test	
	SOURCE:	CBI Stock cultures	
	ACCLIMATION TEMP (o C):	25	
	BROOD RELEASE START DATE & TIME:	2/2/22 22:00	
	BROOD RELEASE END DATE & TIME:	2/3/22 6:00	
	DATE/TIME WATER ADDED:	2/3/22 10:57	
	DATE/TIME ANIMALS ADDED:	2/3/22 11:06	
	ANIMAL AGE WINDOW:	8h 0m	
	MAX AGE AT TEST START:	13h 6m	TAC Max. 24 h
	TEST SET UP BY:	AK	
	SAMPLE COLLECTION DATE &TIME:	2/1/22 23:59	SAMPLE USED A
TEST ID:	SAMPLE AGE AT TEST START:	35h 7m	TAC Max 36 h
AWSL2201ACD	PEER REVIEW BY (INITIALS/DATE):	PB	2/7/22 13:21

Ceriodaphnia daily water quality bench sheet (EPA METHOD 2002.0) Template version ACD-STAT-5trt-061113

	TRTMNT	Day 0 Initial	Day 1	Day 2 Final	SUMMARY WATER QUALITY DATA MEAN	S.D.	MIN.	MAX.
pH (S.U.)	C	8.09	8.02	8.14	8.08	0.06	8.02	8.14
	1	7.86	7.86	8.02	7.91	0.09	7.86	8.02
	2	7.64	7.88	7.99	7.84	0.18	7.64	7.99
	3	7.55	7.75	7.93	7.74	0.19	7.55	7.93
	4	7.45	7.66	7.77	7.63	0.16	7.45	7.77
	5	7.33	7.48	7.57	7.46	0.12	7.33	7.57
Temp. (o C)	C	25	25	24	25	0.6	24	25
	1	25	25	24	25	0.6	24	25
	2	25	25	24	25	0.6	24	25
	3	25	25	24	25	0.6	24	25
	4	25	25	24	25	0.6	24	25
	5	25	25	24	25	0.6	24	25
Diss. Oxygen (mg/l)	C	8.2	8.2	8.0	8.1	0.1	8.0	8.2
	1	8.2	8.3	8.1	8.2	0.1	8.1	8.3
	2	8.2	8.3	8.1	8.2	0.1	8.1	8.3
	3	8.2	8.3	8.2	8.2	0.1	8.2	8.3
	4	8.2	8.0	8.2	8.1	0.1	8.0	8.2
	5	8.2	8.0	8.2	8.1	0.1	8.0	8.2
Cond. (uS/cm)	C	310		331	321	14.8	310	331
	1	859			859		859	859
	2	1057			1057		1057	1057
	3	2070			2070		2070	2070
	4	2870			2870		2870	2870
	5	3620		3660	3640	28.3	3620	3660
Replicate measured		Flask	Surrogate	D				
Initials		AK	LT	LT				
		TRC (mg/l) in highest conc. at end of test:		N/A				
Changes & Notes (Initials, date, specific change or notes)								

Test chamber:	30 ml plastic cup:	✓					
	Other:						
Test solution vol. (15 ml min):	15 ml:	✓					
	Other (ml):						
Illumination & photoperiod:	50-100 ft-c 16L:8D			Template Number:		11	
Number of replicates/treatment:	4						
Initial number animals/replicate:	5						
Test Aerated?	N/A	Date & Time Air Start:		N/A			

TEST ID	TRT ID:	1	2	3	4	5
AWSL2201ACD	CONC(%):	15.0	25.0	50.0	75.0	100

Acute Ceriodaphnia Test-48 Hr Survival

Start Date:		Test ID:	AWSL2201CD	Sample ID:	
End Date:		Lab ID:	CBI	Sample Type:	
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	CD-Ceriodaphnia dubia
Comments:	DATA ENTERED BY PB				

Conc-%	1	2	3	4
CONTROL	1.0000	1.0000	1.0000	1.0000
15	1.0000	1.0000	0.6000	0.4000
25	0.8000	0.4000	0.6000	0.2000
50	0.0000	0.0000	0.0000	0.0000
75	0.0000	0.0000	0.0000	0.0000
100	0.0000	0.0000	0.0000	0.0000

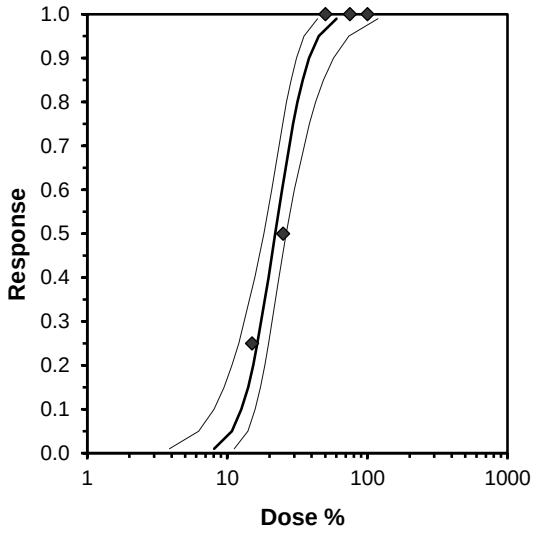
			Transform: Arcsin Square Root					Number	Total
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
CONTROL	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	0	20
15	0.7500	0.7500	1.0653	0.6847	1.3453	31.308	4	5	20
25	0.5000	0.5000	0.7854	0.4636	1.1071	35.048	4	10	20
50	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4	20	20
75	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4	20	20
100	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 > 0.01)	0.93509	0.805	-0.16123	-0.64488
Equality of variance cannot be confirmed				

Maximum Likelihood-Probit

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	5.32223	1.08886	3.18806	7.4564	0	2.28773	7.81472	0.51	1.34274	0.18789	7
Intercept	-2.14639	1.49605	-5.07864	0.78586							
TSCR											

Point	Probits	%	95% Fiducial Limits	
EC01	2.674	8.04717	3.85611	11.2283
EC05	3.355	10.8066	6.2365	14.018
EC10	3.718	12.6459	8.02824	15.8375
EC15	3.964	14.0607	9.49464	17.242
EC20	4.158	15.2971	10.8241	18.4888
EC25	4.326	16.4442	12.0849	19.6742
EC40	4.747	19.7307	15.7243	23.3425
EC50	5.000		18.1516	26.2572
EC60	5.253	24.5666	20.654	29.9643
EC75	5.674	29.4764	24.848	38.4501
EC80	5.842	31.6867	26.534	42.7784
EC85	6.036	34.4731	28.5387	48.6213
EC90	6.282	38.3297	31.1519	57.3505
EC95	6.645	44.8536	35.2816	73.6468
EC99	7.326	60.2343	44.1482	118.837



P. promelas daily biological measurements (EPA 2000.0) Template version APP-STAT-48h-5trt-061113

TRTMNT (%Effl)	Rep	#Live Day 0	#Live Day 1	#Live Day 2	Final Mean % Live		
C	A	10	10	10	100.0		
Lab Control	B	10	10	10			
#1	A	10	10	10	100.0		
15.0	B	10	10	10			
# 2	A	10	10	10	100.0		
25.0	B	10	10	10			
# 3	A	10	10	10	100.0		
50.0	B	10	10	10			
# 4	A	10	10	10	100.0		
75.0	B	10	10	10			
# 5	A	10	10	10	100.0	Test Duration:	48h 13m
100	B	10	10	10			TAC 48+/-0.5h
INITIALS:		AK	LT	LT	% CONTROL SURVIVAL:		100.0
DATE & TIME:		2/3/22 11:06	2/4/22 9:28	2/5/22 11:19			TAC = 90%
CHANGES & NOTES (INITIALS, DATE, SPECIFIC CHANGE MADE		Toxcalc to be performed with permit-specific dilutions.					

SPECIES:	Pimephales promelas		
ACCLIMATION WATER:	Mod. Hard Synthetic Freshwater		
FEEDING PRIOR TO TEST:	Artemia nauplii ad libitum		
FEEDING DURING TEST:	None		
SOURCE:	CBI Stock cultures		
ACCLIMATION TEMP (o C):	25		
HATCH START DATE & TIME:	1/30/22 17:00		
HATCH END DATE & TIME:	1/31/22 10:00		
DATE/TIME WATER ADDED:	2/3/22 10:58		
DATE/TIME ANIMALS ADDED:	2/3/22 11:06		
ANIMAL AGE WINDOW:	17h 0m		TAC Max. 24 h
MAX AGE AT TEST START:	4d		TAC Max. 14 d
TEST SET UP BY:		AK	
SAMPLE COLLECTION DATE & TIME:	2/1/22 23:59	SAMPLE USED	A
SAMPLE AGE AT TEST START:	35h 7m	TAC MAX 36 h	
PEER REVIEW BY (INITIALS/DATE):		PB	2/7/22 13:40

TEST ID:

AWSL2201APP

P. promelas daily water quality bench sheet (EPA METHOD 2002.0) Template version APP-STAT-48h-5trt-06113

	TRTMNT	Day 0 Initial	Day 1	Day 2 Final	SUMMARY WATER QUALITY DATA MEAN	S.D.	MIN.	MAX.
pH (S.U.)	C	8.09	8.20	8.00	8.10	0.10	8.00	8.20
	1	7.86	7.94	7.87	7.89	0.04	7.86	7.94
	2	7.64	7.92	7.74	7.77	0.14	7.64	7.92
	3	7.55	7.82	7.63	7.67	0.14	7.55	7.82
	4	7.45	7.66	7.55	7.55	0.11	7.45	7.66
	5	7.33	7.44	7.20	7.32	0.12	7.20	7.44
Temp. (o C)	C	25	25	24	25	0.6	24	25
	1	25	25	24	25	0.6	24	25
	2	25	25	24	25	0.6	24	25
	3	25	25	24	25	0.6	24	25
	4	25	25	24	25	0.6	24	25
	5	25	25	24	25	0.6	24	25
Diss. Oxygen (mg/l)	C	8.2	8.0	7.9	8.0	0.2	7.9	8.2
	1	8.2	7.3	7.4	7.6	0.5	7.3	8.2
	2	8.2	7.3	7.4	7.6	0.5	7.3	8.2
	3	8.2	7.3	7.5	7.7	0.5	7.3	8.2
	4	8.2	7.3	7.5	7.7	0.5	7.3	8.2
	5	8.2	7.4	7.6	7.7	0.4	7.4	8.2
Cond. (uS/cm)	C	310		330	320	14.1	310	330
	1	859			859		859	859
	2	1057			1057		1057	1057
	3	2070			2070		2070	2070
	4	2870			2870		2870	2870
	5	3620		3660	3640	28.3	3620	3660
Replicate measured		A	A	B				
Initials		AK	LT	LT				
		TRC (mg/l) in highest conc. at end of test:		NA				
Changes & Notes (Initials, date, specific change or notes)								

Test chamber:	400 ml Tri-pour bkr:	✓			
	Other:				
Test solution vol. (200 ml min):	400 ml:	✓			
	Other (ml):				
Illumination & photoperiod:	50-100 ft-c 16L:8D				
Number of replicates/treatment:	2				
Initial number animals/replicate:	10				
Test Aerated?	No	Date & Time Air Start:			

TEST ID	TRT ID:	1	2	3	4	5	D.O. Highest conc. @ aeration:
AWSL2201APP	CONC (%):	15.0	25.0	50.0	75.0	100	Total live highest conc.@ aeration

Effluent and Dilution Water Log (Freshwater Tests). FWEFFL061013

											SUMMARY WATER QUALITY DATA				
Initial sample charac-terization	Bottle(1):	A1									MEAN	S.D.	MIN.	MAX.	PARAMETER
	Arrival Temp. (oC, from CoC):	1									1		1	1	Arrival Temp.
	TRC (mg/l)(2):	<DL													
	TRC Corrected(2):	✓													
	Hardness (mg/l):	1382									1382		1382	1382	Hardness (mg/l)
	Alkalinity (mg/l):	15									15		15	15	Alkalinity (mg/l)
	NH3-N (mg/l):	<1.0													
	Color/Appearance(3):	C													
	Obvious odor?	NO													
	Date & Time:	2/3/22 9:34													
	Initials:	LT													
Sample prep measure-ments	Test Day:	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7		MEAN	S.D.	MIN.	MAX.	
	Bottle(s):	A1-1													
	Prep. Temp. (oC):	25									25		25	25	Temp. (oC)
	D.O. (mg/l) After Warming:	9.6													
	Aeration Time (min):	3													
	Adjusted D.O. (mg/l):	8.2									8.2		8.2	8.2	D.O. (mg/l)
	Final pH (S.U.):	7.42									7.42		7.42	7.42	pH (S.U.)
	Conductivity (uS/cm)(4):	3620									3620		3620	3620	Cond. (uS/cm)
	Final TRC (mg/l)(5):	N.D.													
	Sample Filtered (60 um)?														
	Date & Time:	2/3/22 10:46													
	Initials:	AK													
Dilution water	Test Day:	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7		MEAN	S.D.	MIN.	MAX.	
	Vat Number:	3													
	Temperature (oC):	25									25		25	25	Temp. (oC)
	Conductivity (uS/cm):	308									308		308	308	Cond. (uS/cm)
	D.O. (mg/l):	8.2									8.2		8.2	8.2	D.O. (mg/l)
	pH (S.U.):	7.85									7.85		7.85	7.85	pH (S.U.)
	Hardness (mg/l):	98									98		98	98	Hardness (mg/l)
	Alkalinity (mg/l):	62									62		62	62	Alkalinity (mg/l)
	Date & Time:	2/3/22 8:00													
	Initials:	LT													
	Changes & Notes (Initials, date, specific change or notes)														
	Peer review Initial/Date:	PB	2/9/22 12:17	DILUTION WATER TYPE:	Mod. Hard Synthetic Freshwater (EPA)	ND=Not Determined/Measured, NA=Not Applicable. 1) Ninth character of lab sample ID on chain of custody AND bottle number in collection series. Together with Project ID constitutes entire sample bottle ID. 2) TRC MDL 0.02 mg/l; QL 0.22 mg/l. Corrected value if Mn, Cr potential positive interference. Corrected using KI and NaAsO2. 3) C-clear, O-opaque, T-turbid, S-solids (Sl-slight, M-moderate, H-heavy), Y-yellow, B-brown, Bl-black, G-green, P-pink, Gr-grey, Or-orange. 4) Measured on first use of sample only. 5) Final TRC measured only if chlorine present in initial characterization.. NOTE: All test temperature measurements conducted with calibrated thermocouples so no correction factor applicable.													
PROJECT ID:	AWSL2201	ADDITIONAL EFFLUENT TREATMENT:													

ENTHALPY ANALYTICAL
formerly *Air, Water & Soil Laboratories*

Coastal Bioanalysts 6400 Enterprise Ct Gloucester VA 23061

CLE - AWSL2202-A
22-0191

1941 REYMET ROAD
RICHMOND, VIRGINIA 23237
(804) 358-8295 PHONE
(804)358-8297 FAX

Chain of Custody
Form#: D1331
Rev. 1.0
Effective: Feb 14, 2014

CHAIN OF CUSTODY

COMPANY NAME: Air, Water & Soil Labs. INC	INVOICE TO: AWS LABS	PROJECT NAME/Quote #: 22B0065
CONTACT: Sarah Endsley	INVOICE CONTACT: RIC-env@enthalpy.com	SITE NAME: 22B0065
ADDRESS: 1941 Reymet Rd. Richmond, VA 23237	INVOICE ADDRESS:	PROJECT NUMBER: 22B0065
PHONE #: 804-358-8295	INVOICE PHONE #:	P.O. #: PO-022417
FAX #: 804-358-8297	EMAIL: ric-env@enthalpy.com	Pretreatment Program:
Is sample for compliance reporting? YES NO	Is sample from a chlorinated supply? YES NO	PWS I.D. #:
SAMPLER NAME (PRINT):	SAMPLER SIGNATURE:	Turn Around Time: 10 Days

Matrix Codes: WW=Waste Water/Storm Water GW=Ground Water DW=Drinking Water S=Soil/Solids OR=Organic A=Air WP=Wipe OT=Other _____

ANALYSIS / (PRESERVATIVE)

Please use the following dilutions as discussed:
CLE (Outfall 029) = 25%, 45%, 60%, 80%, 100%

Crowder Tanks (Outfall 007) = 15%, 25%, 50%, 75%, 100%

Set up samples Feb 3rd (out of holding time) ✓

COMMENTS

Preservative Codes: N-Nitric Acid, H-Hydrochloric Acid, S-Sulfuric Acid, H-Sodium Hydroxide, A-Ascorbic Acid, Z-Zinc Acetate, T-Sodium Thiosulfate, M-Methanol

PLEASE NOTE PRESERVATIVES, INTERFERENCE CHECKS or RUSH RATE (Client)

CLIENT SAMPLE I.D	Grab	Composite	Field Filtered (Dissolved Metals)	Composite Start Date	Composite Start Time	Grab Date or Composite Stop Date	Grab Time or Composite Stop Time	Time Preserved	Matrix (See Codes)	Number of Containers	Acute Toxicity - P. Promelas / D. cubia	
1) 22B0065-01: Crowder Tank (007)		X		2.1.22	0800	2.1.22	2359		WW	1	AWSL2201-A	X
2) 22B0065-02: CLE (029)		X		2.1.22	0000	2.2.22	2359		WW	1	AWSL2202-A	X
3)												
4)												
5)												
6)												
7)												
8)												
9)												
10)												

RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME
M Stevens	2/2/22 1:21	[illegible] Pryor	2/2/22
RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME
			1621
RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME
		L Thomas @ CBI	2/3/22 0845

QC Data Package
Level I ☐
Level II ☐
Level III ☐
Level IV ☐

LAB USE ONLY

COOLER TEMP 1 °C

TV-LT

ENTHALPY ANALYTICAL
formerly *Air, Water & Soil Laboratories*

Coastal Bioanalysts 6400 Enterprise Ct Gloucester, VA 23061

1941 REYMET ROAD
RICHMOND, VIRGINIA 23237
(804) 358-8295 PHONE
(804)358-8297 FAX

Chain of Custody
Form #: D1331
Rev. 1.0
Effective: Feb 14, 2014

CHAIN OF CUSTODY

COMPANY NAME: Air, Water & Soil Labs, INC	INVOICE TO: AWS LABS	PROJECT NAME/Quote #: 22B0065
CONTACT: Sarah Endsley	INVOICE CONTACT: RIC-env@enthalpy.com	SITE NAME: 22B0065
ADDRESS:1941 Reymet Rd, Richmond, VA 23237	INVOICE ADDRESS:	PROJECT NUMBER: 22B0065
PHONE #: 804-358-8295	INVOICE PHONE #:	P.O. #: PO-022417
FAX #:804-358-8297	EMAIL: ric-env@enthalpy.com	Pretreatment Program:
Is sample for compliance reporting? YES NO	Is sample from a chlorinated supply? YES NO	PWS I.D. #:
SAMPLER NAME (PRINT):	SAMPLER SIGNATURE:	**Turn Around Time:10 Days**

Matrix Codes: WW=Waste Water/Storm Water GW=Ground Water DW=Drinking Water S=Soil/Solids OR=Organic A=Air WP=Wipe OT=Other_____

CLIENT SAMPLE I.D.	Grab	Composite	Field Filtered (Dissolved Metals)	Composite Start Date	Composite Start Time	Grab Date or Composite Stop Date	Grab Time or Composite Stop Time	Time Preserved	Matrix (See Codes)	Number of Containers	ANALYSIS / (PRESERVATIVE): Acute Toxicity - P. Promelas / D. cubia	Please use the following dilutions as discussed: CLE (Outfall 029) = 25%, 45%, 60%, 80%, 100% Crowder Tanks (Outfall 007) = 15%, 25%, 50%, 75%, 100% Set up samples Feb 3rd (out of holding time)	COMMENTS (Preservative Codes: N=Nitric Acid C=Hydrochloric Acid S=Sulfuric Acid H=Sodium Hydroxide A=Ascorbic Acid Z=Zinc Acetate T=Sodium Thiosulfate M=Methanol; PLEASE NOTE PRESERVATIVE(S), INTERFERENCE CHECKS or PUMP RATE (L/min))
1) 22B0065-01: Crowder Tank (007)		X		2.1.22	0800	2.1.22	2359		WW	1		X	
2) 22B0065-02: CLE (029)		X		2.1.22	0000	2.~~1~~.22 2-1-22	2359		WW	1		X	
3)													
4)													
5)													
6)													
7)													
8)													
9)													
10)													

RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME
M Stevens	2/2/22 16:21	Noreen Pryor	2/2/22
RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME
			1621
RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME

QC Data Package
- Level I ☐
- Level II ☐
- Level III ☐
- Level IV ☐

LAB USE ONLY COOLER TEMP _____°C

Coastal Bioanalysts - Acute Tox Split Feb 2022

22B0065-01 A Due: 02/09/2022 18:00
Non-Potable Water-P1 gal
BAE Systems, Collected: 02/01/2022 23:59
Crowder Tank (007)

AWSL2201-A

SAMPLE ID Crowder Tank (007)
SAMPLE DATE 2.1.22 | SAMPLE TIME 2359
SAMPLED BY DVaughn | PRESERVATIVE
ANALYSIS REQUESTED
__ GRAB
✓ COMPOSITE
2.222

22B0065-02 A Due: 02/09/2022 18:00
Non-Potable Water-P1 gal
BAE Systems, Collected: 02/01/2022 23:59
CLE (029)

AWSL2202-A

SAMPLE ID CLE (029)
SAMPLE DATE 2.1.22 | SAMPLE TIME 2359
SAMPLED BY DVaughn | PRESERVATIVE
ANALYSIS REQUESTED
__ GRAB
✓ COMPOSITE
2.2.22

Client: Enthalpy Analytical/Air, Water and Soil Laboratories
Project ID: AWSL2202
Client Sample ID: BAE-Radford Army Ammunition Plant 22B0065-02A
Permit No.: VA0000248 CLE (029)
Sample Period: 2/1/22

Coastal Bioanalysts, Inc.

Report of Analysis: Whole Effluent Toxicity (WET)

Submitted To:	**Prepared By:**
JP Verheul Business Development Manager / Senior Chemist Enthalpy Analytical/Air, Water and Soil Laboratories 1941 Reymet Road, Richmond, VA 23237	Coastal Bioanalysts, Inc. 6400 Enterprise Court Gloucester, VA 23061 (804) 694-8285 www.coastalbio.com Contact: Peter F. De Lisle, Technical Director

Acute Test Results*				
Species-Test Method	**Test Period**	**NOAEC**	**48-h LC50**	**T.U.$_{Ac}$**
C. dubia EPA 2002.0	2/3/22-2/5/22	N/A	<25.0	**>4.00**
P. promelas EPA 2000.0	2/3/22-2/5/22	N/A	40.8	**2.45**

Details regarding test conduct and data analysis provided in attached bench sheets and printouts as applicable.
For each test method record the T.U.$_{Ac}$ value (bold) on the DMR.

Acute Test QA/QC	**Reference Toxicant: KCl**	**Units: mg/l**	**Test Organism Source: CBI Stock Cultures**		
Species-Method (Ref. Test Date)	**Data Source**	**% Control Survival**	**48-h LC50**	**95% C.L./A.L. For LC50**	**RTT in Control?**
C. dubia 2002.0	RTT	100	499	462-540	Yes
(2/2/22-2/4/22)	CC	100	526	450-602	
P. promelas 2000.0	RTT	100	1016	934-1104	Yes
(2/2/22-2/4/22)	CC	100	1000	832-1168	

Note: RTT = Reference Toxicant Test, CC = Control Chart.

The results of analysis contained within this report relate only to the sample as received in the laboratory. This report shall not be reproduced except in full without written approval from the laboratory. Unless noted below, these test results meet all requirements of NELAP.

APPROVED:

Peter F. De Lisle

Digitally signed by Peter F. De Lisle
DN: cn=Peter F. De Lisle, o=Coastal Bioanalysts, Inc., ou=Toxicology, email=pfd@coastalbio.com, c=US
Date: 2022.02.10 14:40:15 -05'00'

Peter F. De Lisle, Ph.D.
Technical Director

Deviations from, additions to, or exclusions from the test method, non-standard conditions or data qualifiers and, as appropriate, a statement of compliance/non-compliance: **Revised 2/10/22 to include revised CoC.**

Please leave feedback regarding our services at: http://coastalbio.com/survey

VELAP# 460030
EPA# VA01116

NELAP ACCREDITED LABORATORY

GLOSSARY OF TERMS AND ABBREVIATIONS

A.L. (Acceptance Limits): The results of a given reference toxicant test are compared to the control chart mean value ± 2 standard deviations. These limits approximate the 95% probability limits for the "true" reference toxicant value.

Chronic Value (ChrV): The geometric mean of the NOEC and LOEC. Units are same as test concentration units.

C.L. (Confidence Limits): These are the probability limits, based on the data set and statistical model employed, that the "true value" lies within the limits specified. Typically limits are based on 95% or 99% probabilities.

Control chart: A cumulative summary chart of results from QC tests with reference toxicants. The results of a given reference toxicant test are compared to the control chart mean value and 95% Acceptance Limits (A.L.) (mean ± 2 standard deviations).

IC25: The concentration of sample or chemical, calculated from the data set using statistical models, causing a 25% reduction in test organism growth, reproduction, etc. The lower the IC25, the more toxic the chemical or sample. Units are same as test concentration units.

LC50: The concentration of sample or chemical, calculated from the data set using statistical models, causing a 50% reduction in test organism survival. The lower the LC50, the more toxic the chemical or sample. Units are same as test concentration units. Note: The LC50 value must always be associated with the duration of exposure. Thus 48-h LC50, 96-h LC50, etc. are calculated.

LOEC: Lowest-observable-effect-concentration. The lowest concentration of sample or chemical in a chronic test dilution series in which the test organisms exhibit a statistically significant reduction in any of the test end points (e.g. growth, survival, reproduction) compared to control organisms. Units are same as test concentration units.

PMSD: Percent Minimum Significant Difference: The minimum difference which can exist between a test treatment and the controls in a particular test and be statistically significant; a measure of test sensitivity. The lower the PMSD the more sensitive the test.

N/A: Not applicable.

N/D: Not determined or measured.

NOAEC: No-observable-acute-effect-concentration. The highest concentration of sample or chemical in an acute test dilution series in which the test organisms exhibit no statistically significant reduction in the test end point (e.g. survival) compared to control organisms. Units are same as test concentration units.

NOEC: No-observable-effect-concentration. The highest concentration of sample or chemical in a chronic test dilution series in which the test organisms exhibit no statistically significant reduction in any of the test end points (e.g. growth, survival, reproduction) compared to control organisms. Some regulatory definitions also require that the NOEC be less than the LOEC. Units are same as test concentration units.

Q.L.: Quantitation Limit. Level, concentration, or quantity of a target variable (analyte) that can be reported at a specified degree of confidence.

T.U.: Toxic units. Expresses the relative toxicity of an effluent in such a manner that the larger the toxic unit value the more toxic the effluent. $T.U._{Ac} = 100/LC50$. $T.U._{Chr} = 100/NOEC$. A dimensionless unit.

C. dubia daily biological measurements (EPA 2002.0) Template version ACD-STAT-5trt-061113

TRTMNT (% Effl)	Rep	#Live Day 0	#Live Day 1	#Live Day 2	Final Mean % Live		
C	A	5	5	5	100.0		
	B	5	5	5			
Lab	C	5	5	5			
Control	D	5	5	5			
#1	A	5	0	0	0.0		
25.0	B	5	0	0			
% Effl	C	5	3	0			
	D	5	0	0			
# 2	A	5	0	0	0.0		
45.0	B	5	0	0			
% Effl	C	5	0	0			
	D	5	0	0			
# 3	A	5	0	0	0.0		
60.0	B	5	0	0			
% Effl	C	5	3	0			
	D	5	0	0			
# 4	A	5	2	0	0.0		
80.0	B	5	0	0			
% Effl	C	5	0	0			
	D	5	0	0			
# 5	A	5	5	0	0.0		
100	B	5	0	0			
% Effl	C	5	0	0		Test Duration:	48h 29m
	D	5	0	0			TAC 48+/-0.5h
INITIALS:		LT	LT	LT	% CONTROL SURVIVAL:		100.0
DATE & TIME:		2/3/22 10:54	2/4/22 9:13	2/5/22 11:23			TAC = 90%
CHANGES & NOTES (INITIALS, DATE, SPECIFIC CHANGE MADE		Toxcalc to be performed with permit-specific dilutions.					

	SPECIES:	Ceriodaphnia dubia	
	ACCLIMATION WATER:	Mod. Hard Synthetic Freshwater	
	FEEDING PRIOR TO TEST:	YCT + Selenastrum capricornutum	
	FEEDING DURING TEST:	None -YCT + Selenastrum 2+ h before test	
	SOURCE:	CBI Stock cultures	
	ACCLIMATION TEMP (o C):	25	
	BROOD RELEASE START DATE & TIME:	2/2/22 22:00	
	BROOD RELEASE END DATE & TIME:	2/3/22 6:00	
	DATE/TIME WATER ADDED:	2/3/22 10:53	
	DATE/TIME ANIMALS ADDED:	2/3/22 10:54	
	ANIMAL AGE WINDOW:	8h 0m	
	MAX AGE AT TEST START:	12h 55m	TAC Max. 24 h
	TEST SET UP BY:	LT	
	SAMPLE COLLECTION DATE &TIME:	2/1/22 23:59	SAMPLE USED A
TEST ID:	SAMPLE AGE AT TEST START:	34h 56m	TAC Max 36 h
AWSL2202ACD	PEER REVIEW BY (INITIALS/DATE):	PB	2/7/22 13:21

Ceriodaphnia daily water quality bench sheet (EPA METHOD 2002.0) Template version ACD-STAT-5trt-061113

	TRTMNT	Day 0 Initial	Day 1	Day 2 Final	SUMMARY WATER QUALITY DATA MEAN	S.D.	MIN.	MAX.
pH (S.U.)	C	8.13	8.20	7.99	8.11	0.11	7.99	8.20
	1	8.12	8.15	8.05	8.11	0.05	8.05	8.15
	2	8.12	8.18		8.15	0.04	8.12	8.18
	3	8.12	8.26	8.25	8.21	0.08	8.12	8.26
	4	8.15	8.32	8.27	8.25	0.09	8.15	8.32
	5	8.16	8.40	8.33	8.30	0.12	8.16	8.40
Temp. (o C)	C	25	24	24	24	0.6	24	25
	1	25	24	24	24	0.6	24	25
	2	25	24		25	0.7	24	25
	3	25	24	24	24	0.6	24	25
	4	25	24	24	24	0.6	24	25
	5	25	24	24	24	0.6	24	25
Diss. Oxygen (mg/l)	C	8.2	8.2	8.0	8.1	0.1	8.0	8.2
	1	8.2	8.2	8.1	8.2	0.1	8.1	8.2
	2	8.2	8.2		8.2	0.0	8.2	8.2
	3	8.2	8.2	8.0	8.1	0.1	8.0	8.2
	4	8.2	8.0	7.9	8.0	0.2	7.9	8.2
	5	8.2	8.0	7.9	8.0	0.2	7.9	8.2
Cond. (uS/cm)	C	306		330	318	17.0	306	330
	1	376			376		376	376
	2	457			457		457	457
	3	490			490		490	490
	4	548			548		548	548
	5	602		641	622	27.6	602	641
Replicate measured		Flask	Surrogate	D				
Initials		LT	LT	LT				
		TRC (mg/l) in highest conc. at end of test:		N/A				
Changes & Notes (Initials, date, specific change or notes)								

Test chamber:	30 ml plastic cup:	✓					
	Other:						
Test solution vol. (15 ml min):	15 ml:	✓					
	Other (ml):						
Illumination & photoperiod:	50-100 ft-c 16L:8D			Template Number:		10	
Number of replicates/treatment:	4						
Initial number animals/replicate:	5						
Test Aerated?	N/A	Date & Time Air Start:		N/A			

TEST ID	TRT ID:	1	2	3	4	5
AWSL2202ACD	CONC(%):	25.0	45.0	60.0	80.0	100

P. promelas daily biological measurements (EPA 2000.0) Template version APP-STAT-48h-5trt-061113

TRTMNT (%Effl)	Rep	#Live Day 0	#Live Day 1	#Live Day 2	Final Mean % Live		
C	A	10	10	10	100.0		
Lab Control	B	10	10	10			
#1	A	10	10	10	100.0		
25.0	B	10	10	10			
# 2	A	10	10	9	45.0		
45.0	B	10	10	0			
# 3	A	10	6	0	0.0		
60.0	B	10	3	0			
# 4	A	10	0	0	0.0		
80.0	B	10	0	0			
# 5	A	10	0	0	0.0	Test Duration:	48h 27m
100	B	10	0	0			TAC 48+/-0.5h
INITIALS:		LT	LT	LT	% CONTROL SURVIVAL:		100.0
DATE & TIME:		2/3/22 10:53	2/4/22 9:19	2/5/22 11:20			TAC = 90%
CHANGES & NOTES (INITIALS, DATE, SPECIFIC CHANGE MADE		Toxcalc to be performed with permit-specific dilutions.					

SPECIES:	Pimephales promelas		
ACCLIMATION WATER:	Mod. Hard Synthetic Freshwater		
FEEDING PRIOR TO TEST:	Artemia nauplii ad libitum		
FEEDING DURING TEST:	None		
SOURCE:	CBI Stock cultures		
ACCLIMATION TEMP (o C):	25		
HATCH START DATE & TIME:	1/30/22 17:00		
HATCH END DATE & TIME:	1/31/22 10:00		
DATE/TIME WATER ADDED:	2/3/22 10:53		
DATE/TIME ANIMALS ADDED:	2/3/22 10:53		
ANIMAL AGE WINDOW:	17h 0m		TAC Max. 24 h
MAX AGE AT TEST START:	4d		TAC Max. 14 d
TEST SET UP BY:		LT	
SAMPLE COLLECTION DATE & TIME:	2/1/22 23:59	SAMPLE USED	A
SAMPLE AGE AT TEST START:	34h 54m	TAC MAX 36 h	
PEER REVIEW BY (INITIALS/DATE):		PB	2/7/22 13:23

TEST ID: AWSL2202APP

P. promelas daily water quality bench sheet (EPA METHOD 2002.0) Template version APP-STAT-48h-5trt-06113

	TRTMNT	Day 0 Initial	Day 1	Day 2 Final	SUMMARY WATER QUALITY DATA MEAN	S.D.	MIN.	MAX.
pH (S.U.)	C	8.13	8.07	8.05	8.08	0.04	8.05	8.13
	1	8.12	8.08	7.79	8.00	0.18	7.79	8.12
	2	8.12	8.00	7.76	7.96	0.18	7.76	8.12
	3	8.12	8.00	7.67	7.93	0.23	7.67	8.12
	4	8.15	8.00		8.08	0.11	8.00	8.15
	5	8.16	8.00		8.08	0.11	8.00	8.16
Temp. (o C)	C	25	25	24	25	0.6	24	25
	1	25	25	24	25	0.6	24	25
	2	25	25	24	25	0.6	24	25
	3	25	25	24	25	0.6	24	25
	4	25	25		25	0.0	25	25
	5	25	25		25	0.0	25	25
Diss. Oxygen (mg/l)	C	8.2	8.1	8.0	8.1	0.1	8.0	8.2
	1	8.2	7.8	6.9	7.6	0.7	6.9	8.2
	2	8.2	7.0	6.3	7.2	1.0	6.3	8.2
	3	8.2	6.7	4.8	6.6	1.7	4.8	8.2
	4	8.2	6.5		7.4	1.2	6.5	8.2
	5	8.2	4.8		6.5	2.4	4.8	8.2
Cond. (uS/cm)	C	306		330	318	17.0	306	330
	1	376			376		376	376
	2	457			457		457	457
	3	490		509	500	13.4	490	509
	4	548			548		548	548
	5	602			602		602	602
Replicate measured		B	A	B				
Initials		LT	LT	LT				
		TRC (mg/l) in highest conc. at end of test:		NA				
Changes & Notes (Initials, date, specific change or notes)								

Test chamber:	400 ml Tri-pour bkr:	✓			
	Other:				
Test solution vol. (200 ml min):	400 ml:	✓			
	Other (ml):				
Illumination & photoperiod:	50-100 ft-c 16L:8D				
Number of replicates/treatment:	2				
Initial number animals/replicate:	10				
Test Aerated?	No	Date & Time Air Start:			

TEST ID	TRT ID:	1	2	3	4	5	D.O. Highest conc. @ aeration:
AWSL2202APP	CONC (%):	25.0	45.0	60.0	80.0	100	Total live highest conc.@ aeration

Acute Fish Test-48 Hr Survival

Start Date:		Test ID:	AWSL2202PP	Sample ID:	
End Date:		Lab ID:	CBI	Sample Type:	
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	PP-Pimephales promelas
Comments:	DATA ENTERED BY PB				

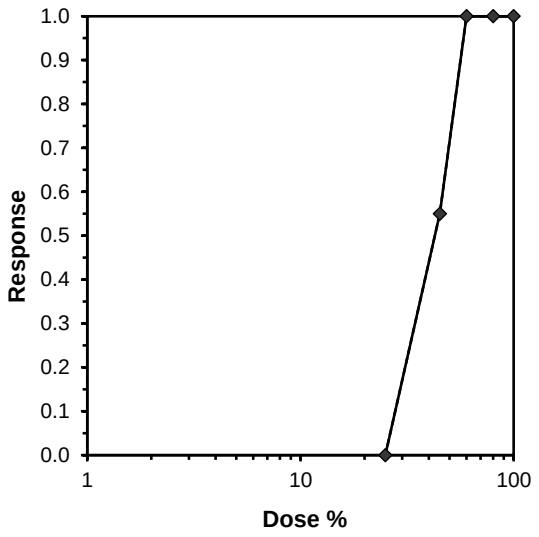
Conc-%	1	2
CONTROL	1.0000	1.0000
25	1.0000	1.0000
45	0.9000	0.0000
60	0.0000	0.0000
80	0.0000	0.0000
100	0.0000	0.0000

			Transform: Arcsin Square Root					Number	Total
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
CONTROL	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	2	0	20
25	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	2	0	20
45	0.4500	0.4500	0.7039	0.1588	1.2490	109.521	2	11	20
60	0.0000	0.0000	0.1588	0.1588	0.1588	0.000	2	20	20
80	0.0000	0.0000	0.1588	0.1588	0.1588	0.000	2	20	20
100	0.0000	0.0000	0.1588	0.1588	0.1588	0.000	2	20	20

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Normality of the data set cannot be confirmed				
Equality of variance cannot be confirmed				

Trimmed Spearman-Karber

Trim Level	EC50	95% CL	
0.0%	40.844	37.053	45.021
5.0%	41.061	36.844	45.761
10.0%	41.279	36.521	46.657
20.0%	41.715	35.328	49.257
Auto-0.0%		37.053	45.021



pd

Effluent and Dilution Water Log (Freshwater Tests). FWEFFL061013

											SUMMARY WATER QUALITY DATA				
Initial sample charac-terization	Bottle(1):	A1									MEAN	S.D.	MIN.	MAX.	PARAMETER
	Arrival Temp. (oC, from CoC):	1									1		1	1	Arrival Temp.
	TRC (mg/l)(2):	<DL													
	TRC Corrected(2):														
	Hardness (mg/l):	120									120		120	120	Hardness (mg/l)
	Alkalinity (mg/l):	167									167		167	167	Alkalinity (mg/l)
	NH3-N (mg/l):	1.3													
	Color/Appearance(3):	C													
	Obvious odor?	NO													
	Date & Time:	2/3/22 9:34													
	Initials:	LT													
Sample prep measure-ments	Test Day:	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7		MEAN	S.D.	MIN.	MAX.	
	Bottle(s):	A1-1													
	Prep. Temp. (oC):	25									25		25	25	Temp. (oC)
	D.O. (mg/l) After Warming:	10.5													
	Aeration Time (min):	3													
	Adjusted D.O. (mg/l):	8.2									8.2		8.2	8.2	D.O. (mg/l)
	Final pH (S.U.):	8.10									8.10		8.10	8.10	pH (S.U.)
	Conductivity (uS/cm)(4):	606									606		606	606	Cond. (uS/cm)
	Final TRC (mg/l)(5):	N.D.													
	Sample Filtered (60 um)?														
	Date & Time:	2/3/22 10:51													
	Initials:	LT													
Dilution water	Test Day:	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7		MEAN	S.D.	MIN.	MAX.	
	Vat Number:	3													
	Temperature (oC):	25									25		25	25	Temp. (oC)
	Conductivity (uS/cm):	308									308		308	308	Cond. (uS/cm)
	D.O. (mg/l):	8.2									8.2		8.2	8.2	D.O. (mg/l)
	pH (S.U.):	7.85									7.85		7.85	7.85	pH (S.U.)
	Hardness (mg/l):	98									98		98	98	Hardness (mg/l)
	Alkalinity (mg/l):	62									62		62	62	Alkalinity (mg/l)
	Date & Time:	2/3/22 8:00													
	Initials:	LT													
	Changes & Notes (Initials, date, specific change or notes)														
	Peer review Initial/Date:	PB	2/9/22 12:17	DILUTION WATER TYPE:	Mod. Hard Synthetic Freshwater (EPA)	ND=Not Determined/Measured, NA=Not Applicable. 1) Ninth character of lab sample ID on chain of custody AND bottle number in collection series. Together with Project ID constitutes entire sample bottle ID. 2) TRC MDL 0.02 mg/l; QL 0.22 mg/l. Corrected value if Mn, Cr potential positive interference. Corrected using KI and NaAsO2. 3) C-clear, O-opaque, T-turbid, S-solids (Sl-slight, M-moderate, H-heavy), Y-yellow, B-brown, Bl-black, G-green, P-pink, Gr-grey, Or-orange. 4) Measured on first use of sample only. 5) Final TRC measured only if chlorine present in initial characterization.. NOTE: All test temperature measurements conducted with calibrated thermocouples so no correction factor applicable.				
PROJECT ID:	AWSL2202	ADDITIONAL EFFLUENT TREATMENT:													

ENTHALPY ANALYTICAL
formerly *Air, Water & Soil Laboratories*

Coastal Bioanalysts 6400 Enterprise Ct Gloucester VA 23061

CLE - AWSL2202-A
22-0191

1941 REYMET ROAD
RICHMOND, VIRGINIA 23237
(804) 358-8295 PHONE
(804)358-8297 FAX

Chain of Custody
Form#: D1331
Rev. 1.0
Effective: Feb 14, 2014

CHAIN OF CUSTODY

COMPANY NAME: Air, Water & Soil Labs. INC	INVOICE TO: AWS LABS	PROJECT NAME/Quote #: 22B0065
CONTACT: Sarah Endsley	INVOICE CONTACT: RIC-env@enthalpy.com	SITE NAME: 22B0065
ADDRESS: 1941 Reymet Rd. Richmond, VA 23237	INVOICE ADDRESS:	PROJECT NUMBER: 22B0065
PHONE #: 804-358-8295	INVOICE PHONE #:	P.O. #: PO-022417
FAX #: 804-358-8297	EMAIL: ric-env@enthalpy.com	Pretreatment Program:
Is sample for compliance reporting? YES NO	Is sample from a chlorinated supply? YES NO	PWS I.D. #:
SAMPLER NAME (PRINT):	SAMPLER SIGNATURE:	Turn Around Time: 10 Days

Matrix Codes: WW=Waste Water/Storm Water GW=Ground Water DW=Drinking Water S=Soil/Solids OR=Organic A=Air WP=Wipe OT=Other _____

ANALYSIS / (PRESERVATIVE)

Please use the following dilutions as discussed:
CLE (Outfall 029) = 25%, 45%, 60%, 80%, 100%

Crowder Tanks (Outfall 007) = 15%, 25%, 50%, 75%, 100%

Set up samples Feb 3rd (out of holding time) ✓

COMMENTS

Preservative Codes: N-Nitric Acid, C-Hydrochloric Acid, S-Sulfuric Acid, H-Sodium Hydroxide, A-Ascorbic Acid, Z-Zinc Acetate, T-Sodium Thiosulfate, M-Methanol

PLEASE NOTE PRESERVATIVES, INTERFERENCE CHECKS or PUMP RATE (Liters)

CLIENT SAMPLE I.D	Grab	Composite	Field Filtered (Dissolved Metals)	Composite Start Date	Composite Start Time	Grab Date or Composite Stop Date	Grab Time or Composite Stop Time	Time Preserved	Matrix (See Codes)	Number of Containers	Acute Toxicity - P. Promelas / D. cubia	
1) 22B0065-01: Crowder Tank (007)		X		2.1.22	0800	2.1.22	2359		WW	1	AWSL2201-A	X
2) 22B0065-02: CLE (029)		X		2.1.22	0000	2.2.22	2359		WW	1	AWSL2202-A	X
3)												
4)												
5)												
6)												
7)												
8)												
9)												
10)												

RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME
M Stevens	2/2/22 1:21	[illegible] Pryor	2/2/22
RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME
			1621
RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME
		L Thomas @ CBI	2/3/22 0845

QC Data Package
Level I ☐
Level II ☐
Level III ☐
Level IV ☐

LAB USE ONLY

COOLER TEMP 1 °C

TV-LT

Coastal Bioanalysts - Acute Tox Sqtl Feb 2022

ENTHALPY ANALYTICAL
formerly *Air, Water & Soil Laboratories*

Coastal Bioanalysts 6400 Enterprise Ct Gloucester, VA 23061

1941 REYMET ROAD
RICHMOND, VIRGINIA 23237
(804) 358-8295 PHONE
(804)358-8297 FAX

Chain of Custody
Form #: D1331
Rev. 1.0
Effective: Feb 14, 2014

CHAIN OF CUSTODY

COMPANY NAME: Air, Water & Soil Labs, INC	INVOICE TO: AWS LABS	PROJECT NAME/Quote #: 22B0065
CONTACT: Sarah Endsley	INVOICE CONTACT: RIC-env@enthalpy.com	SITE NAME: 22B0065
ADDRESS:1941 Reymet Rd, Richmond, VA 23237	INVOICE ADDRESS:	PROJECT NUMBER: 22B0065
PHONE #: 804-358-8295	INVOICE PHONE #:	P.O. #: PO-022417
FAX #:804-358-8297	EMAIL: ric-env@enthalpy.com	Pretreatment Program:
Is sample for compliance reporting? YES NO	Is sample from a chlorinated supply? YES NO	PWS I.D. #:
SAMPLER NAME (PRINT):	SAMPLER SIGNATURE:	**Turn Around Time:10 Days**

Matrix Codes: WW=Waste Water/Storm Water GW=Ground Water DW=Drinking Water S=Soil/Solids OR=Organic A=Air WP=Wipe OT=Other_____

CLIENT SAMPLE I.D.	Grab	Composite	Field Filtered (Dissolved Metals)	Composite Start Date	Composite Start Time	Grab Date or Composite Stop Date	Grab Time or Composite Stop Time	Time Preserved	Matrix (See Codes)	Number of Containers	ANALYSIS / (PRESERVATIVE): Acute Toxicity - P. Promelas / D. cubia	Please use the following dilutions as discussed: CLE (Outfall 029) = 25%, 45%, 60%, 80%, 100% Crowder Tanks (Outfall 007) = 15%, 25%, 50%, 75%, 100% Set up samples Feb 3rd (out of holding time)	COMMENTS (Preservative Codes: N=Nitric Acid C=Hydrochloric Acid S=Sulfuric Acid H=Sodium Hydroxide A=Ascorbic Acid Z=Zinc Acetate T=Sodium Thiosulfate M=Methanol; PLEASE NOTE PRESERVATIVE(S), INTERFERENCE CHECKS or PUMP RATE (L/min))
1) 22B0065-01: Crowder Tank (007)		X		2.1.22	0800	2.1.22	2359		WW	1		X	
2) 22B0065-02: CLE (029)		X		2.1.22	0000	2.1.22 2-1-22	2359		WW	1		X	
3)													
4)													
5)													
6)													
7)													
8)													
9)													
10)													

RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME
M Stevens	2/2/22 16:21	Noreen Pryor	2/2/22
RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME
			1621
RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME

QC Data Package
- Level I ☐
- Level II ☐
- Level III ☐
- Level IV ☐

LAB USE ONLY COOLER TEMP _____°C

Coastal Bioanalysts - Acute Tox Split Feb 2022

22B0065-01 A Due: 02/09/2022 18:00
Non-Potable Water-P1 gal
BAE Systems, Collected: 02/01/2022 23:59
Crowder Tank (007)

AWSL2201-A

SAMPLE ID Crowder Tank (007)
SAMPLE DATE 2.1.22 | SAMPLE TIME 2359
SAMPLED BY DVaughn | PRESERVATIVE
ANALYSIS REQUESTED
__ GRAB
✓ COMPOSITE
2.222

22B0065-02 A Due: 02/09/2022 18:00
Non-Potable Water-P1 gal
BAE Systems, Collected: 02/01/2022 23:59
CLE (029)

AWSL2202-A

SAMPLE ID CLE (029)
SAMPLE DATE 2.1.22 | SAMPLE TIME 2359
SAMPLED BY DVaughn | PRESERVATIVE
ANALYSIS REQUESTED
__ GRAB
✓ COMPOSITE
2.2.22

Toxicity Tests
For
BAE Systems

Report # 2726

Submitted To: Dr. Ashley Bandy

Submitted By:

Biological Monitoring, Inc.
1800 Kraft Drive, Suite 104
Blacksburg, VA 24060

Phone: 540-953-2821
Fax: 540-951-1481

Report Date: Mar 1, 2022

Biological Monitoring, Inc. is accredited by The NELAC Institute (TNI 2009, ID:460015). The test results reported herein meet all requirements of TNI. The procedures are deemed compliant with the methods and acceptable for reporting.

Quality Manager

BIOLOGICAL MONITORING, INC
1800 KRAFT DRIVE SUITE 104 BLACKSBURG VIRGINIA 24060
PH:540-953-2821 EMAIL:BMI@BIOMON.COM WWW.BIOMON.COM
TNI ACCREDITED LAB# 460015

Toxicity Testing Data Summary

Client BAE Systems **Permit #** NA **Sample** 029

Test ID	BAE022322-3	**Result**	LC50 = 80.2, TUa =1.25	**Pass/Fail**	NA	**Next Step**	NA
Test ID	BAE022322-4	**Result**	LC50 = 69.3, TUa = 1.44	**Pass/Fail**	NA	**Next Step**	NA

BIOLOGICAL MONITORING, INC
1800 KRAFT DRIVE SUITE 104 BLACKSBURG VIRGINIA 24060
PH:540-953-2821 EMAIL:BMI@BIOMON.COM WWW.BIOMON.COM
TNI ACCREDITED LAB# 460015

Certificate of Analysis

Client	**BAE Systems**	**Report #**	**2726**
BMI Project #	**4186**	**Report Date**	**Mar 1, 2022**
Permit #	**NA**	**Sample ID #s**	**BAE022322-2**
Sample	**029**	**Test ID #**	**BAE022322-3**

Test Type	**Static Acute**		**Organism**	**Pimephales promelas**	
Test Start Date	**Feb 23, 2022**	**Test Start Time**	**1330**	**EPA Method #**	**2000**
Test End Date	**Feb 25, 2022**	**Test End Time**	**1330**	**Photoperiod**	**16h L/ 8h D**

Endpoint	Survival	**Method**	Spearman Karber	**Result**	LC50 = 80.2%
Endpoint	Survival	**Method**	Graphical	**Result**	
Endpoint		**Method**		**Result**	
Endpoint		**Method**		**Result**	
Endpoint		**Method**		**Result**	

Final Result LC50 = 80.2, TUa =1.25 **Pass/Fail**

BIOLOGICAL MONITORING, INC
1800 KRAFT DRIVE SUITE 104 BLACKSBURG VIRGINIA 24060
PH:540-953-2821 EMAIL:BMI@BIOMON.COM WWW.BIOMON.COM
TNI ACCREDITED LAB# 460015

Certificate of Analysis

Client	**BAE Systems**	**Report #**	**2726**
BMI Project #	**4186**	**Report Date**	**Mar 1, 2022**
Permit #	**NA**	**Sample ID #s**	**BAE022322-2**
Sample	**029**	**Test ID #**	**BAE022322-4**

Test Type	**Static Acute**			**Organism**	**Ceriodaphnia dubia**
Test Start Date	**Feb 23, 2022**	**Test Start Time**	**1330**	**EPA Method #**	**2002**
Test End Date	**Feb 25, 2022**	**Test End Time**	**1330**	**Photoperiod**	**16h L/ 8h D**

Endpoint	Survival	**Method**	Graphical	**Result**	LC50 = 69.3
Endpoint	Survival	**Method**	Graphical	**Result**	
Endpoint		**Method**		**Result**	
Endpoint		**Method**		**Result**	
Endpoint		**Method**		**Result**	

Final Result LC50 = 69.3 TUa =1.44 **Pass/Fail**

Acute Toxicity Test
(*Pimephales promelas*)

Experiment I.D.# BAE022322-3
Biologist(s): JR VR PR MM SS LJ
Permit # NA
Client: BAE Systems
Effluent toxicant: CLE 029
Sample Type: Grab (Composite)
Sample Chlorine: <0.02
Dilution Water Used MHRW
Feeding Schedule: Not fed
Aeration: —
Template #: 4x6 10dd

Start of Test Date: 2-23-22 Time: 1330
End of Test Date: 2-25-22 Time: 1330
Test Duration: 48 hours
Test Temperature: 25 +/- 1 deg C
Test Volume: 350 ml
Test Containers Used: 400 ml TriPours
Renewal Frequency: None
Test Organism Age: 3 days
Organism Batch #: ABS022222-1
Organisms per concentration: 20
Waterbath/Shelf #: 4

SAMPLE COLLECTION				TEST RENEWAL			
Date(s)		Time(s)					
From:	To:	From:	To:	Date(s)	Time(s)	Test Day	Diluent Batch #:
2-22-22	2-22-22	0000	2359	2-23-22	1330	0	8122

Meters: Instrument Id#: Temp.: 073 pH: 061

DO: 061 Conductivity/Salinity: 061

Conditions of surviving organisms at end of test: Normal w/exception below

Comments: The surviving fish in 80% were extremely weak

① VR 3-1-22

Experiment ID: BAE022322-3

Conc: Units	Rep.	Number of Live Organisms			Dissolved Oxygen (mg/L)			pH			Alkalinity mg/L as $CaCO_3$	Hardness mg/L as $CaCO_3$	Conductivity (umhos) or Salinity 0/00			Temperature (C)		
		0	24	48	0	24	48	0	24	48	0	0	0	24	48	0	24	48
%	A	5	5	4	6.79	7.74	7.84	8.13	8.19	8.03	64	94	314	325	347	25	26	25
	B	5	5	5														
0	C	5	5	5														
	D	5	5	5														
	A	5	5	5	6.98	7.71	7.00	7.97	8.14	8.18			336	346	364	25	26	25
25	B	5	5	5														
	C	5	5	5														
	D	5	5	5														
	A	5	5	5	7.16	7.68	7.00	7.99	8.12	8.14			358	370	387	25	26	25
45	B	5	5	5														
	C	5	5	4														
	D	5	4	4														
Recorded By:		[illegible]	[illegible]	[illegible]	[illegible]	SS	[illegible]	[illegible]	SS	[illegible]	[illegible]	[illegible]	[illegible]	SS	[illegible]	[illegible]	[illegible]	[illegible]

Experiment ID: BAE022322-3

Conc: Units	Rep.	Number of Live Organisms			Dissolved Oxygen (mg/L)			pH			Alkalinity mg/L as $CaCO_3$	Hardness mg/L as $CaCO_3$	Conductivity (umhos) or Salinity 0/00			Temperature (C)		
		0	24	48	0	24	48	0	24	48	0	0	0	24	48	0	24	48
%	A	5	5	4	7.08	7.33	6.56	7.90	7.97	8.08			403	416	436	25	26	25
60	B	5	5	5														
	C	5	5	5														
	D	5	5	5														
	A	5	5	5	6.37	7.39	6.44	7.73	8.11	8.05			616	538	534	25	26	25
80	B	5	5	3														
	C	5	5	3														
	D	5	5	3														
	A	5	1	0	5.67	6.09	6.00	7.64	8.04	8.22	500	620	760	778	807	25	26	25
100	B	5	0	–														
	C	5	0	–														
	D	5	0	–														
Recorded By:		[illegible]	[illegible]	[illegible]	[illegible]	SS	[illegible]	[illegible]	SS		[illegible]	[illegible]	[illegible]	SS		[illegible]	[illegible]	[illegible]

CETIS Analytical Report

Fathead Minnow 48-h Acute Survival Test — **Biological Monitoring, Inc.**

Analysis ID:	12-8806-1666	**Endpoint:**	48h Survival Rate	**CETIS Version:**	CETISv1.9.4
Analyzed:	01 Mar-22 10:42	**Analysis:**	Untrimmed Spearman-Kärber	**Status Level:**	1
Batch ID:	14-2303-0155	**Test Type:**	Survival (48h)	**Analyst:**	Lab Tech
Start Date:	23 Feb-22 13:30	**Protocol:**	EPA/821/R-02-012 (2002)	**Diluent:**	Mod-Hard Synthetic Water
Ending Date:	25 Feb-22 13:30	**Species:**	Pimephales promelas	**Brine:**	
Test Length:	48h	**Taxon:**	Actinopterygii	**Source:**	Aquatic Biosystems, CO **Age:** 3
Sample ID:	16-8896-5040	**Code:**	BAE022322-3	**Project:**	Special Studies
Sample Date:	22 Feb-22 23:59	**Material:**	Effluent	**Source:**	029
Receipt Date:	23 Feb-22 13:00	**CAS (PC):**		**Station:**	029
Sample Age:	14h	**Client:**	BAE Systems		

Spearman-Kärber Estimates

Threshold Option	Threshold	Trim	Mu	Sigma	LC50	95% LCL	95% UCL
Control Threshold	0.05	0.00%	1.904	0.01583	80.19	74.55	86.25

48h Survival Rate Summary

			Calculated Variate(A/B)							Isotonic Variate	
Conc-%	Code	Count	Mean	Min	Max	Std Dev	CV%	%Effect	A/B	Mean	%Effect
0	D	4	0.9500	0.8000	1.0000	0.1000	10.53%	0.0%	19/20	0.975	0.0%
25		4	1.0000	1.0000	1.0000	0.0000	0.00%	-5.26%	20/20	0.975	0.0%
45		4	0.9000	0.8000	1.0000	0.1155	12.83%	5.26%	18/20	0.925	5.13%
60		4	0.9500	0.8000	1.0000	0.1000	10.53%	0.0%	19/20	0.925	5.13%
80		4	0.7000	0.6000	1.0000	0.2000	28.57%	26.32%	14/20	0.7	28.21%
100		4	0.0000	0.0000	0.0000	0.0000		100.0%	0/20	0	100.0%

48h Survival Rate Detail

Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4
0	D	0.8000	1.0000	1.0000	1.0000
25		1.0000	1.0000	1.0000	1.0000
45		1.0000	1.0000	0.8000	0.8000
60		0.8000	1.0000	1.0000	1.0000
80		1.0000	0.6000	0.6000	0.6000
100		0.0000	0.0000	0.0000	0.0000

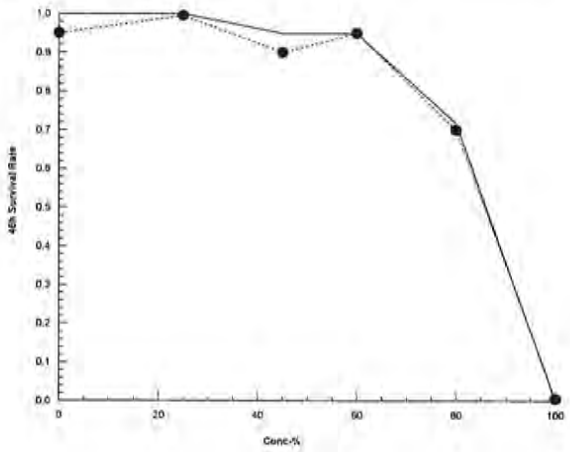
48h Survival Rate Binomials

Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4
0	D	4/5	5/5	5/5	5/5
25		5/5	5/5	5/5	5/5
45		5/5	5/5	4/5	4/5
60		4/5	5/5	5/5	5/5
80		5/5	3/5	3/5	3/5
100		0/5	0/5	0/5	0/5

Fathead Minnow 48-h Acute Survival Test — **Biological Monitoring, Inc.**

Analysis ID:	12-8806-1666	**Endpoint:**	48h Survival Rate	**CETIS Version:**	CETISv1.9.4
Analyzed:	01 Mar-22 10:42	**Analysis:**	Untrimmed Spearman-Kärber	**Status Level:**	1

Graphics



Acute Toxicity Test
(*Ceriodaphnia dubia*)

Experiment I.D.# BAE022322-4
Biologist(s): JR VR PR MM SS LJ KP
Permit # NA
Client: BAF Systems
Effluent toxicant: CLE 029
Sample Type: composite
Sample Chlorine: <0.02
Dilution Water Used MHRW
Feeding Schedule: Not fed
Aeration: —
Template #: 5x6 Odd

Start of Test Date: 2-23-22 Time: 1330
End of Test Date: 2-25-22 Time: 1330
Test Duration: 48 hours
Test Temperature: 25 +/- 1 deg C
Test Volume: 30 ml
Test Containers Used: 50 ml TriPours
Renewal Frequency: None
Test Organism Age: <24 hours
Organism Batch #: 021622
Organisms per concentration: 20
Waterbath/Shelf #: 9

SAMPLE COLLECTION				TEST RENEWAL			
Date(s)		Time(s)					
From:	To:	From:	To:	Date(s)	Time(s)	Test Day	Diluent Batch #:
2-22-22	2-22-22	0000	2359	2-23-22	1330	0	8122

Meters: Instrument Id#: Temp.: 073 pH: 061

DO: 061 Conductivity/Salinity: 061

Conditions of surviving organisms at end of test: Normal

Comments:

Experiment ID: BAE022322-4

Conc: Units	Rep.	Number of Live Organisms			Dissolved Oxygen (mg/L)			pH			Alkalinity mg/L as $CaCO_3$	Hardness mg/L as $CaCO_3$	Conductivity (umhos) or Salinity 0/00			Temperature (C)		
		0	24	48	0	24	48	0	24	48	0	0	0	24	48	0	24	48
%	A	5	5	5	6.79	7.73	7.64	8.13	8.20	8.24	64	94	314	336	348	26	25	25
	B	5	5	5														
0	C	5	5	5														
	D	5	5	5														
	A	5	5	5	6.98	7.67	7.60	7.92	8.17	8.20			336	356	360	26	25	25
	B	5	5	5														
25	C	5	5	5														
	D	5	5	5														
	A	5	5	5	7.16	7.35	7.40	7.99	8.09	8.11			358	379	382	26	25	25
45	B	5	5	5														
	C	5	5	5														
	D	5	5	5														
Recorded By:		KOR	PGL	PGL	KOR	SS	KOR	KOR	SS	KOR	KOR	KOR	KOR	SS	KOR	KOR	SS	KOR

Experiment ID: BAED22322-4

Conc: Units	Rep.	Number of Live Organisms			Dissolved Oxygen (mg/L)			pH			Alkalinity mg/L as $CaCO_3$	Hardness mg/L as $CaCO_3$	Conductivity (umhos) or Salinity 0/00			Temperature (C)		
		0	24	48	0	24	48	0	24	48	0	0	0	24	48	0	24	48
%	A	5	5	5	7.02	7.12	7.00	7.90	8.03	8.06			403	428	437	26	25	25
60	B	5	5	5														
	C	5	5	5														
	D	5	5	5														
	A	5	0	–	6.32	6.83	6.90	7.73	8.03	8.06			616	522	581	26	25	25
80	B	5	0	–														
	C	5	0	–														
	D	5	1	0														
	A	5	0	–	5.67	5.92	6.00	7.64	8.15	8.17	500	420	760	776	784	26	25	25
100	B	5	0	–														
	C	5	0	–														
	D	5	0	–														
Recorded By:		KOR	PGL	PGL	KOR	SS	KOR	KOR	SS	KOR	KOR	KOR	KOR	SS	KOR	KOR	SS	KOR

CETIS Analytical Report

Ceriodaphnia 48-h Acute Survival Test — **Biological Monitoring, Inc.**

Analysis ID:	14-4983-7530	**Endpoint:**	48h Survival Rate	**CETIS Version:**	CETISv1.9.4
Analyzed:	01 Mar-22 11:12	**Analysis:**	Binomial Method	**Status Level:**	1

Batch ID:	03-6254-1027	**Test Type:**	Survival (48h)	**Analyst:**	Lab Tech		
Start Date:	23 Feb-22 13:30	**Protocol:**	EPA/821/R-02-012 (2002)	**Diluent:**	Mod-Hard Synthetic Water		
Ending Date:	25 Feb-22 13:30	**Species:**	Ceriodaphnia dubia	**Brine:**			
Test Length:	48h	**Taxon:**	Branchiopoda	**Source:**	In-House Culture	**Age:**	24

Sample ID:	17-5921-8113	**Code:**	BAE022322-4	**Project:**	Special Studies
Sample Date:	22 Feb-22 23:59	**Material:**	Effluent	**Source:**	029
Receipt Date:	23 Feb-22 13:00	**CAS (PC):**		**Station:**	029
Sample Age:	14h	**Client:**	BAE Systems		

Binomial/Graphical Estimates

Threshold Option	Threshold	Trim	Mu	Sigma	LC50	95% LCL	95% UCL
Control Threshold	0	0.00%	1.841	0	69.28	60	80

Test Acceptability Criteria

		TAC Limits			
Attribute	**Test Stat**	**Lower**	**Upper**	**Overlap**	**Decision**
Control Resp	1	0.9	>>	Yes	Passes Criteria

48h Survival Rate Summary

			Calculated Variate(A/B)							Isotonic Variate	
Conc-%	**Code**	**Count**	**Mean**	**Min**	**Max**	**Std Dev**	**CV%**	**%Effect**	**A/B**	**Mean**	**%Effect**
0	D	4	1.0000	1.0000	1.0000	0.0000	0.00%	0.0%	20/20	1	0.0%
25		4	1.0000	1.0000	1.0000	0.0000	0.00%	0.0%	20/20	1	0.0%
45		4	1.0000	1.0000	1.0000	0.0000	0.00%	0.0%	20/20	1	0.0%
60		4	1.0000	1.0000	1.0000	0.0000	0.00%	0.0%	20/20	1	0.0%
80		4	0.0000	0.0000	0.0000	0.0000		100.0%	0/20	0	100.0%
100		4	0.0000	0.0000	0.0000	0.0000		100.0%	0/20	0	100.0%

48h Survival Rate Detail

Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4
0	D	1.0000	1.0000	1.0000	1.0000
25		1.0000	1.0000	1.0000	1.0000
45		1.0000	1.0000	1.0000	1.0000
60		1.0000	1.0000	1.0000	1.0000
80		0.0000	0.0000	0.0000	0.0000
100		0.0000	0.0000	0.0000	0.0000

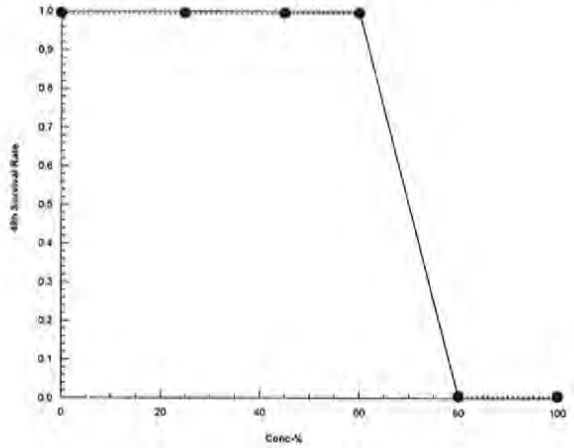
48h Survival Rate Binomials

Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4
0	D	5/5	5/5	5/5	5/5
25		5/5	5/5	5/5	5/5
45		5/5	5/5	5/5	5/5
60		5/5	5/5	5/5	5/5
80		0/5	0/5	0/5	0/5
100		0/5	0/5	0/5	0/5

Ceriodaphnia 48-h Acute Survival Test — **Biological Monitoring, Inc.**

Analysis ID:	14-4983-7530	**Endpoint:**	48h Survival Rate	**CETIS Version:**	CETISv1.9.4
Analyzed:	01 Mar-22 11:12	**Analysis:**	Binomial Method	**Status Level:**	1

Graphics



BIOLOGICAL MONITORING, INC.
1800 KRAFT DRIVE SUITE 104 BLACKSBURG VIRGINIA 24060
PH: 540-953-2821 FAX: 540-951-1481 WWW.BIOMON.COM

NELAC ACCREDITED LAB # 460015

Sample Collection – Chain of Custody Form

Lab Sample ID (Lab Use Only): B A E 0 2 2 3 2 2 - 2

General Information

Client: Radford Army Ammunition Plant (RFAAP) Contact Name/Phone #: Matt Alberts: matt.alberts@baesystems.com, 540-639-7762; Ashley Bandy: ashley.bandy@baesystems.com, 540-639-7034

NPDES Permit #: NA, noncompliance samples Outfall Name/#: CLE (029)

Sample Chlorinated? No Dechlorinated? No

Should BMI Dechlorinate Sample? No

Test should be set up and run on Thursday, Feb. 24, 2022 using the following dilutions: 25%, 45%, 60%, 80%, and 100%

Sampling Information

* Both organisms

[ ] Grab Sample Date Time Volume

[✓] Composite Sample Type 24 hr. Time Flow

Composite Start Date 2-22-22 Composite Start Time 00:00

Composite End Date 2-22-22 Composite End Time 23:59

Sub-samples Frequency Volume

Field Measurements

Temp at Collection Point	Temp In Collection Device	pH	Chlorine	Date/Time	Initials

Custody Information

Relinquished By	Date	Time	Received By	Date	Time
Ashley Bandy	2/23/22	12:47pm	Marlaine Marvin	2/23/22	1247

Ashley Bandy (Printed Name/Affiliation) Ashley Bandy (Signature) 2/23/22 (Date)

Sample Check In (Lab Use Only)

Temperature 0.8°C pH 7.71 Chlorine <0.02 DO 7.18 Conductivity/Salinity 776

On Ice? ✓ Custody Seal? NA Alkalinity 500 Hardness 620

Visual Description Lt. gray Odor None

Ammonia (NH3-N) 2.72 Initials [illegible] Date/Time 2-23-22/1300

1941 Reymet Road ● Richmond, Virginia 23237 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Laboratory Order ID 22B1373

Client Name:	BAE Systems, Inc. - RFAAP	Date Received:	February 23, 2022 13:12
	Route 114	Date Issued:	March 9, 2022 16:01
	Radford, VA 24141	Project Number:	[none]
Submitted To:	Sheree Andrews	Purchase Order:	RFAC-032621-01-RLL
Client Site I.D.:	3-Way Toxicity Split - Coastal		

Enclosed are the results of analyses for samples received by the laboratory on 02/23/2022 13:12. If you have any questions concerning this report, please feel free to contact the laboratory.

Sincerely,

Ted Soyars

Technical Director

End Notes:

The test results listed in this report relate only to the samples submitted to the laboratory and as received by the Laboratory.

Unless otherwise noted, the test results for solid materials are calculated on a wet weight basis. Analyses for pH, dissolved oxygen, temperature, residual chlorine and sulfite that are performed in the laboratory do not meet NELAC requirements due to extremely short holding times. These analyses should be performed in the field. The results of field analyses performed by the Sampler included in the Certificate of Analysis are done so at the client's request and are not included in the laboratory's fields of certification nor have they been audited for adherence to a reference method or procedure.

The signature on the final report certifies that these results conform to all applicable NELAC standards unless otherwise specified. For a complete list of the Laboratory's NELAC certified parameters please contact customer service.

This report shall not be reproduced except in full without the expressed and written approval of an authorized representative of Air Water & Soil Laboratories, Inc.

TNI Accredited
VELAP ID 460021

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Received: Date Issued: Project Number: Purchase Order:	February 23, 2022 13:12 March 9, 2022 16:01 [none] RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	3-Way Toxicity Split - Coastal		

ANALYTICAL REPORT FOR SAMPLES

Laboratory Order ID 22B1373

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
Crowder Tank (007)	22B1373-01	Waste Water	02/22/2022 00:00 to 02/22/2022 23:59	02/23/2022 13:12
CLE (029)	22B1373-02	Waste Water	02/22/2022 00:00 to 02/22/2022 23:59	02/23/2022 13:12

Analysis for Toxicity was subcontracted to Coastal Bio. The subcontracted results are attached at the end of this Certificate of Analysis.

ENTHALPY ANALYTICAL

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Received: Date Issued: Project Number: Purchase Order:	February 23, 2022 13:12 March 9, 2022 16:01 [none] RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	3-Way Toxicity Split - Coastal		

Laboratory Order ID: 22B1373

Analytical Results

Sample I.D. Crowder Tank (007) **Laboratory Sample ID:** 22B1373-01

Composite Start-End Date/Time: 02/22/2022 00:00 - 02/22/2022 23:59

Field Residual Cl: **Field pH:**

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Subcontracted Analysis									
Acute Toxicity CD	01	EPA	Attached		--	1	03/09/22 07:57	03/09/22 07:57	N/A

Analytical Results

Sample I.D. CLE (029) **Laboratory Sample ID:** 22B1373-02

Composite Start-End Date/Time: 02/22/2022 00:00 - 02/22/2022 23:59

Field Residual Cl: **Field pH:**

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Subcontracted Analysis									
Acute Toxicity CD	02	EPA	Attached		--	1	03/09/22 07:57	03/09/22 07:57	N/A

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Received: Date Issued: Project Number: Purchase Order:	February 23, 2022 13:12 March 9, 2022 16:01 [none] RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	3-Way Toxicity Split - Coastal		

Analytical Summary

Sample ID	Preparation Factors Initial / Final	Method	Batch ID	Sequence ID	Calibration ID
Subcontracted Analysis		**Preparation Method:**	**Subcontract**		
22B1373-01	1.00 mL / 1.00 mL	EPA	BFC0342		
22B1373-02	1.00 mL / 1.00 mL	EPA	BFC0342		

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Received: Date Issued: Project Number: Purchase Order:	February 23, 2022 13:12 March 9, 2022 16:01 [none] RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	3-Way Toxicity Split - Coastal		

Certified Analyses included in this Report

Analyte **Certifications**

Code	Description	Laboratory ID	Expires
MADEP	Massachusetts DEP	M-VA913	06/30/2022
MdDOE	Maryland DE Drinking Water	341	12/31/2022
NC	North Carolina DENR	495	07/31/2022
NCDEQ	North Carolina DEQ	495	12/31/2022
NCDOH	North Carolina Department of Health	51714	07/31/2022
NJDEP	NELAP-New Jersey DEP	VA015	06/30/2022
NYDOH	New York DOH Drinking Water	12096	04/01/2022
PADEP	NELAP-Pennsylvania Certificate #007	68-03503	10/31/2022
VELAP	NELAP-Virginia Certificate #11539	460021	06/14/2022

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Received: Date Issued: Project Number: Purchase Order:	February 23, 2022 13:12 March 9, 2022 16:01 [none] RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	3-Way Toxicity Split - Coastal		

Summary of Data Qualifiers

Attached	Attached
RPD	Relative Percent Difference
Qual	Qualifers
-RE	Denotes sample was re-analyzed
D.F.	Dilution Factor. Please also see the Preparation Factor in the Analysis Summary section.
TIC	Tentatively Identified Compounds are compounds that are identified by comparing the analyte mass spectral pattern with the NIST spectral library. A TIC spectral match is reported when the pattern is at least 75% consistent with the published pattern. Compound concentrations are estimated and are calculated using an internal standard response factor of 1.
PCBs, Total	Total PCBs are defined as the sum of detected Aroclors 1016, 1221, 1232, 1248, 1254, 1260, 1262, and 1268.

Client: Enthalpy Analytical/Air, Water and Soil Laboratories
Project ID: AWSL2204
Client Sample ID: BAE-Radford Army Ammunition Plant 22B1373-01A
Permit No.: VA0000248 Crowder Tank (007)
Sample Period: 2/22/22

Coastal Bioanalysts, Inc.

Report of Analysis: Whole Effluent Toxicity (WET)

Submitted To:	**Prepared By:**
JP Verheul Business Development Manager / Senior Chemist Enthalpy Analytical/Air, Water and Soil Laboratories 1941 Reymet Road, Richmond, VA 23237	Coastal Bioanalysts, Inc. 6400 Enterprise Court Gloucester, VA 23061 (804) 694-8285 www.coastalbio.com Contact: Peter F. De Lisle, Technical Director

Acute Test Results*				
Species-Test Method	**Test Period**	**NOAEC**	**48-h LC50**	**T.U.$_{Ac}$**
C. dubia EPA 2002.0	2/24/22-2/26/22	N/A	<15.0	**>6.67**
P. promelas EPA 2000.0	2/24/22-2/26/22	N/A	44.0	**2.27**

Details regarding test conduct and data analysis provided in attached bench sheets and printouts as applicable.
For each test method record the T.U.$_{Ac}$ value (bold) on the DMR.

Acute Test QA/QC	**Reference Toxicant: KCl**	**Units: mg/l**	**Test Organism Source: CBI Stock Cultures**		
Species-Method (Ref. Test Date)	**Data Source**	**% Control Survival**	**48-h LC50**	**95% C.L./A.L. For LC50**	**RTT in Control?**
C. dubia 2002.0	RTT	100	499	462-540	Yes
(2/2/22-2/4/22)	CC	100	526	450-602	
P. promelas 2000.0	RTT	100	1016	934-1104	Yes
(2/2/22-2/4/22)	CC	100	1000	832-1168	

Note: RTT = Reference Toxicant Test, CC = Control Chart.

The results of analysis contained within this report relate only to the sample as received in the laboratory. This report shall not be reproduced except in full without written approval from the laboratory. Unless noted below, these test results meet all requirements of NELAP.

APPROVED: Peter F. De Lisle

Digitally signed by Peter F. De Lisle
DN: cn=Peter F. De Lisle, o=Coastal Bioanalysts, Inc., ou=Toxicology, email=pfd@coastalbio.com, c=US
Date: 2022.03.03 15:30:25 -05'00'

Peter F. De Lisle, Ph.D.
Technical Director

Deviations from, additions to, or exclusions from the test method, non-standard conditions or data qualifiers and, as appropriate, a statement of compliance/non-compliance: **None.**

Please leave feedback regarding our services at: http://coastalbio.com/survey

VELAP# 460030
EPA# VA01116

NELAP ACCREDITED LABORATORY

GLOSSARY OF TERMS AND ABBREVIATIONS

A.L. (Acceptance Limits): The results of a given reference toxicant test are compared to the control chart mean value ± 2 standard deviations. These limits approximate the 95% probability limits for the "true" reference toxicant value.

Chronic Value (ChrV): The geometric mean of the NOEC and LOEC. Units are same as test concentration units.

C.L. (Confidence Limits): These are the probability limits, based on the data set and statistical model employed, that the "true value" lies within the limits specified. Typically limits are based on 95% or 99% probabilities.

Control chart: A cumulative summary chart of results from QC tests with reference toxicants. The results of a given reference toxicant test are compared to the control chart mean value and 95% Acceptance Limits (A.L.) (mean ± 2 standard deviations).

IC25: The concentration of sample or chemical, calculated from the data set using statistical models, causing a 25% reduction in test organism growth, reproduction, etc. The lower the IC25, the more toxic the chemical or sample. Units are same as test concentration units.

LC50: The concentration of sample or chemical, calculated from the data set using statistical models, causing a 50% reduction in test organism survival. The lower the LC50, the more toxic the chemical or sample. Units are same as test concentration units. Note: The LC50 value must always be associated with the duration of exposure. Thus 48-h LC50, 96-h LC50, etc. are calculated.

LOEC: Lowest-observable-effect-concentration. The lowest concentration of sample or chemical in a chronic test dilution series in which the test organisms exhibit a statistically significant reduction in any of the test end points (e.g. growth, survival, reproduction) compared to control organisms. Units are same as test concentration units.

PMSD: Percent Minimum Significant Difference: The minimum difference which can exist between a test treatment and the controls in a particular test and be statistically significant; a measure of test sensitivity. The lower the PMSD the more sensitive the test.

N/A: Not applicable.

N/D: Not determined or measured.

NOAEC: No-observable-acute-effect-concentration. The highest concentration of sample or chemical in an acute test dilution series in which the test organisms exhibit no statistically significant reduction in the test end point (e.g. survival) compared to control organisms. Units are same as test concentration units.

NOEC: No-observable-effect-concentration. The highest concentration of sample or chemical in a chronic test dilution series in which the test organisms exhibit no statistically significant reduction in any of the test end points (e.g. growth, survival, reproduction) compared to control organisms. Some regulatory definitions also require that the NOEC be less than the LOEC. Units are same as test concentration units.

Q.L.: Quantitation Limit. Level, concentration, or quantity of a target variable (analyte) that can be reported at a specified degree of confidence.

T.U.: Toxic units. Expresses the relative toxicity of an effluent in such a manner that the larger the toxic unit value the more toxic the effluent. $T.U._{Ac} = 100/LC50$. $T.U._{Chr} = 100/NOEC$. A dimensionless unit.

C. dubia daily biological measurements (EPA 2002.0) Template version ACD-STAT-5trt-061113

TRTMNT (% Effl)	Rep	#Live Day 0	#Live Day 1	#Live Day 2	Final Mean % Live
C	A	5	5	5	100.0
	B	5	5	5	
Lab	C	5	5	5	
Control	D	5	5	5	
#1	A	5	0	0	5.0
15.0	B	5	5	1	
% Effl	C	5	0	0	
	D	5	0	0	
# 2	A	5	0	0	0.0
25.0	B	5	0	0	
% Effl	C	5	0	0	
	D	5	0	0	
# 3	A	5	4	0	0.0
50.0	B	5	2	0	
% Effl	C	5	0	0	
	D	5	0	0	
# 4	A	5	0	0	0.0
75.0	B	5	0	0	
% Effl	C	5	0	0	
	D	5	0	0	
# 5	A	5	3	0	0.0
100	B	5	0	0	
% Effl	C	5	5	0	
	D	5	4	0	
INITIALS:		AK	LT	LT	% CONTROL SURVIVAL:
DATE & TIME:		2/24/22 11:50	2/25/22 8:05	2/26/22 12:16	

Test Duration:	48h 26m
	TAC 48+/-0.5h
% CONTROL SURVIVAL:	100.0
	TAC = 90%

CHANGES & NOTES (INITIALS, DATE, SPECIFIC CHANGE MADE	Toxcalc to be performed with permit-specific dilutions

	SPECIES:	Ceriodaphnia dubia	
	ACCLIMATION WATER:	Mod. Hard Synthetic Freshwater	
	FEEDING PRIOR TO TEST:	YCT + Selenastrum capricornutum	
	FEEDING DURING TEST:	None -YCT + Selenastrum 2+ h before test	
	SOURCE:	CBI Stock cultures	
	ACCLIMATION TEMP (o C):	25	
	BROOD RELEASE START DATE & TIME:	2/23/22 22:00	
	BROOD RELEASE END DATE & TIME:	2/24/22 6:00	
	DATE/TIME WATER ADDED:	2/24/22 11:39	
	DATE/TIME ANIMALS ADDED:	2/24/22 11:50	
	ANIMAL AGE WINDOW:	8h 0m	
	MAX AGE AT TEST START:	13h 51m	TAC Max. 24 h
	TEST SET UP BY:	AK	
	SAMPLE COLLECTION DATE &TIME:	2/22/22 23:59	SAMPLE USED A
TEST ID:	SAMPLE AGE AT TEST START:	35h 52m	TAC Max 36 h
AWSL2204ACD	PEER REVIEW BY (INITIALS/DATE):	PB	3/1/22 10:50

Ceriodaphnia daily water quality bench sheet (EPA METHOD 2002.0) Template version ACD-STAT-5trt-061113

	TRTMNT	Day 0 Initial	Day 1	Day 2 Final	SUMMARY WATER QUALITY DATA MEAN	S.D.	MIN.	MAX.
pH (S.U.)	C	8.13	8.11	8.24	8.16	0.07	8.11	8.24
	1	8.03	8.10	8.20	8.11	0.09	8.03	8.20
	2	7.99	8.11		8.05	0.08	7.99	8.11
	3	7.93	8.10	8.29	8.11	0.18	7.93	8.29
	4	7.85	8.14		8.00	0.21	7.85	8.14
	5	7.76	8.05	8.16	7.99	0.21	7.76	8.16
Temp. (o C)	C	25	25	25	25	0.0	25	25
	1	25	25	25	25	0.0	25	25
	2	25	25		25	0.0	25	25
	3	25	25	25	25	0.0	25	25
	4	25	25		25	0.0	25	25
	5	26	25	24	25	1.0	24	26
Diss. Oxygen (mg/l)	C	8.1	8.3	8.4	8.3	0.2	8.1	8.4
	1	8.0	8.3	8.5	8.3	0.3	8.0	8.5
	2	7.8	8.4		8.1	0.4	7.8	8.4
	3	7.5	8.5	8.5	8.2	0.6	7.5	8.5
	4	7.3	8.5		7.9	0.8	7.3	8.5
	5	6.9	8.4	8.2	7.8	0.8	6.9	8.4
Cond. (uS/cm)	C	303		315	309	8.5	303	315
	1	366			366		366	366
	2	388			388		388	388
	3	450			450		450	450
	4	580			580		580	580
	5	756		763	760	4.9	756	763
Replicate measured		Flask	Surrogate	B				
Initials		AK	LT	LT				
		TRC (mg/l) in highest conc. at end of test:		N/A				
Changes & Notes (Initials, date, specific change or notes)								

Test chamber:	30 ml plastic cup:	✓					
	Other:						
Test solution vol. (15 ml min):	15 ml:	✓					
	Other (ml):						
Illumination & photoperiod:	50-100 ft-c 16L:8D			Template Number:		10	
Number of replicates/treatment:	4						
Initial number animals/replicate:	5						
Test Aerated?	N/A	Date & Time Air Start:		N/A			

TEST ID	TRT ID:	1	2	3	4	5
AWSL2204ACD	CONC(%):	15.0	25.0	50.0	75.0	100

P. promelas daily biological measurements (EPA 2000.0) Template version APP-STAT-48h-5trt-061113

TRTMNT (%Effl)	Rep	#Live Day 0	#Live Day 1	#Live Day 2	Final Mean % Live		
C	A	10	10	10	100.0		
Lab Control	B	10	10	10			
#1	A	10	10	10	100.0		
15.0	B	10	10	10			
# 2	A	10	10	10	100.0		
25.0	B	10	10	10			
# 3	A	10	10	4	40.0		
50.0	B	10	7	4			
# 4	A	10	1	0	0.0		
75.0	B	10	0	0			
# 5	A	10	0	0	0.0	Test Duration:	48h 21m
100	B	10	0	0			TAC 48+/-0.5h
INITIALS:		AK	LT	LT	% CONTROL SURVIVAL:		100.0
DATE & TIME:		2/24/22 11:50	2/25/22 8:13	2/26/22 12:10			TAC = 90%
CHANGES & NOTES (INITIALS, DATE, SPECIFIC CHANGE MADE		Toxcalc to be performed with permit-specific dilutions					

SPECIES:	Pimephales promelas		
ACCLIMATION WATER:	Mod. Hard Synthetic Freshwater		
FEEDING PRIOR TO TEST:	Artemia nauplii ad libitum		
FEEDING DURING TEST:	None		
SOURCE:	CBI Stock cultures		
ACCLIMATION TEMP (o C):	25		
HATCH START DATE & TIME:	2/21/22 17:00		
HATCH END DATE & TIME:	2/22/22 10:00		
DATE/TIME WATER ADDED:	2/24/22 11:38		
DATE/TIME ANIMALS ADDED:	2/24/22 11:50		
ANIMAL AGE WINDOW:	17h 0m	TAC Max. 24 h	
MAX AGE AT TEST START:	3d	TAC Max. 14 d	
TEST SET UP BY:		AK	
SAMPLE COLLECTION DATE & TIME:	2/22/22 23:59	SAMPLE USED	A
SAMPLE AGE AT TEST START:	35h 51m	TAC MAX 36 h	
PEER REVIEW BY (INITIALS/DATE):		PB	3/1/22 10:51

TEST ID: AWSL2204APP

P. promelas daily water quality bench sheet (EPA METHOD 2002.0) Template version APP-STAT-48h-5trt-06113

	TRTMNT	Day 0 Initial	Day 1	Day 2 Final	SUMMARY WATER QUALITY DATA MEAN	S.D.	MIN.	MAX.
pH (S.U.)	C	8.13	8.08	8.07	8.09	0.03	8.07	8.13
	1	8.03	8.06	8.02	8.04	0.02	8.02	8.06
	2	7.99	8.00	7.81	7.93	0.11	7.81	8.00
	3	7.93	7.91	7.79	7.88	0.08	7.79	7.93
	4	7.85	7.91	7.85	7.87	0.03	7.85	7.91
	5	7.76	7.94		7.85	0.13	7.76	7.94
Temp. (o C)	C	25	24	24	24	0.6	24	25
	1	25	24	24	24	0.6	24	25
	2	25	24	24	24	0.6	24	25
	3	25	24	24	24	0.6	24	25
	4	25	24	24	24	0.6	24	25
	5	26	24		25	1.4	24	26
Diss. Oxygen (mg/l)	C	8.1	8.2	7.8	8.0	0.2	7.8	8.2
	1	8.0	8.1	7.7	7.9	0.2	7.7	8.1
	2	7.8	6.8	7.0	7.2	0.5	6.8	7.8
	3	7.5	6.3	6.3	6.7	0.7	6.3	7.5
	4	7.3	5.5	5.4	6.1	1.1	5.4	7.3
	5	6.9	5.0		6.0	1.3	5.0	6.9
Cond. (uS/cm)	C	303		330	317	19.1	303	330
	1	366			366		366	366
	2	388			388		388	388
	3	450			450		450	450
	4	580		664	622	59.4	580	664
	5	756			756		756	756
Replicate measured		B	A	B				
Initials		AK	LT	LT				
		TRC (mg/l) in highest conc. at end of test:		NA				
Changes & Notes (Initials, date, specific change or notes)								

	Test chamber:	400 ml Tri-pour bkr:	✓			
		Other:				
	Test solution vol. (200 ml min):	400 ml:	✓			
		Other (ml):				
	Illumination & photoperiod:	50-100 ft-c 16L:8D				
	Number of replicates/treatment:	2				
	Initial number animals/replicate:	10				
	Test Aerated?	No	Date & Time Air Start:			
TEST ID	TRT ID:	1	2	3	4	5
AWSL2204APP	CONC (%):	15.0	25.0	50.0	75.0	100

D.O. Highest conc. @ aeration:

Total live highest conc.@ aeration

Acute Fish Test-48 Hr Survival

Start Date:		Test ID:	AWSL2204PP	Sample ID:	
End Date:		Lab ID:	CBI	Sample Type:	
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	PP-Pimephales promelas
Comments:	DATA ENTERED BY PB				

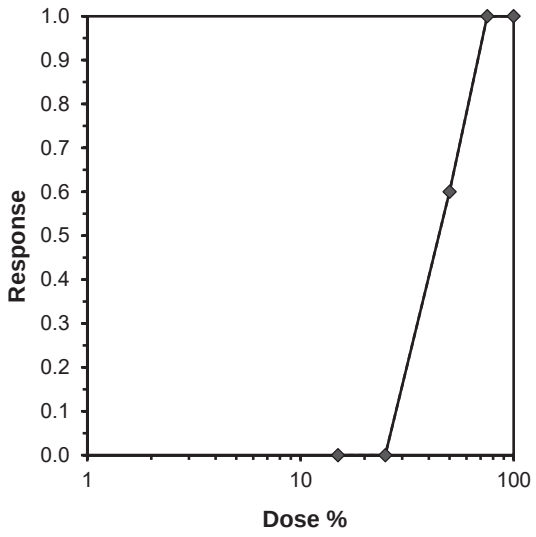
Conc-%	1	2
CONTROL	1.0000	1.0000
15	1.0000	1.0000
25	1.0000	1.0000
50	0.4000	0.4000
75	0.0000	0.0000
100	0.0000	0.0000

			Transform: Arcsin Square Root					Number	Total
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
CONTROL	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	2	0	20
15	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	2	0	20
25	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	2	0	20
50	0.4000	0.4000	0.6847	0.6847	0.6847	0.000	2	12	20
75	0.0000	0.0000	0.1588	0.1588	0.1588	0.000	2	20	20
100	0.0000	0.0000	0.1588	0.1588	0.1588	0.000	2	20	20

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Normality of the data set cannot be confirmed				
Equality of variance cannot be confirmed				

Trimmed Spearman-Karber

Trim Level	EC50	95% CL	
0.0%	44.043	39.049	49.676
5.0%	44.118	38.603	50.420
10.0%	44.192	38.051	51.323
20.0%	44.335	36.439	53.942
Auto-0.0%		39.049	49.676



pd

Effluent and Dilution Water Log (Freshwater Tests). FWEFFL061013

											SUMMARY WATER QUALITY DATA				
Initial sample charac-terization	Bottle(1):	A1									MEAN	S.D.	MIN.	MAX.	PARAMETER
	Arrival Temp. (oC, from CoC):	1									1		1	1	Arrival Temp.
	TRC (mg/l)(2):	<DL													
	TRC Corrected(2):														
	Hardness (mg/l):	134									134		134	134	Hardness (mg/l)
	Alkalinity (mg/l):	212									212		212	212	Alkalinity (mg/l)
	NH3-N (mg/l):	<1.0													
	Color/Appearance(3):	T Bl													
	Obvious odor?	NO													
	Date & Time:	2/24/22 11:05													
	Initials:	AK													
Sample prep measure-ments	Test Day:	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7		MEAN	S.D.	MIN.	MAX.	
	Bottle(s):	A1													
	Prep. Temp. (oC):	25									25		25	25	Temp. (oC)
	D.O. (mg/l) After Warming:	7.2													
	Aeration Time (min):	0													
	Adjusted D.O. (mg/l):	7.2									7.2		7.2	7.2	D.O. (mg/l)
	Final pH (S.U.):	7.80									7.80		7.80	7.80	pH (S.U.)
	Conductivity (uS/cm)(4):	760									760		760	760	Cond. (uS/cm)
	Final TRC (mg/l)(5):	N.D.													
	Sample Filtered (60 um)?														
	Date & Time:	2/24/22 11:12													
	Initials:	AK													
Dilution water	Test Day:	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7		MEAN	S.D.	MIN.	MAX.	
	Vat Number:	3													
	Temperature (oC):	25									25		25	25	Temp. (oC)
	Conductivity (uS/cm):	302									302		302	302	Cond. (uS/cm)
	D.O. (mg/l):	8.2									8.2		8.2	8.2	D.O. (mg/l)
	pH (S.U.):	8.02									8.02		8.02	8.02	pH (S.U.)
	Hardness (mg/l):	96									96		96	96	Hardness (mg/l)
	Alkalinity (mg/l):	64									64		64	64	Alkalinity (mg/l)
	Date & Time:	2/24/22 8:00													
	Initials:	CPV													
	Changes & Notes (Initials, date, specific change or notes)														
	Peer review Initial/Date:	PB	3/3/22 13:27	DILUTION WATER TYPE:	Mod. Hard Synthetic Freshwater (EPA)	ND=Not Determined/Measured, NA=Not Applicable. 1) Ninth character of lab sample ID on chain of custody AND bottle number in collection series. Together with Project ID constitutes entire sample bottle ID. 2) TRC MDL 0.02 mg/l; QL 0.22 mg/l. Corrected value if Mn, Cr potential positive interference. Corrected using KI and NaAsO2. 3) C-clear, O-opaque, T-turbid, S-solids (Sl-slight, M-moderate, H-heavy), Y-yellow, B-brown, Bl-black, G-green, P-pink, Gr-grey, Or-orange. 4) Measured on first use of sample only. 5) Final TRC measured only if chlorine present in initial characterization.. NOTE: All test temperature measurements conducted with calibrated thermocouples so no correction factor applicable.													
PROJECT ID:	AWSL2204	ADDITIONAL EFFLUENT TREATMENT:													

ENTHALPY ANALYTICAL
formerly *Air, Water & Soil Laboratories*

Coastal Bioanalysts
6400 Enterprise Ct
Gloucester, VA 23061

AWSL2204-A (1)
AWSL2205-A(2)
22-0363 (1) 22-0364 (2)

1941 REYMET ROAD
RICHMOND, VIRGINIA 23237
(804) 358-8295 PHONE
(804)358-8297 FAX

Chain of Custody
Form #: D1331
Rev. 1.0
Effective: Feb 14, 2014

CHAIN OF CUSTODY

COMPANY NAME: Air, Water & Soil Labs, INC	INVOICE TO: AWS LABS	PROJECT NAME/Quote #: 22B1373
CONTACT: Sarah Endsley	INVOICE CONTACT: RIC-env@enthalpy.com	SITE NAME: 22B1373
ADDRESS:1941 Reymet Rd, Richmond, VA 23237	INVOICE ADDRESS:	PROJECT NUMBER: 22B1373
PHONE #: 804-358-8295	INVOICE PHONE #:	P.O. #: 80-023556
FAX #:804-358-8297	EMAIL: ric-env@enthalpy.com	Pretreatment Program:
Is sample for compliance reporting? YES NO	Is sample from a chlorinated supply? YES NO	PWS I.D. #:
SAMPLER NAME (PRINT):	SAMPLER SIGNATURE:	**Turn Around Time:10 Days**

Matrix Codes: WW=Waste Water/Storm Water GW=Ground Water DW=Drinking Water S=Soil/Solids OR=Organic A=Air WP=Wipe OT=Other_____

CLIENT SAMPLE I.D.	Grab	Composite	Field Filtered (Dissolved Metals)	Composite Start Date	Composite Start Time	Grab Date or Composite Stop Date	Grab Time or Composite Stop Time	Time Preserved	Matrix (See Codes)	Number of Containers	ANALYSIS / (PRESERVATIVE): Acute Toxicity - P. Promelas / D. cubia	Please use the following dilutions as discussed: CLE (Outfall 029) = 25%, 45%, 60%, 80%, 100% Crowder Tanks (Outfall 007) = 15%, 25%, 50%, 75%, 100%
1) 22B1373-01: Crowder Tank (007)		X		2.22.22	0000	2.22.22	2359		WW	1		X
2) 22B1373-02: CLE (029)		X		2.22.22	0	2.22.22	2359		WW	1		X
10)												

COMMENTS

Preservative Codes: N=Nitric Acid C=Hydrochloric Acid S=Sulfuric Acid H=Sodium Hydroxide A=Ascorbic Acid Z=Zinc Acetate T=Sodium Thiosulfate M=Methanol

PLEASE NOTE PRESERVATIVE(S), INTERFERENCE CHECKS or PUMP RATE (L/min)

Order #: 2B17001
Project:
Sample ID: CLE(029)
Matrix: NPW Container: C er
Pres: Cool < 6 °C
Chronic Toxicity sub
Date: 2.22.22
Time: 2359
Taken By: DV

22B1373-02 A Due: 03/09/2022 18:00
Non-Potable Water-Cubitainer
AE Systems, Inc
Collected: 02/22/2022 23:59
CLE (029)
AWSL 2205-A
22B1373-02 A

22B1373-01 A Due: 03/09/2022 18:00
Non-Potable Water-Cubitainer
AE Systems, Inc
Collected: 02/22/2022 23:59
Crowder Tank (007)
22B1373-01 A

Order #: 2B17001
Project: Crowder Tank
Sample ID: (007)
Matrix: NPW Container: Cubitainer
Pres: Cool < 6 °C
Chronic Toxicity sub
Date: 2.22.22
Time: 2359
Taken By: DV
2.23.22
AWSL 2204-A (1)

RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME
JH 2/24/22	0915	Carter Vroman	2/24/22 0915
RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME
		A. Krueger	2/24/22 1100
RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME

QC Data Package
Level I ☐
Level II ☐
Level III ☐
Level IV ☐

LAB USE ONLY

COOLER TEMP 10 °C

TV: AK

Client: Enthalpy Analytical/Air, Water and Soil Laboratories
Project ID: AWSL2205
Client Sample ID: BAE-Radford Army Ammunition Plant 22B1373-02A
Permit No.: VA0000248 CLE (029)
Sample Period: 2/22/22

Coastal Bioanalysts, Inc.

Report of Analysis: Whole Effluent Toxicity (WET)

Submitted To:	**Prepared By:**
JP Verheul Business Development Manager / Senior Chemist Enthalpy Analytical/Air, Water and Soil Laboratories 1941 Reymet Road, Richmond, VA 23237	Coastal Bioanalysts, Inc. 6400 Enterprise Court Gloucester, VA 23061 (804) 694-8285 www.coastalbio.com Contact: Peter F. De Lisle, Technical Director

Acute Test Results*				
Species-Test Method	**Test Period**	**NOAEC**	**48-h LC50**	**T.U.$_{Ac}$**
C. dubia EPA 2002.0	2/24/22-2/26/22	N/A	<25.0	**>4.00**
P. promelas EPA 2000.0	2/24/22-2/26/22	N/A	>100	**<1.00**

Details regarding test conduct and data analysis provided in attached bench sheets and printouts as applicable.
For each test method record the T.U.$_{Ac}$ value (bold) on the DMR.

Acute Test QA/QC	**Reference Toxicant: KCl**	**Units: mg/l**	**Test Organism Source: CBI Stock Cultures**		
Species-Method (Ref. Test Date)	**Data Source**	**% Control Survival**	**48-h LC50**	**95% C.L./A.L. For LC50**	**RTT in Control?**
C. dubia 2002.0	RTT	100	499	462-540	Yes
(2/2/22-2/4/22)	CC	100	526	450-602	
P. promelas 2000.0	RTT	100	1016	934-1104	Yes
(2/2/22-2/4/22)	CC	100	1000	832-1168	

Note: RTT = Reference Toxicant Test, CC = Control Chart.

The results of analysis contained within this report relate only to the sample as received in the laboratory. This report shall not be reproduced except in full without written approval from the laboratory. Unless noted below, these test results meet all requirements of NELAP.

APPROVED: Peter F. De Lisle

Digitally signed by Peter F. De Lisle
DN: cn=Peter F. De Lisle, o=Coastal Bioanalysts, Inc., ou=Toxicology, email=pfd@coastalbio.com, c=US
Date: 2022.03.03 15:52:10 -05'00'

Peter F. De Lisle, Ph.D.
Technical Director

Deviations from, additions to, or exclusions from the test method, non-standard conditions or data qualifiers and, as appropriate, a statement of compliance/non-compliance: **None.**

Please leave feedback regarding our services at: http://coastalbio.com/survey

VELAP# 460030
EPA# VA01116

NELAP ACCREDITED LABORATORY

Coastal Bioanalysts, Inc.

GLOSSARY OF TERMS AND ABBREVIATIONS

A.L. (Acceptance Limits): The results of a given reference toxicant test are compared to the control chart mean value ± 2 standard deviations. These limits approximate the 95% probability limits for the "true" reference toxicant value.

Chronic Value (ChrV): The geometric mean of the NOEC and LOEC. Units are same as test concentration units.

C.L. (Confidence Limits): These are the probability limits, based on the data set and statistical model employed, that the "true value" lies within the limits specified. Typically limits are based on 95% or 99% probabilities.

Control chart: A cumulative summary chart of results from QC tests with reference toxicants. The results of a given reference toxicant test are compared to the control chart mean value and 95% Acceptance Limits (A.L.) (mean ± 2 standard deviations).

IC25: The concentration of sample or chemical, calculated from the data set using statistical models, causing a 25% reduction in test organism growth, reproduction, etc. The lower the IC25, the more toxic the chemical or sample. Units are same as test concentration units.

LC50: The concentration of sample or chemical, calculated from the data set using statistical models, causing a 50% reduction in test organism survival. The lower the LC50, the more toxic the chemical or sample. Units are same as test concentration units. Note: The LC50 value must always be associated with the duration of exposure. Thus 48-h LC50, 96-h LC50, etc. are calculated.

LOEC: Lowest-observable-effect-concentration. The lowest concentration of sample or chemical in a chronic test dilution series in which the test organisms exhibit a statistically significant reduction in any of the test end points (e.g. growth, survival, reproduction) compared to control organisms. Units are same as test concentration units.

PMSD: Percent Minimum Significant Difference: The minimum difference which can exist between a test treatment and the controls in a particular test and be statistically significant; a measure of test sensitivity. The lower the PMSD the more sensitive the test.

N/A: Not applicable.

N/D: Not determined or measured.

NOAEC: No-observable-acute-effect-concentration. The highest concentration of sample or chemical in an acute test dilution series in which the test organisms exhibit no statistically significant reduction in the test end point (e.g. survival) compared to control organisms. Units are same as test concentration units.

NOEC: No-observable-effect-concentration. The highest concentration of sample or chemical in a chronic test dilution series in which the test organisms exhibit no statistically significant reduction in any of the test end points (e.g. growth, survival, reproduction) compared to control organisms. Some regulatory definitions also require that the NOEC be less than the LOEC. Units are same as test concentration units.

Q.L.: Quantitation Limit. Level, concentration, or quantity of a target variable (analyte) that can be reported at a specified degree of confidence.

T.U.: Toxic units. Expresses the relative toxicity of an effluent in such a manner that the larger the toxic unit value the more toxic the effluent. $T.U._{Ac} = 100/LC50$. $T.U._{Chr} = 100/NOEC$. A dimensionless unit.

VELAP# 460030
EPA# VA01116

C. dubia daily biological measurements (EPA 2002.0) Template version ACD-STAT-5trt-061113

TRTMNT (% Effl)	Rep	#Live Day 0	#Live Day 1	#Live Day 2	Final Mean % Live		
C	A	5	5	5	100.0		
	B	5	5	5			
Lab	C	5	5	5			
Control	D	5	5	5			
#1	A	5	0	0	0.0		
25.0	B	5	2	0			
% Effl	C	5	5	0			
	D	5	5	0			
# 2	A	5	1	0	0.0		
45.0	B	5	1	0			
% Effl	C	5	0	0			
	D	5	5	0			
# 3	A	5	5	0	0.0		
60.0	B	5	1	0			
% Effl	C	5	5	0			
	D	5	1	0			
# 4	A	5	5	0	0.0		
80.0	B	5	2	0			
% Effl	C	5	3	0			
	D	5	0	0			
# 5	A	5	0	0	0.0		
100	B	5	5	0			
% Effl	C	5	4	0		Test Duration:	48h 23m
	D	5	5	0			TAC 48+/-0.5h
INITIALS:		CPV	LT	LT	% CONTROL SURVIVAL:		100.0
DATE & TIME:		2/24/22 11:38	2/25/22 8:25	2/26/22 12:02			TAC = 90%
CHANGES & NOTES (INITIALS, DATE, SPECIFIC CHANGE MADE		Toxcalc to be performed with permit-specific dilutions					

	SPECIES:	Ceriodaphnia dubia	
	ACCLIMATION WATER:	Mod. Hard Synthetic Freshwater	
	FEEDING PRIOR TO TEST:	YCT + Selenastrum capricornutum	
	FEEDING DURING TEST:	None -YCT + Selenastrum 2+ h before test	
	SOURCE:	CBI Stock cultures	
	ACCLIMATION TEMP (o C):	25	
	BROOD RELEASE START DATE & TIME:	2/23/22 22:00	
	BROOD RELEASE END DATE & TIME:	2/24/22 6:00	
	DATE/TIME WATER ADDED:	2/24/22 11:23	
	DATE/TIME ANIMALS ADDED:	2/24/22 11:38	
	ANIMAL AGE WINDOW:	7h 59m	
	MAX AGE AT TEST START:	13h 38m	TAC Max. 24 h
	TEST SET UP BY:	CPV	
	SAMPLE COLLECTION DATE &TIME:	2/22/22 23:59	SAMPLE USED A
TEST ID:	SAMPLE AGE AT TEST START:	35h 40m	TAC Max 36 h
AWSL2205ACD	PEER REVIEW BY (INITIALS/DATE):	PB	3/1/22 10:53

Ceriodaphnia daily water quality bench sheet (EPA METHOD 2002.0) Template version ACD-STAT-5trt-061113

	TRTMNT	Day 0 Initial	Day 1	Day 2 Final	SUMMARY WATER QUALITY DATA MEAN	S.D.	MIN.	MAX.
pH (S.U.)	C	8.14	8.10	8.24	8.16	0.07	8.10	8.24
	1	8.03	8.03	8.16	8.07	0.08	8.03	8.16
	2	7.88	7.82	8.08	7.93	0.14	7.82	8.08
	3	7.81	7.75	7.96	7.84	0.11	7.75	7.96
	4	7.70	7.50	7.84	7.68	0.17	7.50	7.84
	5	7.48	7.31	7.68	7.49	0.19	7.31	7.68
Temp. (o C)	C	25	24	24	24	0.6	24	25
	1	25	24	24	24	0.6	24	25
	2	25	24	24	24	0.6	24	25
	3	25	24	24	24	0.6	24	25
	4	25	24	24	24	0.6	24	25
	5	25	24	24	24	0.6	24	25
Diss. Oxygen (mg/l)	C	8.2	8.3	8.4	8.3	0.1	8.2	8.4
	1	8.2	8.3	8.3	8.3	0.1	8.2	8.3
	2	8.2	8.4	8.3	8.3	0.1	8.2	8.4
	3	8.2	8.4	8.4	8.3	0.1	8.2	8.4
	4	8.2	8.3	8.4	8.3	0.1	8.2	8.4
	5	8.2	8.3	8.3	8.3	0.1	8.2	8.3
Cond. (uS/cm)	C	302		304	303	1.4	302	304
	1	617			617		617	617
	2	850			850		850	850
	3	995			995		995	995
	4	1208			1208		1208	1208
	5	1375		1420	1398	31.8	1375	1420
Replicate measured		Flask	Surrogate	B				
Initials		CPV	LT	LT				
		TRC (mg/l) in highest conc. at end of test:		N/A				
Changes & Notes (Initials, date, specific change or notes)								

Test chamber:	30 ml plastic cup:	✓					
	Other:						
Test solution vol. (15 ml min):	15 ml:	✓					
	Other (ml):						
Illumination & photoperiod:	50-100 ft-c 16L:8D			Template Number:		2	
Number of replicates/treatment:	4						
Initial number animals/replicate:	5						
Test Aerated?	N/A	Date & Time Air Start:		N/A			

TEST ID	TRT ID:	1	2	3	4	5
AWSL2205ACD	CONC(%):	25.0	45.0	60.0	80.0	100

P. promelas daily biological measurements (EPA 2000.0) Template version APP-STAT-48h-5trt-061113

TRTMNT (%Effl)	Rep	#Live Day 0	#Live Day 1	#Live Day 2	Final Mean % Live		
C	A	10	10	10	100.0		
Lab Control	B	10	10	10			
#1	A	10	10	10	100.0		
25.0	B	10	10	10			
# 2	A	10	10	10	100.0		
45.0	B	10	10	10			
# 3	A	10	10	9	95.0		
60.0	B	10	10	10			
# 4	A	10	10	9	95.0		
80.0	B	10	10	10			
# 5	A	10	10	9	95.0	Test Duration:	48h 26m
100	B	10	10	10			TAC 48+/-0.5h
INITIALS:		CPV	LT	LT	% CONTROL SURVIVAL:		100.0
DATE & TIME:		2/24/22 11:44	2/25/22 8:19	2/26/22 12:10			TAC = 90%
CHANGES & NOTES (INITIALS, DATE, SPECIFIC CHANGE MADE		Toxcalc to be performed with permit-specific dilutions. NOTE: string material trailing from some fish in effluent treatments but not controls. See attached pic. LT					

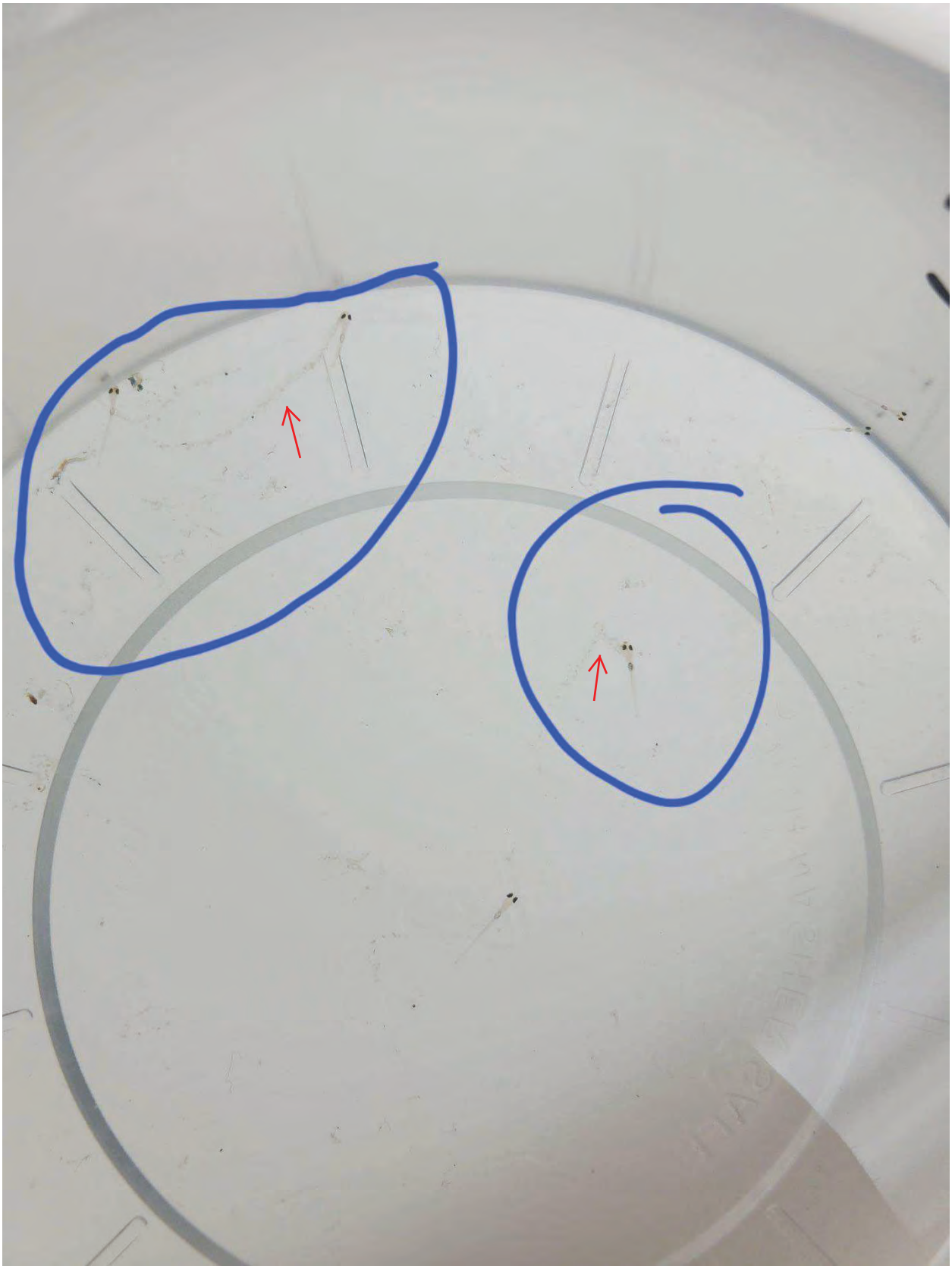
SPECIES:	Pimephales promelas		
ACCLIMATION WATER:	Mod. Hard Synthetic Freshwater		
FEEDING PRIOR TO TEST:	Artemia nauplii ad libitum		
FEEDING DURING TEST:	None		
SOURCE:	CBI Stock cultures		
ACCLIMATION TEMP (o C):	25		
HATCH START DATE & TIME:	2/23/22 17:00		
HATCH END DATE & TIME:	2/24/22 10:00		
DATE/TIME WATER ADDED:	2/24/22 11:23		
DATE/TIME ANIMALS ADDED:	2/24/22 11:44		
ANIMAL AGE WINDOW:	17h 0m		TAC Max. 24 h
MAX AGE AT TEST START:	1d		TAC Max. 14 d
TEST SET UP BY:		CPV	
SAMPLE COLLECTION DATE & TIME:	2/22/22 23:59	SAMPLE USED	A
SAMPLE AGE AT TEST START:	35h 46m	TAC MAX 36 h	
PEER REVIEW BY (INITIALS/DATE):		PB	3/1/22 10:54

TEST ID: AWSL2205APP

P. promelas daily water quality bench sheet (EPA METHOD 2002.0) Template version APP-STAT-48h-5trt-06113

	TRTMNT	Day 0 Initial	Day 1	Day 2 Final	SUMMARY WATER QUALITY DATA MEAN	S.D.	MIN.	MAX.
pH (S.U.)	C	8.14	8.10	8.15	8.13	0.03	8.10	8.15
	1	8.03	7.80	8.00	7.94	0.13	7.80	8.03
	2	7.88	7.71	7.80	7.80	0.09	7.71	7.88
	3	7.81	7.59	7.55	7.65	0.14	7.55	7.81
	4	7.70	7.38	7.52	7.53	0.16	7.38	7.70
	5	7.48	7.11	7.25	7.28	0.19	7.11	7.48
Temp. (o C)	C	25	24	24	24	0.6	24	25
	1	25	24	24	24	0.6	24	25
	2	25	24	24	24	0.6	24	25
	3	25	24	24	24	0.6	24	25
	4	25	24	24	24	0.6	24	25
	5	25	24	24	24	0.6	24	25
Diss. Oxygen (mg/l)	C	8.2	8.0	7.9	8.0	0.2	7.9	8.2
	1	8.2	7.8	7.6	7.9	0.3	7.6	8.2
	2	8.2	7.5	7.4	7.7	0.4	7.4	8.2
	3	8.2	7.4	7.3	7.6	0.5	7.3	8.2
	4	8.2	7.5	7.4	7.7	0.4	7.4	8.2
	5	8.2	7.2	7.5	7.6	0.5	7.2	8.2
Cond. (uS/cm)	C	302		323	313	14.8	302	323
	1	617			617		617	617
	2	850			850		850	850
	3	995			995		995	995
	4	1208			1208		1208	1208
	5	1375		1450	1413	53.0	1375	1450
Replicate measured		B	A	B				
Initials		CPV	LT	LT				
		TRC (mg/l) in highest conc. at end of test:		NA				
Changes & Notes (Initials, date, specific change or notes)								

	Test chamber:	400 ml Tri-pour bkr:	✓			
		Other:				
	Test solution vol. (200 ml min):	400 ml:	✓			
		Other (ml):				
	Illumination & photoperiod:	50-100 ft-c 16L:8D				
	Number of replicates/treatment:	2				
	Initial number animals/replicate:	10				
	Test Aerated?	No	Date & Time Air Start:			
TEST ID	TRT ID: 1	2	3	4	5	D.O. Highest conc. @ aeration:
AWSL2205APP	CONC (%): 25.0	45.0	60.0	80.0	100	Total live highest conc.@ aeration



Effluent and Dilution Water Log (Freshwater Tests). FWEFFL061013

											SUMMARY WATER QUALITY DATA				
Initial sample charac-terization	Bottle(1):	A1									MEAN	S.D.	MIN.	MAX.	PARAMETER
	Arrival Temp. (oC, from CoC):	1									1		1	1	Arrival Temp.
	TRC (mg/l)(2):	<DL													
	TRC Corrected(2):														
	Hardness (mg/l):	662									662		662	662	Hardness (mg/l)
	Alkalinity (mg/l):	21									21		21	21	Alkalinity (mg/l)
	NH3-N (mg/l):	<1.0													
	Color/Appearance(3):	C													
	Obvious odor?	NO													
	Date & Time:	2/24/22 11:04													
	Initials:	AK													
Sample prep measure-ments	Test Day:	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7		MEAN	S.D.	MIN.	MAX.	
	Bottle(s):	A1													
	Prep. Temp. (oC):	25									25		25	25	Temp. (oC)
	D.O. (mg/l) After Warming:	9.2													
	Aeration Time (min):	2													
	Adjusted D.O. (mg/l):	8.2									8.2		8.2	8.2	D.O. (mg/l)
	Final pH (S.U.):	7.30									7.30		7.30	7.30	pH (S.U.)
	Conductivity (uS/cm)(4):	1385									1385		1385	1385	Cond. (uS/cm)
	Final TRC (mg/l)(5):	N.D.													
	Sample Filtered (60 um)?														
	Date & Time:	2/24/22 11:12													
	Initials:	CPV													
Dilution water	Test Day:	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7		MEAN	S.D.	MIN.	MAX.	
	Vat Number:	3													
	Temperature (oC):	25									25		25	25	Temp. (oC)
	Conductivity (uS/cm):	302									302		302	302	Cond. (uS/cm)
	D.O. (mg/l):	8.2									8.2		8.2	8.2	D.O. (mg/l)
	pH (S.U.):	8.02									8.02		8.02	8.02	pH (S.U.)
	Hardness (mg/l):	96									96		96	96	Hardness (mg/l)
	Alkalinity (mg/l):	64									64		64	64	Alkalinity (mg/l)
	Date & Time:	2/24/22 8:00													
	Initials:	CPV													
	Changes & Notes (Initials, date, specific change or notes)														
	Peer review Initial/Date:	PB	3/3/22 13:27	DILUTION WATER TYPE:	Mod. Hard Synthetic Freshwater (EPA)	ND=Not Determined/Measured, NA=Not Applicable. 1) Ninth character of lab sample ID on chain of custody AND bottle number in collection series. Together with Project ID constitutes entire sample bottle ID. 2) TRC MDL 0.02 mg/l; QL 0.22 mg/l. Corrected value if Mn, Cr potential positive interference. Corrected using KI and NaAsO2. 3) C-clear, O-opaque, T-turbid, S-solids (Sl-slight, M-moderate, H-heavy), Y-yellow, B-brown, Bl-black, G-green, P-pink, Gr-grey, Or-orange. 4) Measured on first use of sample only. 5) Final TRC measured only if chlorine present in initial characterization.. NOTE: All test temperature measurements conducted with calibrated thermocouples so no correction factor applicable.													
PROJECT ID:	AWSL2205	ADDITIONAL EFFLUENT TREATMENT:													

ENTHALPY ANALYTICAL
formerly *Air, Water & Soil Laboratories*

Coastal Bioanalysts
6400 Enterprise Ct
Gloucester, VA 23061

AWSL2204-A (1)
AWSL2205-A(2)
22-0363 (1) 22-0364 (2)

1941 REYMET ROAD
RICHMOND, VIRGINIA 23237
(804) 358-8295 PHONE
(804)358-8297 FAX

Chain of Custody
Form #: D1331
Rev. 1.0
Effective: Feb 14, 2014

CHAIN OF CUSTODY

COMPANY NAME: Air, Water & Soil Labs, INC	INVOICE TO: AWS LABS	PROJECT NAME/Quote #: 22B1373
CONTACT: Sarah Endsley	INVOICE CONTACT: RIC-env@enthalpy.com	SITE NAME: 22B1373
ADDRESS:1941 Reymet Rd, Richmond, VA 23237	INVOICE ADDRESS:	PROJECT NUMBER: 22B1373
PHONE #: 804-358-8295	INVOICE PHONE #:	P.O. #: 80-023556
FAX #:804-358-8297 / EMAIL: ric-env@enthalpy.com		Pretreatment Program:
Is sample for compliance reporting? YES NO	Is sample from a chlorinated supply? YES NO	PWS I.D. #:
SAMPLER NAME (PRINT):	SAMPLER SIGNATURE:	**Turn Around Time:10 Days**

Matrix Codes: WW=Waste Water/Storm Water GW=Ground Water DW=Drinking Water S=Soil/Solids OR=Organic A=Air WP=Wipe OT=Other_____

CLIENT SAMPLE I.D.	Grab	Composite	Field Filtered (Dissolved Metals)	Composite Start Date	Composite Start Time	Grab Date or Composite Stop Date	Grab Time or Composite Stop Time	Time Preserved	Matrix (See Codes)	Number of Containers	ANALYSIS / (PRESERVATIVE): Acute Toxicity - P. Promelas / D. cubia	Please use the following dilutions as discussed: CLE (Outfall 029) = 25%, 45%, 60%, 80%, 100% Crowder Tanks (Outfall 007) = 15%, 25%, 50%, 75%, 100%
1) 22B1373-01: Crowder Tank (007)		X		2.22.22	0000	2.22.22	2359		WW	1		X
2) 22B1373-02: CLE (029)		X		2.22.22	0	2.22.22	2359		WW	1		X
10)												

COMMENTS

Preservative Codes: N=Nitric Acid C=Hydrochloric Acid S=Sulfuric Acid H=Sodium Hydroxide A=Ascorbic Acid Z=Zinc Acetate T=Sodium Thiosulfate M=Methanol

PLEASE NOTE PRESERVATIVE(S), INTERFERENCE CHECKS or PUMP RATE (L/min)

Order #: 2B17001 Date: 2.22.22
Project: Crowder Tank Time: 2359
Sample ID: (007) Taken By: DV
Matrix: NPW Container: Cubitainer
Pres: Cool < 6 °C
Chronic Toxicity sub 2.23.22 AWSL2204-A (1)

Order #: 2B17001 Date: 2.22.22
Project: Time: 2359
Sample ID: CLE(029) Taken By: DV
Matrix: NPW Container: C er
Pres: Cool < 6 °C
Chronic Toxicity sub

22B1373-02 A Due: 03/09/2022 18:00
Non-Potable Water-Cubitainer
AE Systems, Collected: 02/22/2022 23:59
CLE (029)
AWSL 2205-A
22B1373-02 A B

22B1373-01 A Due: 03/09/2022 18:00
Non-Potable Water-Cubitainer
AE Systems, Collected: 02/22/2022 23:59
Crowder Tank (007)
22B1373-01 A B

RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME
JH 2/24/22	0915	Carter Vroman	2/24/22 0915
RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME
		A. Krueger	2/24/22 1100
RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME

QC Data Package
Level I ☐
Level II ☐
Level III ☐
Level IV ☐

LAB USE ONLY

COOLER TEMP 10 °C

TV: AK

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Received: Date Issued: Project Number: Purchase Order:	February 23, 2022 13:12 March 9, 2022 16:01 [none] RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	3-Way Toxicity Split - Coastal		

Sample Conditions Checklist

Samples Received at:	**0.20°C**
How were samples received?	AWS Courier
Were Custody Seals used? If so, were they received intact?	No
Are the custody papers filled out completely and correctly?	Yes
Do all bottle labels agree with custody papers?	Yes
Is the temperature blank or representative sample within acceptable limits or received on ice, and recently taken?	Yes
Are all samples within holding time for requested laboratory tests?	Yes
Is a sufficient amount of sample provided to perform the tests included?	Yes
Are all samples in appropriate containers for the analyses requested?	Yes
Were volatile organic containers received?	No
Are all volatile organic and TOX containers free of headspace?	NA
Is a trip blank provided for each VOC sample set? VOC sample sets include EPA8011, EPA504, EPA8260, EPA624, EPA8015 GRO, EPA8021, EPA524, and RSK-175.	NA
Are all samples received appropriately preserved? Note that metals containers do not require field preservation but lab preservation may delay analysis.	Yes

1941 Reymet Road ● Richmond, Virginia 23237 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Laboratory Order ID 22B1372

Client Name:	BAE Systems, Inc. - RFAAP	Date Received:	February 23, 2022 13:12
	Route 114	Date Issued:	March 14, 2022 15:14
	Radford, VA 24141	Project Number:	[none]
Submitted To:	Sheree Andrews	Purchase Order:	RFAC-032621-01-RLL
Client Site I.D.:	3-Way Toxicity Split - San Diego		

Enclosed are the results of analyses for samples received by the laboratory on 02/23/2022 13:12. If you have any questions concerning this report, please feel free to contact the laboratory.

Sincerely,

Ted Soyars

Technical Director

End Notes:

The test results listed in this report relate only to the samples submitted to the laboratory and as received by the Laboratory.

Unless otherwise noted, the test results for solid materials are calculated on a wet weight basis. Analyses for pH, dissolved oxygen, temperature, residual chlorine and sulfite that are performed in the laboratory do not meet NELAC requirements due to extremely short holding times. These analyses should be performed in the field. The results of field analyses performed by the Sampler included in the Certificate of Analysis are done so at the client's request and are not included in the laboratory's fields of certification nor have they been audited for adherence to a reference method or procedure.

The signature on the final report certifies that these results conform to all applicable NELAC standards unless otherwise specified. For a complete list of the Laboratory's NELAC certified parameters please contact customer service.

This report shall not be reproduced except in full without the expressed and written approval of an authorized representative of Air Water & Soil Laboratories, Inc.

TNI Accredited
VELAP ID 460021

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Received: Date Issued: Project Number: Purchase Order:	February 23, 2022 13:12 March 14, 2022 15:14 [none] RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	3-Way Toxicity Split - San Diego		

ANALYTICAL REPORT FOR SAMPLES

Laboratory Order ID 22B1372

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
Crowder Tank (007)	22B1372-01	Waste Water	02/22/2022 00:00 to 02/22/2022 23:59	02/23/2022 13:12
CLE (029)	22B1372-02	Waste Water	02/22/2022 00:00 to 02/22/2022 23:59	02/23/2022 13:12

Analysis for Toxicity was subcontracted to Enthalpy. The subcontracted results are attached at the end of this Certificate of Analysis.

ENTHALPY ANALYTICAL

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Received: Date Issued: Project Number: Purchase Order:	February 23, 2022 13:12 March 14, 2022 15:14 [none] RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	3-Way Toxicity Split - San Diego		

Laboratory Order ID: 22B1372

Analytical Results

Sample I.D. Crowder Tank (007) **Laboratory Sample ID:** 22B1372-01

Composite Start-End Date/Time: 02/22/2022 00:00 - 02/22/2022 23:59

Field Residual Cl: **Field pH:**

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Subcontracted Analysis									
Acute Toxicity CD	01	EPA	Attached		--	1	03/11/22 08:54	03/11/22 08:54	N/A
Acute Toxicity PP	01	EPA	Attached		--	1	03/11/22 08:54	03/11/22 08:54	N/A

Analytical Results

Sample I.D. CLE (029) **Laboratory Sample ID:** 22B1372-02

Composite Start-End Date/Time: 02/22/2022 00:00 - 02/22/2022 23:59

Field Residual Cl: **Field pH:**

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Subcontracted Analysis									
Acute Toxicity CD	02	EPA	Attached		--	1	03/11/22 08:54	03/11/22 08:54	N/A
Acute Toxicity PP	02	EPA	Attached		--	1	03/11/22 08:54	03/11/22 08:54	N/A

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Received: Date Issued: Project Number: Purchase Order:	February 23, 2022 13:12 March 14, 2022 15:14 [none] RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	3-Way Toxicity Split - San Diego		

Analytical Summary

Sample ID	Preparation Factors Initial / Final	Method	Batch ID	Sequence ID	Calibration ID
Subcontracted Analysis		**Preparation Method:**	***** DEFAULT PREP *****		
22B1372-01	1.00 mL / 1.00 mL	EPA	BFC0470		
22B1372-02	1.00 mL / 1.00 mL	EPA	BFC0470		

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Received: Date Issued: Project Number: Purchase Order:	February 23, 2022 13:12 March 14, 2022 15:14 [none] RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	3-Way Toxicity Split - San Diego		

Certified Analyses included in this Report

Analyte **Certifications**

Code	Description	Laboratory ID	Expires
MADEP	Massachusetts DEP	M-VA913	06/30/2022
MdDOE	Maryland DE Drinking Water	341	12/31/2022
NC	North Carolina DENR	495	07/31/2022
NCDEQ	North Carolina DEQ	495	12/31/2022
NCDOH	North Carolina Department of Health	51714	07/31/2022
NJDEP	NELAP-New Jersey DEP	VA015	06/30/2022
NYDOH	New York DOH Drinking Water	12096	04/01/2022
PADEP	NELAP-Pennsylvania Certificate #007	68-03503	10/31/2022
VELAP	NELAP-Virginia Certificate #11539	460021	06/14/2022

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Received: Date Issued: Project Number: Purchase Order:	February 23, 2022 13:12 March 14, 2022 15:14 [none] RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	3-Way Toxicity Split - San Diego		

Summary of Data Qualifiers

Attached	Attached
RPD	Relative Percent Difference
Qual	Qualifers
-RE	Denotes sample was re-analyzed
D.F.	Dilution Factor. Please also see the Preparation Factor in the Analysis Summary section.
TIC	Tentatively Identified Compounds are compounds that are identified by comparing the analyte mass spectral pattern with the NIST spectral library. A TIC spectral match is reported when the pattern is at least 75% consistent with the published pattern. Compound concentrations are estimated and are calculated using an internal standard response factor of 1.
PCBs, Total	Total PCBs are defined as the sum of detected Aroclors 1016, 1221, 1232, 1248, 1254, 1260, 1262, and 1268.

ENTHALPY ANALYTICAL
formerly *Air, Water & Soil Laboratories*

1941 REYMET ROAD
RICHMOND, VIRGINIA 23237
(804) 358-8295 PHONE
(804)358-8297 FAX

Chain of Custody
Effective: Nov 15, 2018

CHAIN OF CUSTODY

COMPANY NAME: BAE Systems, Inc. - RFAAP	INVOICE TO: Accounts Payable	PROJECT NAME: 3-Way Toxicity Split - San Diego
CONTACT: Ashley Bandy	INVOICE CONTACT:	SITE NAME:
ADDRESS: Route 114 Radford, Va 24141	INVOICE ADDRESS:	PROJECT NUMBER:
PHONE #: 1-540-639-7034	INVOICE PHONE #:	P.O. #:
FAX #: EMAIL: ashley.bandy@baesystems.com		Pretreatment Program:
Is sample for compliance reporting? No	Regulatory State: Va / Is sample from a chlorinated supply? NO	PWS I.D. #:
SAMPLER NAME (PRINT): Denise Vaughn	SAMPLER SIGNATURE: Denise Vaughn	Turn Around Time: Circle 10 5 Days or _Day(s)

Matrix Codes: WW=Waste Water/Storm Water GW=Ground Water DW=Drinking Water S=Soil/Solids OR=Organic A=Air WP=Wipe OT=Other_____

CLIENT SAMPLE I.D.	Grab	Composite	Field Filtered (Dissolved Metals)	Composite Start Date	Composite Start Time	Grab Date or Composite Stop Date	Grab Time or Composite Stop Time	Time Preserved 2.23.22	Matrix (See Codes)	Number of Containers	ANALYSIS / (PRESERVATIVE): Acute Toxicity - Ceriodaphnia dubia	Acute Toxicity - Pimephales							COMMENTS: Preservative Codes: N=Nitric Acid C=Hydrochloric Acid S=Sulfuric Acid H=Sodium Hydroxide A=Ascorbic Acid Z=Zinc Acetate T=Sodium Thiosulfate M=Methanol; PLEASE NOTE PRESERVATIVE(S), INTERFERENCE CHECKS or PUMP RATE (L/min)
1) Crowder Tank (007)		X		2.22.22	0000	2.22.22	2359	0815	WW	1	x	x		15%, 25%, 50%, 75%, 100% Dilutions					
2) CLE (029)		x		2.22.22	0000	2.22.22	2359	0830	WW	1	x	x		25%, 45%, 60%, 80%, 100% Dilutions					
3)																			
4)																			
5)																			
6)																			
7)																			
8)																			
9)																			
10)																			

All tests are to be set up and run on Thursday, Feb. 24, 2022

RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME
Denise Vaughn	2.23.22/0841	[signature]	2/23/22 0841
[signature] 2/23/22	1312	[signature] 2/23/22	1312

QC Data Package
Level III ☐
Level IV ☐

LAB USE ONLY Therm ID: 271 COOLER TEMP 0.2 °C
Custody Seals used and intact? (Y / N) Received on ice? (Y / N)

22B1372

BAE Systems, Inc. 22B1372
Toxicity - Feb 2022 Split Sample
Recd: 02/23/2022 Due: 03/09/2022

v130325002 JC 02-22-22

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Received: Date Issued: Project Number: Purchase Order:	February 23, 2022 13:12 March 14, 2022 15:14 [none] RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	3-Way Toxicity Split - San Diego		

Sample Conditions Checklist

Samples Received at:	**0.20°C**
How were samples received?	AWS Courier
Were Custody Seals used? If so, were they received intact?	No
Are the custody papers filled out completely and correctly?	Yes
Do all bottle labels agree with custody papers?	Yes
Is the temperature blank or representative sample within acceptable limits or received on ice, and recently taken?	Yes
Are all samples within holding time for requested laboratory tests?	Yes
Is a sufficient amount of sample provided to perform the tests included?	Yes
Are all samples in appropriate containers for the analyses requested?	Yes
Were volatile organic containers received?	No
Are all volatile organic and TOX containers free of headspace?	NA
Is a trip blank provided for each VOC sample set? VOC sample sets include EPA8011, EPA504, EPA8260, EPA624, EPA8015 GRO, EPA8021, EPA524, and RSK-175.	NA
Are all samples received appropriately preserved? Note that metals containers do not require field preservation but lab preservation may delay analysis.	Yes

ENTHALPY ANALYTICAL
TOXICITY LABORATORY & CONSULTING

Toxicity Test Results for BAE Systems

Sample Collection Date: February 22, 2022

Prepared for: BAE Systems (C/O Enthalpy Analytical South Richmond/AWS)

Testing Lab: Enthalpy Analytical San Diego
4340 Vandever Avenue
San Diego, CA 92120

Submitted: March 10, 2022

Data Quality Assurance:

- Enthalpy Analytical is accredited in accordance with NELAP by the State of Oregon Environmental Laboratory Accreditation Program (Certificate No. 4053). It is also certified by the State of California Department of Health Services Environmental Laboratory Accreditation Program (Certificate No. 1802) and the State of Washington Department of Ecology (Lab ID C552).
- All data have been reviewed and verified.
- All test results have met minimum test acceptability criteria under their respective EPA protocols, unless otherwise noted in this report.
- All results have met internal Quality Assurance Program requirements.

Data Verified by: Peter Arthur

California
4340 Vandever Ave
San Diego, CA 92120
858.587.7333

Introduction

Two wastewater samples were collected for whole effluent toxicity (WET) analysis and shipped from Enthalpy Analytical South Richmond (formerly AWS). Testing was conducted at the Enthalpy Analytical Laboratory in San Diego, California using the fathead minnow (*Pimephales promelas*) and water flea (*Ceriodaphnia dubia*) acute survival tests.

Materials and Methods

Sample Information

Client:	BAE Systems
Sample IDs:	1. 22B1372-1: Crowder Tank (Outfall 007) 2. 22B1372-2: CLE (Outfall 029)
Sample Collection Date, Time[a]:	1. 2/22/22, 20:59 (PST) 2. 2/22/22, 20:59 (PST)
Sample Receipt Date, Time:	2/24/22, 10:55
Sampling Method:	Composite

[a] Collection times converted to Pacific Standard Time from Eastern Standard Time

Table 1. Water Quality Parameters

Sample ID	pH	DO (mg/L)	Temp. (ºC)	Conductivity (µS/cm)	Alkalinity (mg/L)	Hardness (mg/L)	Total Chlorine (mg/L)
Outfall 007	7.02	10.7	1.5	1,521	19	630	<0.02
Outfall 029	7.58	8.4	1.9	815	179	119	0.04

DO = dissolved oxygen; Temp. = temperature

48hr Fathead Minnow Acute Survival Test Specifications

Test Start Date, Time:	Outfall 007- 2/24/22, 15:40
	Outfall 029- 2/24/22, 14:55
Test End Date, Time:	Outfall 007- 2/26/22, 14:50
	Outfall 029- 2/26/22, 14:55
Test Organism:	*Pimephales promelas* (fathead minnow)
Test Endpoint:	48-hour survival
Test Organism Source:	Aquatic Biosystems (Fort Collins, CO)
Lab Control:	Diluted mineral water (8:2)
Test Concentrations:	Outfall 007- 100, 75, 50, 25, 15%, plus lab control
	Outfall 029- 100, 80, 60, 45, 25%, plus lab control
Protocol Used:	EPA-821-R-02-012 (USEPA, 2002)
Acceptability Criteria:	Mean control survival ≥ 90%
Statistical Analysis Software:	CETIS™, version 1.8.7.20

48hr Water Flea Acute Survival Test Specifications

Test Start Date, Time:	Outfall 007- 2/24/22, 15:50
	Outfall 029- 2/24/22, 15:50
Test End Date, Time:	Outfall 007- 2/26/22, 14:00
	Outfall 029- 2/26/22, 14:25
Test Organism:	*Ceriodaphnia dubia* (water flea)
Test Endpoint:	48-hour survival
Test Organism Source:	In-house culture
Lab Control:	Diluted mineral water (8:2)
Test Concentrations:	Outfall 007- 100, 75, 50, 25, 15%, plus lab control
	Outfall 029- 100, 80, 60, 45, 25%, plus lab control
Protocol Used:	EPA-821-R-02-012 (USEPA, 2002)
Acceptability Criteria:	Mean control survival ≥ 90%
Statistical Analysis Software:	CETIS™, version 1.8.7.20

Statistical Analysis

Statistical analyses were conducted using EPA flowchart specifications as outlined in the test guidance manual (USEPA 2002). Organism performance in the samples was compared to that observed in the concurrent lab controls. Results were used to calculate whether a statistically significant effect was observed between the control and sample result. Results are reported as No Effect Concentration (NOEC), median lethal concentration (LC_{50}), and acute toxic unit (TU_a). Statistical analyses were performed using the Comprehensive Environmental Toxicity Information System™ (CETIS) software by Tidepool Scientific Software, version 1.8.7.20.

Results

There were no statistically significant effects detected in the Outfall 007 sample for either species tested. The resulting NOEC is 100 percent, and the TU_a is calculated as less than 1.0.

There were statistically significant effects detected for the Outfall 029 sample in the 45, 60, 80, and 100 percent concentrations for both species. The resulting NOEC is 25 percent, and TU_a values are 2.0 and 2.6 for fathead minnows and water fleas, respectively.

Results are summarized in Tables 2 and 3. The raw test data and statistical analysis are presented in full in Appendix A. Sample receipt information and the chain-of-custody (COC) form can be found in Appendices B and C, respectively.

Table 2. Summary of Acute Toxicity Test Results – Outfall 007

Species	Concentration (%)	Mean Survival (%)	NOEC (% effluent)	LC_{50} (% effluent)	TU_a
Fathead Minnow	0.0	100	100	>100	<1.0
	15	100			
	25	100			
	50	97.5			
	75	100			
	100	100			
Water Flea	0.0	100	100	>100	<1.0
	15	100			
	25	100			
	50	100			
	75	80.0			
	100	70.0			

NOEC = No Observed Effect Concentration
LOEC = Lowest Observed Effect Concentration
LC_{50} = Concentration estimated to be Lethal to 50 percent of test organisms
TU_a = Acute toxic unit, calculated as $100/LC_{50}$

Table 3. Summary of Acute Toxicity Test Results – Outfall 029

Species	Concentration (%)	Mean Survival (%)	NOEC (% effluent)	LC_{50} (% effluent)	TU_a
Fathead Minnow	0.0	97.5	25	50.6	2.0
	25	97.5			
	45	**80.0**			
	60	**17.5**			
	80	**0.00**			
	100	**0.00**			
Water Flea	0.0	100	25	38.5	2.6
	25	85.0			
	45	**40.0**			
	60	**0.00**			
	80	**0.00**			
	100	**0.00**			

A **bold** value indicates a statistically significant difference from the control
NOEC = No Observed Effect Concentration
LOEC = Lowest Observed Effect Concentration
LC_{50} = Concentration estimated to be Lethal to 50 percent of test organisms
TU_a = Acute toxic unit, calculated as $100/LC_{50}$

Quality Assurance

The samples were received in good condition and within the recommended temperature range of 0-6°C. However, both samples arrived outside of the 36-hour holding time requirement. Tests were initiated 42 to 43 hours from the time of collection. The holding time exceedance was approved prior to receiving the samples and tests were initiated the same day the samples were received.

The mean control response met minimum test acceptability criteria. All test procedures followed protocol requirements, and the statistical analyses followed standard USEPA flowchart selections. Minor QA/QC issues that were not likely to have any bearing on the test results are noted on the data sheets, and a list of data qualifier codes is available in Appendix D.

Reference Toxicant Test

The monthly reference toxicant tests met all test control acceptability criteria. The calculated LC_{50} values were within two standard deviations of the historical mean for the laboratory, which indicates the test organisms were exhibiting typical sensitivity to copper. Results for the reference toxicant tests used to monitor laboratory performance and test organism sensitivity are summarized in Table 4, and presented in full in Appendix E.

Table 4. Summary of Reference Toxicant Test Results

Test Species and Endpoints	NOEC (µg/L copper)	LC_{50} (µg/L copper)	Historical Mean ± 2SD (µg/L copper)	CV (%)
Fathead Minnow 96-hr Acute Survival	<15	32.6	79.0 ± 72.1	45.6
Water Flea 48-hr Acute Survival	10	16.3	20.3 ± 10.8	26.5

NOEC = the highest concentration tested that produces no observed effect

LC_{50} = the concentration expected to cause a lethal effect to 50% of the test organisms

Historical Mean ± 2SD = the mean LC_{50} value from the 20 previous reference toxicant tests conducted at Enthalpy, plus or minus two standard deviations

CV = coefficient of variation

References

Tidepool Scientific Software. 2000-2013. CETIS Comprehensive Environmental Toxicity Information System Software, Version 1.8.7.20.

USEPA. 2002. Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms. EPA/821/R-02/012, October 2002.

Appendix A

Raw Data and Statistical Analysis

Outfall 007

Fathead Minnow Acute Test

CETIS Summary Report

Report Date:	09 Mar-22 12:08 (p 1 of 1)
Test Code:	2202-S034 | 05-4545-5728

Fathead Minnow 48-h Acute Survival Test — **Nautilus Environmental (CA)**

Batch ID:	08-9153-0738	**Test Type:**	Survival (48h)	**Analyst:**	
Start Date:	24 Feb-22 15:40	**Protocol:**	EPA/821/R-02-012 (2002)	**Diluent:**	Diluted Mineral Water (8:2)
Ending Date:	26 Feb-22 14:50	**Species:**	Pimephales promelas	**Brine:**	Not Applicable
Duration:	47h	**Source:**	Aquatic Biosystems, CO	**Age:**	6d

Sample ID:	00-6422-5798	**Code:**	22-0224	**Client:**	BAE Systems
Sample Date:	22 Feb-22 20:59	**Material:**	Effluent Sample	**Project:**	Laboratory Split Study
Receive Date:	24 Feb-22 10:55	**Source:**	BAE Systems		
Sample Age:	43h (1.5 °C)	**Station:**	Outfall 007 (2281372-1; Crowder Tank)		

Comparison Summary

Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method
20-6688-8003	48h Survival Rate	100	>100	NA	4.57%	1	Steel Many-One Rank Sum Test

Point Estimate Summary

Analysis ID	Endpoint	Level	%	95% LCL	95% UCL	TU	Method
00-3653-7969	48h Survival Rate	EC50	>100	N/A	N/A	<1	Linear Interpolation (ICPIN)

48h Survival Rate Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Lab Control	4	1	1	1	1	1	0	0	0.0%	0.0%
15		4	1	1	1	1	1	0	0	0.0%	0.0%
25		4	1	1	1	1	1	0	0	0.0%	0.0%
50		4	0.975	0.8954	1	0.9	1	0.025	0.05	5.13%	2.5%
75		4	1	1	1	1	1	0	0	0.0%	0.0%
100		4	1	1	1	1	1	0	0	0.0%	0.0%

48h Survival Rate Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Control	1	1	1	1
15		1	1	1	1
25		1	1	1	1
50		1	1	0.9	1
75		1	1	1	1
100		1	1	1	1

CETIS Analytical Report

Report Date: 09 Mar-22 12:08 (p 1 of 2)
Test Code: 2202-S034 | 05-4545-5728

Fathead Minnow 48-h Acute Survival Test — **Nautilus Environmental (CA)**

Analysis ID:	20-6688-8003	**Endpoint:**	48h Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	28 Feb-22 15:07	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	NOEL	LOEL	TOEL	TU
Angular (Corrected)	NA	C > T	NA	NA	4.57%	100	>100	NA	1

Steel Many-One Rank Sum Test

Control	vs	C-%	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)
Lab Control		15	18	10	1	6	0.8333	Asymp	Non-Significant Effect
		25	18	10	1	6	0.8333	Asymp	Non-Significant Effect
		50	16	10	1	6	0.6105	Asymp	Non-Significant Effect
		75	18	10	1	6	0.8333	Asymp	Non-Significant Effect
		100	18	10	1	6	0.8333	Asymp	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.005533194	0.001106639	5	1	0.4457	Non-Significant Effect
Error	0.0199195	0.001106639	18			
Total	0.02545269		23			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Mod Levene Equality of Variance	1	4.248	0.4457	Equal Variances
Variances	Levene Equality of Variance	9	4.248	0.0002	Unequal Variances
Distribution	Shapiro-Wilk W Normality	0.4634	0.884	<0.0001	Non-normal Distribution

48h Survival Rate Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Lab Control	4	1	1	1	1	1	1	0	0.0%	0.0%
15		4	1	1	1	1	1	1	0	0.0%	0.0%
25		4	1	1	1	1	1	1	0	0.0%	0.0%
50		4	0.975	0.8954	1	1	0.9	1	0.025	5.13%	2.5%
75		4	1	1	1	1	1	1	0	0.0%	0.0%
100		4	1	1	1	1	1	1	0	0.0%	0.0%

Angular (Corrected) Transformed Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Lab Control	4	1.412	1.412	1.412	1.412	1.412	1.412	0	0.0%	0.0%
15		4	1.412	1.412	1.412	1.412	1.412	1.412	0	0.0%	0.0%
25		4	1.412	1.412	1.412	1.412	1.412	1.412	0	0.0%	0.0%
50		4	1.371	1.242	1.501	1.412	1.249	1.412	0.04074	5.94%	2.89%
75		4	1.412	1.412	1.412	1.412	1.412	1.412	0	0.0%	0.0%
100		4	1.412	1.412	1.412	1.412	1.412	1.412	0	0.0%	0.0%

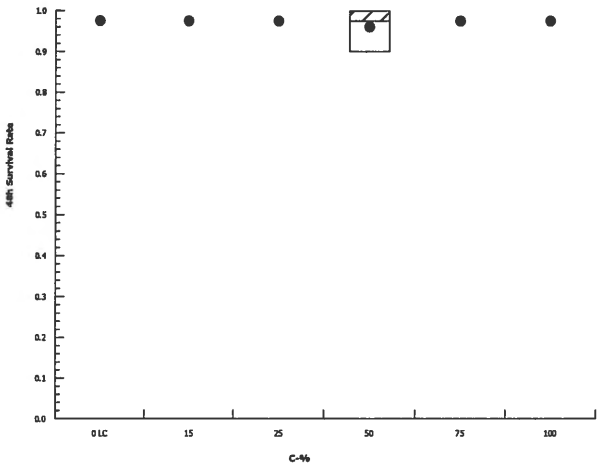
CETIS Analytical Report

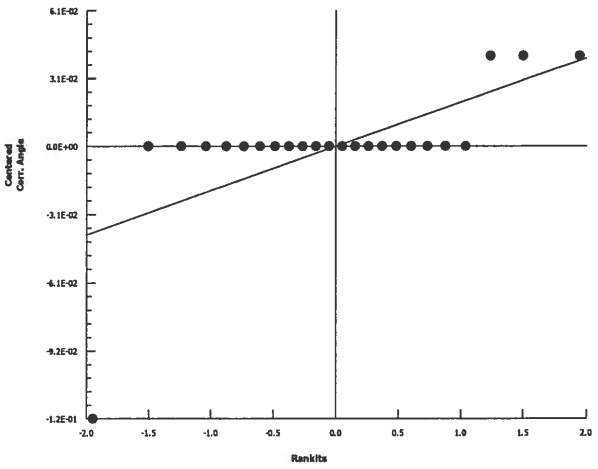
Report Date:	09 Mar-22 12:08 (p 2 of 2)
Test Code:	2202-S034 | 05-4545-5728

Fathead Minnow 48-h Acute Survival Test — **Nautilus Environmental (CA)**

Analysis ID:	20-6688-8003	**Endpoint:**	48h Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	28 Feb-22 15:07	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Graphics





CETIS Analytical Report

Report Date:	09 Mar-22 12:08 (p 1 of 1)
Test Code:	2202-S034 | 05-4545-5728

Fathead Minnow 48-h Acute Survival Test — **Nautilus Environmental (CA)**

Analysis ID:	00-3653-7969	**Endpoint:**	48h Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	09 Mar-22 12:08	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Linear	Linear	387874	1000	Yes	Two-Point Interpolation

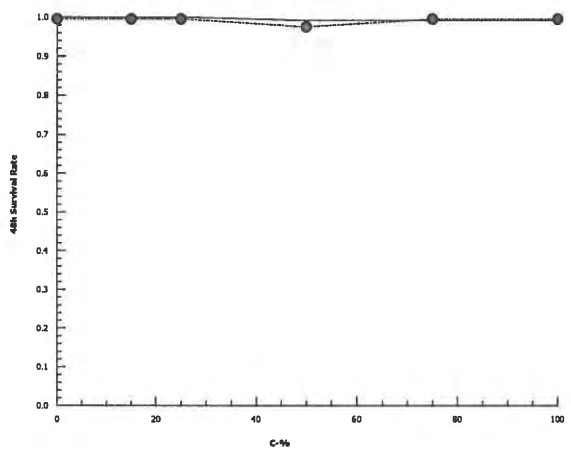
Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
EC50	>100	N/A	N/A	<1	NA	NA

48h Survival Rate Summary

			Calculated Variate(A/B)								
C-%	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
0	Lab Control	4	1	1	1	0	0	0.0%	0.0%	40	40
15		4	1	1	1	0	0	0.0%	0.0%	40	40
25		4	1	1	1	0	0	0.0%	0.0%	40	40
50		4	0.975	0.9	1	0.025	0.05	5.13%	2.5%	39	40
75		4	1	1	1	0	0	0.0%	0.0%	40	40
100		4	1	1	1	0	0	0.0%	0.0%	40	40

Graphics



48-hour Freshwater Acute Bioassay
Static-Renewal Conditions
DF-007

Water Quality Measurements
& Test Organism Survival

Client: BAE Systems
Sample ID: Outfall 007 (22B1372-1: Crowder Tank)
Sample Log-in No.: 22-0224
Test No.: 2202-5034

Test Species: *P. promelas*
Start Date/Time: (A) 2/24/22 ~~2/18/2022~~ 1540 Q11
End Date/Time: (A) 2/26/22 ~~2/18/2022~~ 1450

	Tech Initials		
	0	24	48
Counts:	GM	RT	HH
Readings:	HH	RT	HH
Dilutions made by:	GM	–	–

Concentration %	Rep	Number of Live Organisms			Conductivity (µmhos/cm)			Temperature (°C)			Dissolved Oxygen (mg/L) Q14			pH (units)		
		0	24	48	0	24	48	0	24	48	0	24	48	0	24	48
Lab Control	A	10	10	10	192	192	200	19.4	19.4	19.6	8.9	~~6.9~~ (A)	8.6	8.11	7.85	7.83
	B	10	10	10								8.3				
	C	10	10	10												
	D	10	10	10												
15	A	10	10	10	406	388	396	19.4	19.7	19.8	9.0	~~6.7~~ (B)	8.3	7.97	7.68	7.69
	B	10	10	10								8.1				
	C	10	10	10												
	D	10	10	10												
25	A	10	10	10	538	511	522	19.4	19.7	19.9	9.1	~~6.3~~ (B)	7.8	7.92	7.60	7.60
	B	10	10	10								8.0				
	C	10	10	10												
	D	10	10	10												
50	A	10	10	10	846	835	853	19.3	19.7	19.8	9.1	~~6.0~~ (B)	7.4	7.77	7.45	7.40
	B	10	10	10								7.5				
	C	10	10	9												
	D	10	10	10												
75	A	10	10	10	1206	1132	1157	19.4	19.7	19.8	9.2	~~5.7~~ (B)	7.2	7.61	7.36	7.36
	B	10	10	10								7.2				
	C	10	10	10												
	D	10	10	10												
100	A	10	10	10	1528	1440	1474	19.4	19.6	19.7	9.3	~~5.8~~ (B)	7.1	7.31	7.27	7.20
	B	10	10	10								7.2				
	C	10	10	10												
	D	10	10	10												

Initial Counts QC'd by: HH
Initiated by: GM

Environmental Chamber: C

Animal Source/Date Received: ABS 2/23/22

Age at Initiation: 6 days

Animal Acclimation Qualifiers (circle all that apply): ~~Q22~~ (C) / Q23 / Q24 / none

Comments: Organisms fed prior to initiation, circle one (y / n)
(A) Q18 HH 2/21/22 (B) Q18 RT 2/25/22 (C) Q18 AIS 3/8/22

QC Check: JL 2/28/22

Final Review: AIS 3/8/22

Water Flea Acute Test

CETIS Summary Report

Report Date: 09 Mar-22 12:06 (p 1 of 1)
Test Code: 2202-S035 | 17-5207-7239

Ceriodaphnia 48-h Acute Survival Test — **Nautilus Environmental (CA)**

Batch ID:	02-8194-5814	**Test Type:**	Survival (48h)	**Analyst:**	
Start Date:	24 Feb-22 15:50	**Protocol:**	EPA/821/R-02-012 (2002)	**Diluent:**	Diluted Mineral Water (8:2)
Ending Date:	26 Feb-22 14:00	**Species:**	Ceriodaphnia dubia	**Brine:**	Not Applicable
Duration:	46h	**Source:**	In-House Culture	**Age:**	<24h

Sample ID:	02-1048-1248	**Code:**	22-0224	**Client:**	BAE Systems
Sample Date:	22 Feb-22 20:59	**Material:**	Effluent Sample	**Project:**	Laboratory Split Study
Receive Date:	24 Feb-22 10:55	**Source:**	BAE Systems		
Sample Age:	211 43h (1.5 °C)	**Station:**	Outfall 007 (22B1372-1, Crowder tank)		

Comparison Summary

Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method
09-1298-9025	48h Survival Rate	100	>100	NA	19.9%	1	Steel Many-One Rank Sum Test

Point Estimate Summary

Analysis ID	Endpoint	Level	%	95% LCL	95% UCL	TU	Method
17-1456-8400	48h Survival Rate	EC50	>100	N/A	N/A	<1	Linear Interpolation (ICPIN)

Test Acceptability

Analysis ID	Endpoint	Attribute	Test Stat	TAC Limits	Overlap	Decision
09-1298-9025	48h Survival Rate	Control Resp	1	0.9 - NL	Yes	Passes Acceptability Criteria
17-1456-8400	48h Survival Rate	Control Resp	1	0.9 - NL	Yes	Passes Acceptability Criteria

48h Survival Rate Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Lab Control	4	1	1	1	1	1	0	0	0.0%	0.0%
15		4	1	1	1	1	1	0	0	0.0%	0.0%
25		4	1	1	1	1	1	0	0	0.0%	0.0%
50		4	1	1	1	1	1	0	0	0.0%	0.0%
75		4	0.8	0.5402	1	0.6	1	0.08165	0.1633	20.41%	20.0%
100		4	0.7	0.2891	1	0.4	1	0.1291	0.2582	36.89%	30.0%

48h Survival Rate Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Control	1	1	1	1
15		1	1	1	1
25		1	1	1	1
50		1	1	1	1
75		0.6	0.8	1	0.8
100		1	0.4	0.6	0.8

CETIS Analytical Report

Report Date: 09 Mar-22 12:06 (p 1 of 2)
Test Code: 2202-S035 | 17-5207-7239

Ceriodaphnia 48-h Acute Survival Test — **Nautilus Environmental (CA)**

Analysis ID: 09-1298-9025 **Endpoint:** 48h Survival Rate **CETIS Version:** CETISv1.8.7
Analyzed: 28 Feb-22 14:57 **Analysis:** Nonparametric-Control vs Treatments **Official Results:** Yes

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	NOEL	LOEL	TOEL	TU
Angular (Corrected)	NA	C > T	NA	NA	19.9%	100	>100	NA	1

Steel Many-One Rank Sum Test

Control	vs	C-%	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)
Lab Control		15	18	10	1	6	0.8333	Asymp	Non-Significant Effect
		25	18	10	1	6	0.8333	Asymp	Non-Significant Effect
		50	18	10	1	6	0.8333	Asymp	Non-Significant Effect
		75	12	10	1	6	0.1424	Asymp	Non-Significant Effect
		100	12	10	1	6	0.1424	Asymp	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.4606044	0.09212087	5	4.759	0.0060	Significant Effect
Error	0.3484544	0.01935858	18			
Total	0.8090588		23			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Mod Levene Equality of Variance	6.085	4.248	0.0018	Unequal Variances
Variances	Levene Equality of Variance	6.268	4.248	0.0016	Unequal Variances
Distribution	Shapiro-Wilk W Normality	0.7101	0.884	<0.0001	Non-normal Distribution

48h Survival Rate Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Lab Control	4	1	1	1	1	1	1	0	0.0%	0.0%
15		4	1	1	1	1	1	1	0	0.0%	0.0%
25		4	1	1	1	1	1	1	0	0.0%	0.0%
50		4	1	1	1	1	1	1	0	0.0%	0.0%
75		4	0.8	0.5402	1	0.8	0.6	1	0.08165	20.41%	20.0%
100		4	0.7	0.2891	1	0.7	0.4	1	0.1291	36.89%	30.0%

Angular (Corrected) Transformed Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Lab Control	4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
15		4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
25		4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
50		4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
75		4	1.111	0.813	1.41	1.107	0.8861	1.345	0.09377	16.87%	17.38%
100		4	1.006	0.553	1.459	0.9966	0.6847	1.345	0.1423	28.29%	25.23%

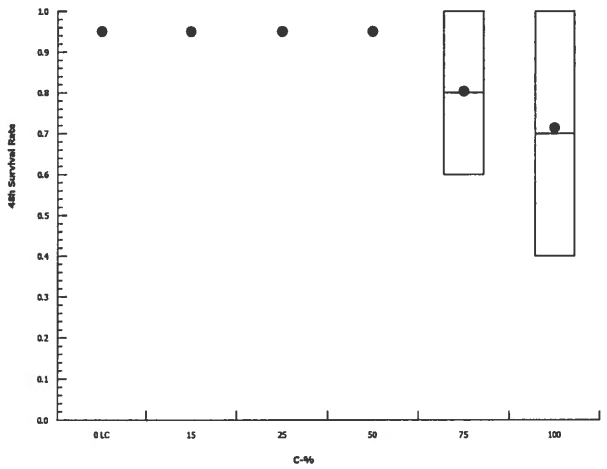
CETIS Analytical Report

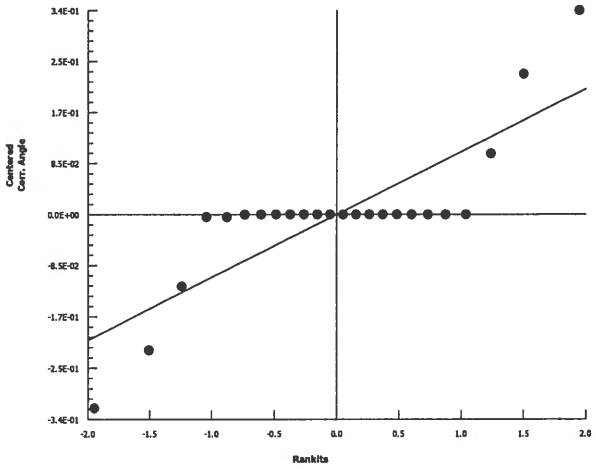
Report Date:	09 Mar-22 12:06 (p 2 of 2)
Test Code:	2202-S035 | 17-5207-7239

Ceriodaphnia 48-h Acute Survival Test — **Nautilus Environmental (CA)**

Analysis ID:	09-1298-9025	**Endpoint:**	48h Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	28 Feb-22 14:57	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Graphics





CETIS Analytical Report

Report Date:	09 Mar-22 12:06 (p 1 of 1)
Test Code:	2202-S035 | 17-5207-7239

Ceriodaphnia 48-h Acute Survival Test — **Nautilus Environmental (CA)**

Analysis ID:	17-1456-8400	**Endpoint:**	48h Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	09 Mar-22 12:02	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Linear	Linear	1878453	1000	Yes	Two-Point Interpolation

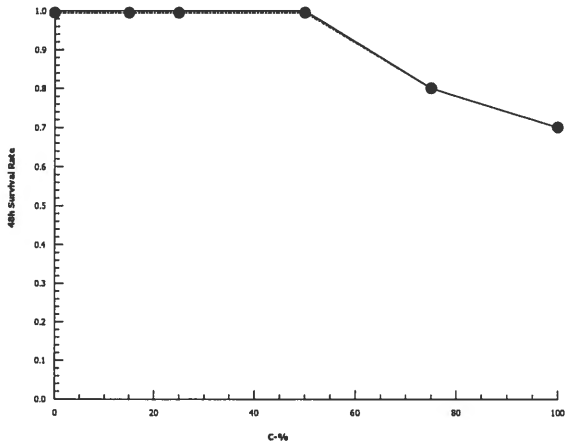
Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
EC50	>100	N/A	N/A	<1	NA	NA

48h Survival Rate Summary

			Calculated Variate(A/B)								
C-%	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
0	Lab Control	4	1	1	1	0	0	0.0%	0.0%	20	20
15		4	1	1	1	0	0	0.0%	0.0%	20	20
25		4	1	1	1	0	0	0.0%	0.0%	20	20
50		4	1	1	1	0	0	0.0%	0.0%	20	20
75		4	0.8	0.6	1	0.08165	0.1633	20.41%	20.0%	16	20
100		4	0.7	0.4	1	0.1291	0.2582	36.89%	30.0%	14	20

Graphics



48-hour Freshwater Acute Bioassay
Static-Renewal Conditions
DF-007

Water Quality Measurements
& Test Organism Survival

Client: BAE Systems
Sample ID: Outfall 007 (2201372-1: Crowder Tank)
Sample Log-in No.: 22- 0224
Test No.: 2202-5635

Test Species: *C. dubia*
Start Date/Time: (B) ~~2/8/2022~~ 2/24/22 1550 Q11
End Date/Time: (A) ~~2/8/2022~~ 2/26/22 1400

	Tech Initials		
	0	24	48
Counts:	HM	RT	HM
Readings:	HM	RT	KL
Dilutions made by:	GM	--	--

Concentration %	Rep	Number of Live Organisms			Conductivity (µmhos/cm)			Temperature (°C)			Dissolved Oxygen (mg/L) Q14			pH (units)		
		0	24	48	0	24	48	0	24	48	0	24 (B)	48	0	24	48
Lab Control	A	5	5	5	194	201	214	19.5	19.8	19.6	9.1	~~7.4~~	7.7	7.96	7.82	8.06
	B	5	5	5								9.0				
	C	5	5	5												
	D	5	5	5								(B)				
15	A	5	5	5	431	416	430	19.3	19.7	19.6	9.1	~~7.4~~	7.7	7.85	7.67	8.00
	B	5	5	5								9.0				
	C	5	5	5												
	D	5	5	5								(B)				
25	A	5	5	5	548	529	534	19.6	19.6	19.6	9.2	~~7.3~~	8.0	7.81	7.61	7.97
	B	5	5	5								8.8				
	C	5	5	5												
	D	5	5	5								(B)				
50	A	5	5	5	876	845	842	19.8	19.6	19.6	9.2	~~7.0~~	8.1	7.68	7.48	7.84
	B	5	5	5								8.6				
	C	5	5	5												
	D	5	5	5								(B)				
75	A	5	5	3	1200	1162	1159	19.7	19.6	19.6	9.2	~~7.0~~	7.9	7.52	7.40	7.68
	B	5	5	4								8.6				
	C	5	5	5												
	D	5	5	4								(B)				
100	A	5	5	5	1522	1478	1465	19.8	19.5	19.6	9.3	~~6.9~~	7.8	7.20	7.27	7.52
	B	5	5	2								8.4				
	C	5	5	3												
	D	5	5	4												

Initial Counts QC'd by: KL
Initiated by: HM
Environmental Chamber: C

Animal Source/Date Received: Internal / N/A
Age at Initiation: 424 hours

Animal Acclimation Qualifiers (circle all that apply): Q22 / Q23 / Q24 / none

Comments: Organisms fed prior to initiation, circle one (y n)
(A) Q18 HM 2/21/22 (B) Q18 LK 2/25/22

QC Check: JL 2/28/22
Final Review: AS 3/8/22

Outfall 029

Fathead Minnow Acute Test

CETIS Summary Report

Report Date:	09 Mar-22 12:12 (p 1 of
Test Code:	2202-S032 | 03-2121-70

Fathead Minnow 48-h Acute Survival Test — **Nautilus Environmental (CA**

Batch ID:	06-9012-4800	**Test Type:**	Survival (48h)	**Analyst:**	
Start Date:	24 Feb-22 14:55	**Protocol:**	EPA/821/R-02-012 (2002)	**Diluent:**	Diluted Mineral Water (8:2)
Ending Date:	26 Feb-22 14:55	**Species:**	Pimephales promelas	**Brine:**	Not Applicable
Duration:	48h	**Source:**	Aquatic Biosystems, CO	**Age:**	6d

Sample ID:	14-6006-9006	**Code:**	22-0223	**Client:**	BAE Systems
Sample Date:	22 Feb-22 20:59	**Material:**	Effluent Sample	**Project:**	Laboratory Split Study
Receive Date:	24 Feb-22 10:55	**Source:**	BAE Systems		
Sample Age:	0-11 42h (1.9 °C)	**Station:**	Outfall 029 (2201372-2:CLE)		

Comparison Summary

Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method
11-2855-8040	48h Survival Rate	25	45	33.54	14.7%	4	Dunnett Multiple Comparison Test

Point Estimate Summary

Analysis ID	Endpoint	Level	%	95% LCL	95% UCL	TU	Method
19-4233-0558	48h Survival Rate	EC50	50.58	47.47	53.9	1.977	Spearman-Kärber

48h Survival Rate Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Lab Control	4	0.975	0.8954	1	0.9	1	0.025	0.05	5.13%	0.0%
25		4	0.975	0.8954	1	0.9	1	0.025	0.05	5.13%	0.0%
45		4	0.8	0.5095	1	0.6	1	0.09129	0.1826	22.82%	17.95%
60		4	0.175	0.09544	0.2546	0.1	0.2	0.025	0.05	28.57%	82.05%
80		4	0	0	0	0	0	0	0		100.0%
100		4	0	0	0	0	0	0	0		100.0%

48h Survival Rate Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Control	1	1	0.9	1
25		1	1	0.9	1
45		0.6	0.9	0.7	1
60		0.1	0.2	0.2	0.2
80		0	0	0	0
100		0	0	0	0

CETIS Analytical Report

Report Date: 09 Mar-22 12:12 (p 1 of
Test Code: 2202-S032 | 03-2121-70

Fathead Minnow 48-h Acute Survival Test — Nautilus Environmental (C

Analysis ID:	11-2855-8040	**Endpoint:**	48h Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	28 Feb-22 15:03	**Analysis:**	Parametric-Control vs Treatments	**Official Results:**	Yes

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	NOEL	LOEL	TOEL	TU
Angular (Corrected)	NA	C > T	NA	NA	14.7%	25	45	33.54	4

Dunnett Multiple Comparison Test

Control	vs	C-%	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
Lab Control		25	0	2.287	0.223	6	0.7500	CDF	Non-Significant Effect
		45*	2.432	2.287	0.223	6	0.0389	CDF	Significant Effect
		60*	9.69	2.287	0.223	6	<0.0001	CDF	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	2.389931	0.7966437	3	42.05	<0.0001	Significant Effect
Error	0.2273372	0.01894477	12			
Total	2.617268		15			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance	6.092	11.34	0.1072	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.8738	0.8408	0.0311	Normal Distribution

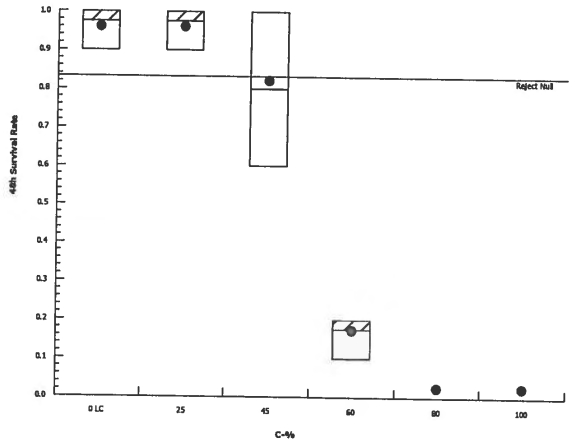
48h Survival Rate Summary

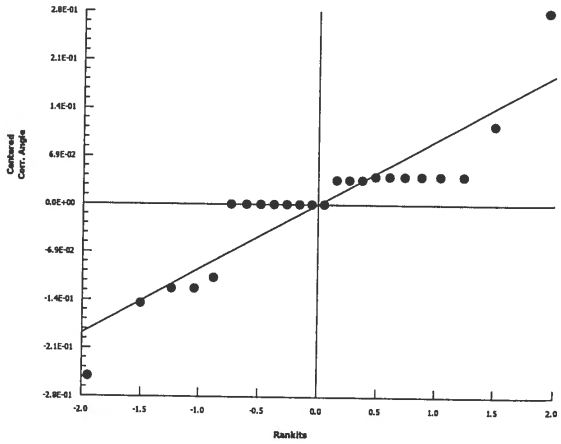
C-%	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Lab Control	4	0.975	0.8954	1	1	0.9	1	0.025	5.13%	0.0%
25		4	0.975	0.8954	1	1	0.9	1	0.025	5.13%	0.0%
45		4	0.8	0.5095	1	0.8	0.6	1	0.09129	22.82%	17.95%
60		4	0.175	0.09544	0.2546	0.2	0.1	0.2	0.025	28.57%	82.05%
80		4	0	0	0	0	0	0	0		100.0%
100		4	0	0	0	0	0	0	0		100.0%

Angular (Corrected) Transformed Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Lab Control	4	1.371	1.242	1.501	1.412	1.249	1.412	0.04074	5.94%	0.0%
25		4	1.371	1.242	1.501	1.412	1.249	1.412	0.04074	5.94%	0.0%
45		4	1.135	0.7531	1.516	1.12	0.8861	1.412	0.1199	21.13%	17.26%
60		4	0.4282	0.3153	0.5411	0.4636	0.3218	0.4636	0.03547	16.57%	68.78%
80		4	0.1588	0.1588	0.1588	0.1588	0.1588	0.1588	0	0.0%	88.42%
100		4	0.1588	0.1588	0.1588	0.1588	0.1588	0.1588	0	0.0%	88.42%

Graphics





CETIS Analytical Report

Report Date: 09 Mar-22 12:12 (p 1 o
Test Code: 2202-S032 | 03-2121-

Fathead Minnow 48-h Acute Survival Test — Nautilus Environmental (

Analysis ID:	19-4233-0558	**Endpoint:**	48h Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	09 Mar-22 12:11	**Analysis:**	Untrimmed Spearman-Kärber	**Official Results:**	Yes

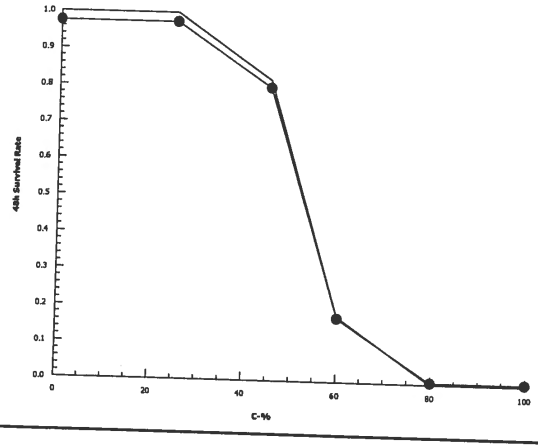
Spearman-Kärber Estimates

Threshold Option	Threshold	Trim	Mu	Sigma	EC50	95% LCL	95% UCL
Control Threshold	0.025	0.00%	1.704	0.0138	50.58	47.47	53.9

48h Survival Rate Summary

			Calculated Variate(A/B)								
C-%	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
0	Lab Control	4	0.975	0.9	1	0.025	0.05	5.13%	0.0%	39	40
25		4	0.975	0.9	1	0.025	0.05	5.13%	0.0%	39	40
45		4	0.8	0.6	1	0.09129	0.1826	22.82%	17.95%	32	40
60		4	0.175	0.1	0.2	0.025	0.05	28.57%	82.05%	7	40
80		4	0	0	0	0	0		100.0%	0	40
100		4	0	0	0	0	0		100.0%	0	40

Graphics



48-hour Freshwater Acute Bioassay
Static-Renewal Conditions
DF-007

Water Quality Measurements & Test Organism Survival

Client: BAE Systems
Sample ID: Outfall 029 (22B1372-2CLE)
Sample Log-in No.: 22-0223
Test No.: 22C2-5032

Test Species: *P. promelas*
Start Date/Time: (R) 2/24/22 ~~2/3/2022~~ 1455 Q11
End Date/Time: (R) 2/26/22 ~~2/5/2022~~ 1455

	Tech Initials		
	0	24	48
Counts:	GM	RT	VL
Readings:	HM	RT	HM
Dilutions made by:	GM	–	–

Concentration %	Rep	Number of Live Organisms			Conductivity (µmhos/cm)			Temperature (°C)			Dissolved Oxygen (mg/L)			pH (units)		
		0	24	48	0	24	48	0	24	48	0	24	48	0	24	48
Lab Control	A	10	10	10	192	188	193	19.6	19.7	19.9	9.0	6.6 (B)	8.4	7.98	7.80	7.88
	B	10	10	10								8.0				
	C	10	9	9												
	D	10	10	10												
25	A	10	10	10	331	317	324	19.5	19.8	19.9	8.7	5.9 (B)	6.4	7.86	7.67	7.70
	B	10	10	10								7.2				
	C	10	9	9												
	D	10	10	10												
45	A	10	9	8 (C) 6	463	445	454	19.6	19.8	19.9	8.4	5.7 (B)	6.0	7.80	7.67	7.70
	B	10	10	9								7.0				
	C	10	10	7												
	D	10	10	10												
60	A	10	1	1	543	515	525	19.6	19.8	19.9	8.1	4.7 (B)	5.5	7.77	7.67	7.70
	B	10	3	2								6.9				
	C	10	2	2												
	D	10	3	2												
80	A	10	0	–	651	615	–	19.6	19.8	–	7.9	4.5 (B)	–	7.73	7.68	–
	B	10	0	–								6.6				
	C	10	0	–												
	D	10	0	–												
100	A	10	0	–	702	715	–	19.1	19.8	–	7.6	4.9 (B)	–	7.71	7.72	–
	B	10	0	–								6.3				
	C	10	0	–												
	D	10	0	–												

Initial Counts QC'd by: HM
Initiated by: GM
Environmental Chamber: C

Animal Source/Date Received: ABS 2/23/22
Age at Initiation: 6days
Animal Acclimation Qualifiers (circle all that apply): Q22 / Q23 / Q24 / none (D)

Comments: Organisms fed prior to initiation, circle one (y / n)
(A) Q18 HM 2/21/22 (B) Q18 RT 2/25/22 (C) Q18 RT 2/26/22 (D) Q18 ACS 3/8/22

QC Check: JL 2/28/22
Final Review: ACS 3/8/22

Water Flea Acute Test

CETIS Summary Report

Report Date: 09 Mar-22 12:05 (p 1 of 1)
Test Code: 2202-S033 | 04-5080-637

Ceriodaphnia 48-h Acute Survival Test — **Nautilus Environmental (CA**

Batch ID:	17-3381-5613	**Test Type:**	Survival (48h)	**Analyst:**	
Start Date:	24 Feb-22 15:50	**Protocol:**	EPA/821/R-02-012 (2002)	**Diluent:**	Diluted Mineral Water (8:2)
Ending Date:	26 Feb-22 14:25	**Species:**	Ceriodaphnia dubia	**Brine:**	Not Applicable
Duration:	47h	**Source:**	In-House Culture	**Age:**	<24h

Sample ID:	11-9991-3780	**Code:**	22-0223	**Client:**	BAE Systems
Sample Date:	22 Feb-22 20:59	**Material:**	Effluent Sample	**Project:**	Laboratory Split Study
Receive Date:	24 Feb-22 10:55	**Source:**	BAE Systems		
Sample Age:	43h (1.9 °C)	**Station:**	Outfall 029 (22B1372-2:CLE)		

Comparison Summary

Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method
13-5921-6823	48h Survival Rate	25	45	33.54	20.9%	4	Dunnett Multiple Comparison Test

Point Estimate Summary

Analysis ID	Endpoint	Level	%	95% LCL	95% UCL	TU	Method
02-4285-7486	48h Survival Rate	EC50	38.47	33.21	44.55	2.6	Trimmed Spearman-Kärber

Test Acceptability

Analysis ID	Endpoint	Attribute	Test Stat	TAC Limits	Overlap	Decision
02-4285-7486	48h Survival Rate	Control Resp	1	0.9 - NL	Yes	Passes Acceptability Criteria
13-5921-6823	48h Survival Rate	Control Resp	1	0.9 - NL	Yes	Passes Acceptability Criteria

48h Survival Rate Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Lab Control	4	1	1	1	1	1	0	0	0.0%	0.0%
25		4	0.85	0.5453	1	0.6	1	0.09574	0.1915	22.53%	15.0%
45		4	0.4	0.1402	0.6598	0.2	0.6	0.08165	0.1633	40.82%	60.0%
60		4	0	0	0	0	0	0	0		100.0%
80		4	0	0	0	0	0	0	0		100.0%
100		4	0	0	0	0	0	0	0		100.0%

48h Survival Rate Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Control	1	1	1	1
25		0.6	1	0.8	1
45		0.6	0.4	0.4	0.2
60		0	0	0	0
80		0	0	0	0
100		0	0	0	0

CETIS Analytical Report

Report Date: 09 Mar-22 12:05 (p 1 of 1)
Test Code: 2202-S033 | 04-5080-637

Ceriodaphnia 48-h Acute Survival Test — **Nautilus Environmental (CA)**

Analysis ID:	13-5921-6823	**Endpoint:**	48h Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	28 Feb-22 14:53	**Analysis:**	Parametric-Control vs Treatments	**Official Results:**	Yes

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	NOEL	LOEL	TOEL	TU
Angular (Corrected)	NA	C > T	NA	NA	20.9%	25	45	33.54	4

Dunnett Multiple Comparison Test

Control	vs	C-%	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
Lab Control		25	1.525	2.18	0.249	6	0.1350	CDF	Non-Significant Effect
		45*	5.82	2.18	0.249	6	0.0002	CDF	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.9526771	0.4763385	2	18.22	0.0007	Significant Effect
Error	0.2353276	0.02614751	9			
Total	1.188005		11			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Mod Levene Equality of Variance	3.408	8.022	0.0791	Equal Variances
Variances	Levene Equality of Variance	4.158	8.022	0.0526	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.8829	0.8025	0.0956	Normal Distribution

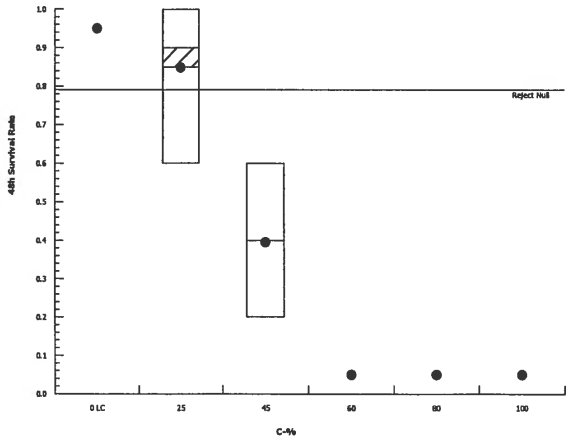
48h Survival Rate Summary

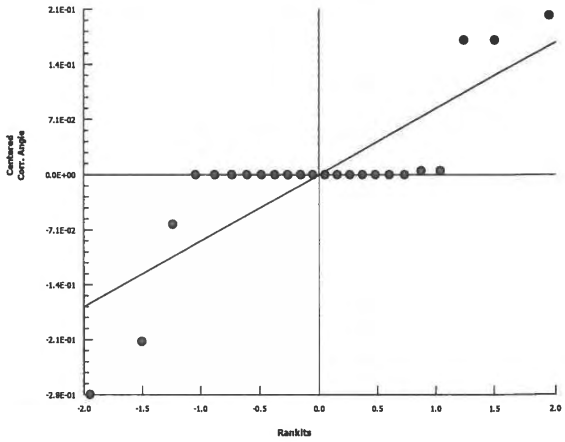
C-%	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Lab Control	4	1	1	1	1	1	1	0	0.0%	0.0%
25		4	0.85	0.5453	1	0.9	0.6	1	0.09574	22.53%	15.0%
45		4	0.4	0.1402	0.6598	0.4	0.2	0.6	0.08165	40.82%	60.0%
60		4	0	0	0	0	0	0	0		100.0%
80		4	0	0	0	0	0	0	0		100.0%
100		4	0	0	0	0	0	0	0		100.0%

Angular (Corrected) Transformed Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Lab Control	4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
25		4	1.171	0.8199	1.522	1.226	0.8861	1.345	0.1103	18.84%	12.96%
45		4	0.6798	0.4052	0.9544	0.6847	0.4636	0.8861	0.08628	25.38%	49.47%
60		4	0.2255	0.2255	0.2256	0.2255	0.2255	0.2255	0	0.0%	83.24%
80		4	0.2255	0.2255	0.2256	0.2255	0.2255	0.2255	0	0.0%	83.24%
100		4	0.2255	0.2255	0.2256	0.2255	0.2255	0.2255	0	0.0%	83.24%

Graphics





CETIS Analytical Report

Report Date: 09 Mar-22 12:05 (p 1 of 1)
Test Code: 2202-S033 | 04-5080-637

Ceriodaphnia 48-h Acute Survival Test — **Nautilus Environmental (CA)**

Analysis ID:	02-4285-7486	**Endpoint:**	48h Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	09 Mar-22 12:04	**Analysis:**	Trimmed Spearman-Kärber	**Official Results:**	Yes

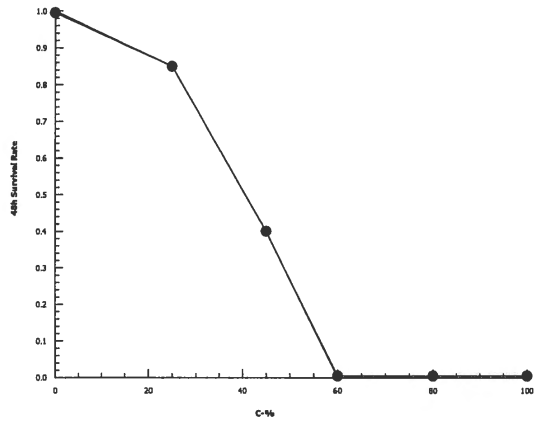
Trimmed Spearman-Kärber Estimates

Threshold Option	Threshold	Trim	Mu	Sigma	EC50	95% LCL	95% UCL
Control Threshold	0	15.00%	1.585	0.03189	38.47	33.21	44.55

48h Survival Rate Summary

			Calculated Variate(A/B)								
C-%	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
0	Lab Control	4	1	1	1	0	0	0.0%	0.0%	20	20
25		4	0.85	0.6	1	0.09574	0.1915	22.53%	15.0%	17	20
45		4	0.4	0.2	0.6	0.08165	0.1633	40.82%	60.0%	8	20
60		4	0	0	0	0	0		100.0%	0	20
80		4	0	0	0	0	0		100.0%	0	20
100		4	0	0	0	0	0		100.0%	0	20

Graphics



48-hour Freshwater Acute Bioassay
Static-Renewal Conditions
DF-007

Water Quality Measurements
& Test Organism Survival

Client: BAE Systems
Sample ID: Outfall 029 (22B1372-2: CLE)
Sample Log-in No.: 22- 0223
Test No.: 2202-S033

Test Species: *C. dubia*
Start Date/Time: (A) 2/24/22 ~~2/3/2022~~ 1550 Q11
End Date/Time: (A) 2/26/22 ~~2/5/2022~~ 1425

	Tech Initials		
	0	24	48
Counts:	GM	RT	HM
Readings:	HM	RT	KL
Dilutions made by:	GM	–	–

Concentration %	Rep	Number of Live Organisms			Conductivity (µmhos/cm)			Temperature (°C)			Dissolved Oxygen (mg/L) Q14			pH (units)		
		0	24	48	0	24	48	0	24	48	0	24	48	0	24	48
Lab Control	A	5	5	5	192	~~242~~	206	19.8	19.8	19.7	9.1	~~7.4~~ (B)	7.8	7.91	7.88	8.08
	B	5	5	5		188						9.0				
	C	5	5	5												
	D	5	5	5								(B)				
25	A	5	3	3	337	325	343	19.7	19.6	19.7	8.8	~~6.7~~	7.7	7.91	7.74	8.12
	B	5	5	5								7.3				
	C	5	5	4												
	D	5	5	5								(B)				
45	A	5	5	3	453	436	454	19.7	19.2	19.7	8.5	~~6.7~~	7.6	7.86	7.79	8.11
	B	5	3	2								7.1				
	C	5	4	2												
	D	5	2	1								(B)				
60	A	5	4	0	550	531	532	19.6	19.7	19.7	8.3	~~5.6~~	7.2	7.83	7.73	8.06
	B	5	3	0								7.0				
	C	5	1	0												
	D	5	3	0								(B)				
80	A	5	3	0	660	636	661	20.1	19.7	19.7	8.0	~~5.3~~	7.2	7.80	7.74	8.07
	B	5	1	0								6.8				
	C	5	0	–												
	D	5	1	0								(B)				
100	A	5	3	0	761	736	763	20.1	19.4	19.7	7.8	~~5.3~~	6.7	7.78	7.78	8.11
	B	5	0	–								6.7				
	C	5	3	0												
	D	5	2	0												

Initial Counts QC'd by: HM
Initiated by: GM
Environmental Chamber: C

Animal Source/Date Received: Internal / N/A
Age at Initiation: <24hr

Animal Acclimation Qualifiers (circle all that apply): Q22 / Q23 / Q24 / none

Comments: Organisms fed prior to initiation, circle one (y) / n)
(A) Q18 HM 2/21/22 (B) Q18 RT 2/25/22

QC Check: JL 2/28/22
Final Review: AMS 3/6/22

Appendix B

Sample Receipt Information

Enthalpy Analytical
4340 Vandever Avenue
San Diego, CA 92120

Client: BAE Systems
Sample ID: Outfall 029 and Outfall 007
Test ID No(s).: 2202-S032 to S035

Sample Check-In Information

DC-005

Sample IDs:	Outfall 029	Outfall 007		
	2201372-2: CLE ~~2201372-1 Crowder Tank~~	2201372-1: Crowder Tank ~~2201372-2: CLE~~ (A)		
Log-in No. (22-xxxx):	0223 PST 2059	0224 PST 2059		
Sample Collection Date & Time:	2/22/22 ~~1359~~	2/22/22 ~~2359~~ (A)		
Sample Receipt Date & Time:	2/24/22 1055 (A)	2/24/22 1055		
Number of Containers & Container Type:	1x4L cubi	1x4L cubi		
Approx. Total Volume Received (L):	~4L	~4L		
Check-in Temperature (°C)	1.9°C	1.5		
Temperature OK? [1]	(Y) N	(Y) N	Y N	Y N
DO (mg/L)	8.4	10.7		
pH (units)	7.58	7.02		
Conductivity (µS/cm)	815	1521		
Salinity (ppt)	0.4	0.8		
Alkalinity (mg/L) [2]	179	19		
Hardness (mg/L) [2,3]	119	630		
Total Chlorine (mg/L)	0.04	<0.02		
Technician Initials	DR	DR		

Test Performed: 48-hr Acute Fathead and Water Flea — Control/Dilution Water: (8:2) / Lab SW / Lab ART Other: _____
Alkalinity: 90 Hardness: 85
Additional Control? Y (N) = _____ Alkalinity: _____ Hardness or Salinity: _____

Test Performed: _____ Control/Dilution Water: 8:2 / Lab SW / Lab ART Other: _____
Alkalinity: _____ Hardness or Salinity: _____
Additional Control? Y N = _____ Alkalinity: _____ Hardness or Salinity: _____

Test Performed: _____ Control/Dilution Water: 8:2 / Lab SW / Lab ART Other: _____
Alkalinity: _____ Hardness or Salinity: _____
Additional Control? Y N = _____ Alkalinity: _____ Hardness or Salinity: _____

Notes: [1] Temperature of sample should be 0-6°C, if received more than 24 hours past collection time.
[2] mg/L as CaCO3, [3] Measured for freshwater samples only, NA = Not Applicable

Additional Comments: (A) QIS DR 02/24/22 (C) QIS AYS 3/8/22
(B) QIS RT 2/25/22

QC Check: JL 2/28/22

Sample Description:
029: Dark Gray, slightly Opaque, no odor, heavy debr
007: no color, clear, no odor, (A) no light debris

COC Complete (Y/N)?
029 Y 007 Y

Filtration? Y (N)
Initials: A) B) C)
Pore Size: _____
Organisms or Debris

Salinity Adjustment? Y N
Test: Source: Target ppt:
Test: Source: Target ppt:
Test: Source: Target ppt:

pH Adjustment? Y (N)

	A	B	C
Initial pH:			
Amount of HCl added:			
Final pH:			

Cl2 Adjustment? Y (N)

	A	B	C
Initial Free Cl_2:			
STS added:			
Final Free Cl_2:			

Sample Aeration? Y (N)

	A	B	C
Initial D.O.			
Duration & Rate			
Final D.O.			

Measure NH3 via test strip (circle one)? Y (N)

NH3 Strip Result* A:_____ B:_____ C:_____
*(if 6 or more, notify PM)

Subsamples for Additional Chemistry Required? Y (N)
NH3 Other _____
Tech Initials A_____ B_____ C_____

Final Review: AYS 3/8/22

Appendix C

Chain-of-Custody Form

ENTHALPY ANALYTICAL
formerly *Air, Water & Soil Laboratories*

Enthalpy Analytical SD:
4340 Vandever Ave, San Diego CA 92120

1941 REYMET ROAD
RICHMOND, VIRGINIA 23237
(804) 358-8295 PHONE
(804)358-8297 FAX

Chain of Custody
Form #: D1331
Rev. 1.0
Effective: Feb 14, 2014

CHAIN OF CUSTODY

COMPANY NAME: Air, Water & Soil Labs, INC	INVOICE TO: AWS LABS	PROJECT NAME/Quote #: 22B1372
CONTACT: Sarah Endsley	INVOICE CONTACT: RIC-env@enthalpy.com	SITE NAME: 22B1372
ADDRESS:1941 Reymet Rd, Richmond, VA 23237	INVOICE ADDRESS:	PROJECT NUMBER: 22B1372
PHONE #: 804-358-8295	INVOICE PHONE #:	P.O. #: ~~PO~~ SE 2/23/22
FAX #:804-358-8297	EMAIL: ric-env@enthalpy.com	Pretreatment Program:
Is sample for compliance reporting? YES NO	Is sample from a chlorinated supply? YES NO	PWS I.D. #:
SAMPLER NAME (PRINT):	SAMPLER SIGNATURE:	**Turn Around Time:10 Days**

Matrix Codes: WW=Waste Water/Storm Water GW=Ground Water DW=Drinking Water S=Soil/Solids OR=Organic A=Air WP=Wipe OT=Other_____

CLIENT SAMPLE I.D.	Grab	Composite	Field Filtered (Dissolved Metals)	Composite Start Date	Composite Start Time	Grab Date or Composite Stop Date	Grab Time or Composite Stop Time	Time Preserved	Matrix (See Codes)	Number of Containers	ANALYSIS / (PRESERVATIVE): Acute Toxicity - P. Promelas / D. cubia	Please use the following dilutions as discussed: CLE (Outfall 029) = 25%, 45%, 60%, 80%, 100% Crowder Tanks (Outfall 007) = 15%, 25%, 50%, 75%, 100%	COMMENTS: Preservative Codes: N=Nitric Acid C=Hydrochloric Acid S=Sulfuric Acid H=Sodium Hydroxide A=Ascorbic Acid Z=Zinc Acetate T=Sodium Thiosulfate M=Methanol. PLEASE NOTE PRESERVATIVE(S), INTERFERENCE CHECKS or PUMP RATE (L/min)
1) 22B1372-1: Crowder Tank (007)		X		2.22.22	0000	2.22.22	2359		WW	1		X	22-0224
2) 22B1372-2: CLE (029)		X		2.22.22	0	2.22.22	2359		WW	1		X	22-0223
3)													
4)													
5)													
6)													
7)													
8)													
9)													
10)													

RELINQUISHED: DATE / TIME	RECEIVED: DATE / TIME	QC Data Package	LAB USE ONLY	COOLER TEMP _____°C
JH 2/23/22 1412	FEDEX EXPRESS 2/23/22 1412	Level I ☐		
RELINQUISHED: DATE / TIME	RECEIVED: DATE / TIME	Level II ☐		
	Z-Z Denise Rios 2/24/22 1055	Level III ☐		
RELINQUISHED: DATE / TIME	RECEIVED: DATE / TIME	Level IV ☐		

EA San Diego - Acute Tox Split Feb 2022

Appendix D

List of Data Qualifier Codes

Glossary of Qualifier Codes

Q1 - Temperature out of recommended range; corrective action taken and recorded in Test Temperature Correction Log

Q2 - Temperature out of recommended range; no action taken, test terminated same day

Q3 - Sample pH adjusted to within range of 6-9 with reagent grade NaOH or HCl, as needed

Q4 - Test aerated; D.O. levels dropped below 4.0 mg/L

Q5 - Test initiated with continuous aeration due to an anticipated drop in D.O.

Q6 - Airline obstructed or fell out of replicate and replaced; drop in D.O. occurred

Q7 - Salinity out of recommended range

Q8 - Spilled test chamber/ Unable to recover test organism(s)

Q9 - Inadequate sample volume remaining, partial renewal performed

Q10 - Inadequate sample volume remaining, no renewal performed

Q11 - Sample out of holding time; refer to QA section of report

Q12 - Replicate(s) not initiated; excluded from data analysis

Q13 - Survival counts not recorded due to poor visibility or heavy debris

Q14 - D.O. percent saturation was checked and was ≤ 110%

Q15 - Did not meet minimum test acceptability criteria. Refer to QA section of report.

Q16 - Percent minimum significant difference (PMSD) was below the lower bound limit for acceptability. This indicates that statistics may be over-sensitive in detecting a difference from the control due to low variability in the data set. Test results were reviewed and reported in accordance with guidance found in EPA-833-R-00-003, 2000 unless otherwise specified.

Q17 - Percent minimum significant difference (PMSD) was above the upper bound limit for acceptability. This indicates that statistics may be under-sensitive in detecting a difference from the control due to high variability in the data set. Test results were reviewed and reported in accordance with EPA-833-R-00-003, 2000 guidance unless otherwise specified.

Q18 - Incorrect or illegible Entry

Q19 - Miscalculation

Q20 - PMSD criteria do not apply to the test of significant toxicity (TST) analysis

Q21 - Other (provide reason in comments section)

Q22 - Greater than 10% batch mortality observed upon receipt and/or in holding prior to test initiation. Organisms acclimated to test conditions at Enthalpy and ultimately deemed fit to use for testing.

Q23 - Test organisms experienced a temperature shift greater than 3°C within 1 day or were received at a temperature greater than 3°C outside the recommended test temperature range and had minimal time to acclimate prior to test initiation. However, due to age-specific protocol requirements and/or sample holding time constraints, the organisms were used to initiate test(s). Organisms were ultimately deemed fit to use for testing.

Q24 - Test organisms experienced a salinity shift greater than 3 ppt within 1 day or were received at a salinity greater than 3 ppt outside the recommended test salinity range and had minimal time to acclimate prior to test initiation. However, due to age-specific protocol requirements and/or sample holding time constraints, the organisms were used to initiate test(s). Organisms were ultimately deemed fit to use for testing.

Appendix E

Reference Toxicant Test Results

CETIS Summary Report

Report Date: 02 Mar-22 13:22 (p 1 of 1)
Test Code: 220224ppra | 17-0760-7068

Fathead Minnow 96-h Acute Survival Test — **Nautilus Environmental (CA)**

Batch ID:	15-4954-2769	**Test Type:**	Survival (96h)	**Analyst:**	
Start Date:	24 Feb-22 16:10	**Protocol:**	EPA/821/R-02-012 (2002)	**Diluent:**	Diluted Mineral Water (8:2)
Ending Date:	28 Feb-22 15:05	**Species:**	Pimephales promelas	**Brine:**	Not Applicable
Duration:	95h	**Source:**	Aquatic Biosystems, CO	**Age:**	6d

Sample ID:	05-2315-6384	**Code:**	220224ppra	**Client:**	Internal
Sample Date:	24 Feb-22	**Material:**	Copper chloride	**Project:**	
Receive Date:	24 Feb-22	**Source:**	Reference Toxicant		
Sample Age:	16h	**Station:**	Copper Chloride		

Comparison Summary

Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method
21-2001-3495	96h Survival Rate	<15	15	NA	16.0%		Dunnett Multiple Comparison Test

Point Estimate Summary

Analysis ID	Endpoint	Level	µg/L	95% LCL	95% UCL	TU	Method
11-1555-4113	96h Survival Rate	EC50	32.6	25.51	41.67		Trimmed Spearman-Kärber

Test Acceptability

Analysis ID	Endpoint	Attribute	Test Stat	TAC Limits	Overlap	Decision
11-1555-4113	96h Survival Rate	Control Resp	0.975	0.9 - NL	Yes	Passes Acceptability Criteria
21-2001-3495	96h Survival Rate	Control Resp	0.975	0.9 - NL	Yes	Passes Acceptability Criteria

96h Survival Rate Summary

C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Lab Control	4	0.975	0.8954	1	0.9	1	0.025	0.05	5.13%	0.0%
15		4	0.725	0.5727	0.8773	0.6	0.8	0.04787	0.09574	13.21%	25.64%
30		4	0.575	0.2222	0.9278	0.3	0.8	0.1109	0.2217	38.56%	41.03%
60		4	0.175	0.02265	0.3273	0.1	0.3	0.04787	0.09574	54.71%	82.05%
120		4	0	0	0	0	0	0	0		100.0%
240		4	0	0	0	0	0	0	0		100.0%

96h Survival Rate Detail

C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Control	0.9	1	1	1
15		0.8	0.6	0.7	0.8
30		0.7	0.3	0.8	0.5
60		0.1	0.1	0.3	0.2
120		0	0	0	0
240		0	0	0	0

CETIS Analytical Report

Report Date: 02 Mar-22 13:22 (p 1 of 1)
Test Code: 220224ppra | 17-0760-7068

Fathead Minnow 96-h Acute Survival Test — **Nautilus Environmental (CA)**

Analysis ID:	21-2001-3495	**Endpoint:**	96h Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	02 Mar-22 13:21	**Analysis:**	Parametric-Control vs Treatments	**Official Results:**	Yes

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	NOEL	LOEL	TOEL	TU
Angular (Corrected)	NA	C > T	NA	NA	16.0%	<15	15	NA	

Dunnett Multiple Comparison Test

Control	vs	C-µg/L	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
Lab Control		15*	3.329	2.287	0.239	6	0.0078	CDF	Significant Effect
		30*	4.83	2.287	0.239	6	0.0006	CDF	Significant Effect
		60*	9.074	2.287	0.239	6	<0.0001	CDF	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	1.861886	0.6206287	3	28.33	<0.0001	Significant Effect
Error	0.2628433	0.02190361	12			
Total	2.124729		15			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance	3.404	11.34	0.3334	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.9705	0.8408	0.8473	Normal Distribution

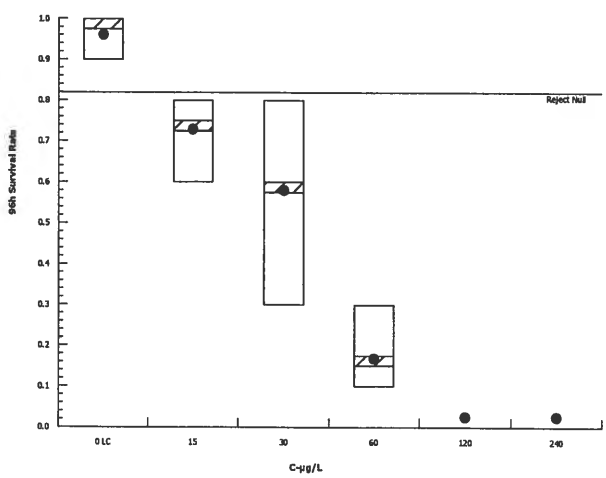
96h Survival Rate Summary

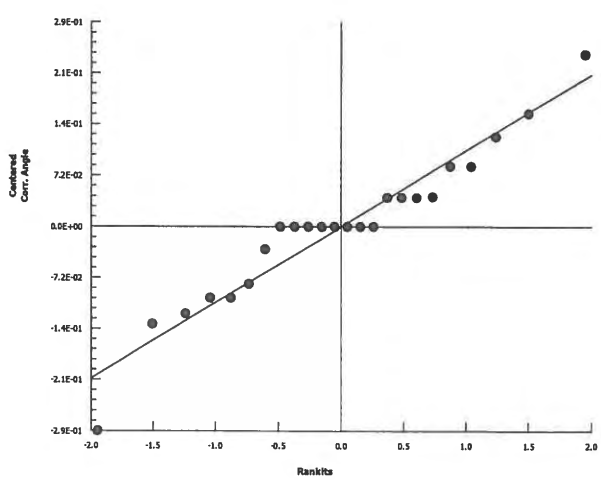
C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Lab Control	4	0.975	0.8954	1	1	0.9	1	0.025	5.13%	0.0%
15		4	0.725	0.5727	0.8773	0.75	0.6	0.8	0.04787	13.21%	25.64%
30		4	0.575	0.2222	0.9278	0.6	0.3	0.8	0.1109	38.56%	41.03%
60		4	0.175	0.02265	0.3273	0.15	0.1	0.3	0.04787	54.71%	82.05%
120		4	0	0	0	0	0	0	0		100.0%
240		4	0	0	0	0	0	0	0		100.0%

Angular (Corrected) Transformed Summary

C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Lab Control	4	1.371	1.242	1.501	1.412	1.249	1.412	0.04074	5.94%	0.0%
15		4	1.023	0.8537	1.192	1.049	0.8861	1.107	0.05317	10.4%	25.41%
30		4	0.8658	0.4957	1.236	0.8883	0.5796	1.107	0.1163	26.86%	36.86%
60		4	0.4217	0.2232	0.6202	0.3927	0.3218	0.5796	0.06237	29.58%	69.25%
120		4	0.1588	0.1588	0.1588	0.1588	0.1588	0.1588	0	0.0%	88.42%
240		4	0.1588	0.1588	0.1588	0.1588	0.1588	0.1588	0	0.0%	88.42%

Graphics





CETIS Analytical Report

Report Date: 02 Mar-22 13:22 (p 1 of 1)
Test Code: 220224ppra | 17-0760-7068

Fathead Minnow 96-h Acute Survival Test — **Nautilus Environmental (CA)**

Analysis ID:	11-1555-4113	**Endpoint:**	96h Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	02 Mar-22 13:21	**Analysis:**	Trimmed Spearman-Kärber	**Official Results:**	Yes

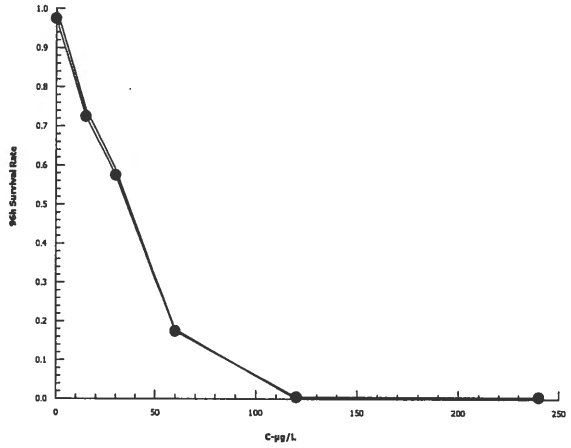
Trimmed Spearman-Kärber Estimates

Threshold Option	Threshold	Trim	Mu	Sigma	EC50	95% LCL	95% UCL
Control Threshold	0.025	25.64%	1.513	0.05326	32.6	25.51	41.67

96h Survival Rate Summary

			Calculated Variate(A/B)								
C-µg/L	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
0	Lab Control	4	0.975	0.9	1	0.025	0.05	5.13%	0.0%	39	40
15		4	0.725	0.6	0.8	0.04787	0.09574	13.21%	25.64%	29	40
30		4	0.575	0.3	0.8	0.1109	0.2217	38.56%	41.03%	23	40
60		4	0.175	0.1	0.3	0.04787	0.09574	54.71%	82.05%	7	40
120		4	0	0	0	0	0		100.0%	0	40
240		4	0	0	0	0	0		100.0%	0	40

Graphics

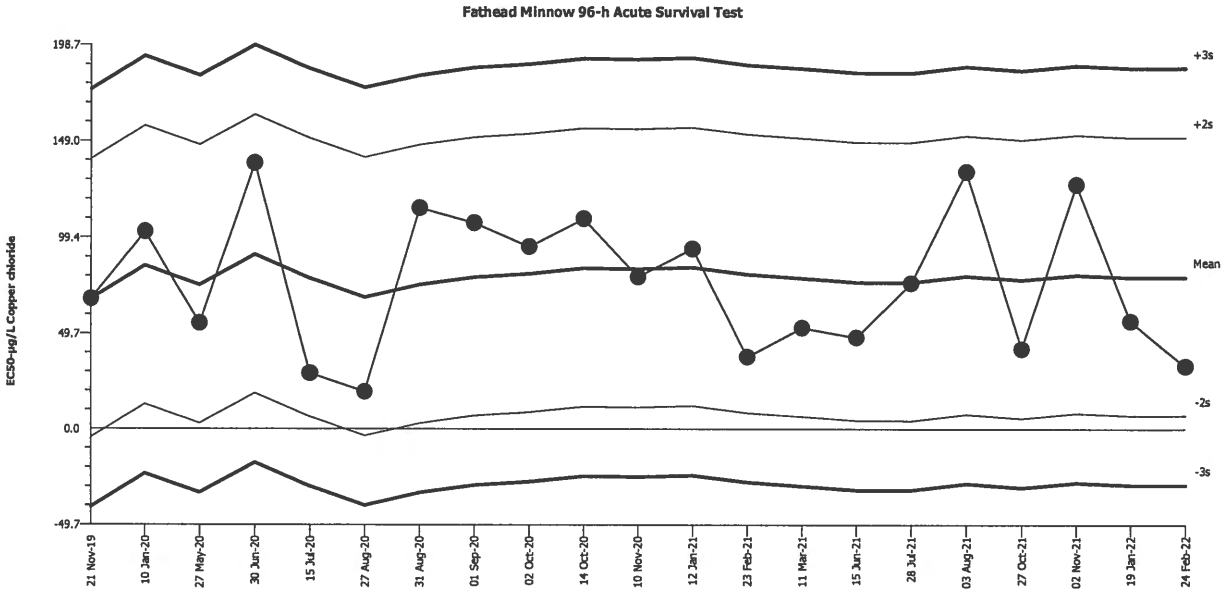


CETIS QC Plot

Report Date: 02 Mar-22 13:23 (1 of 1)

Fathead Minnow 96-h Acute Survival Test — **Nautilus Environmental (CA)**

Test Type:	Survival (96h)	**Organism:**	Pimephales promelas (Fathead Minn	**Material:**	Copper chloride
Protocol:	EPA/821/R-02-012 (2002)	**Endpoint:**	96h Survival Rate	**Source:**	Reference Toxicant-REF



Mean:	78.96	**Count:**	20	**-2s Warning Limit:**	6.899	**-3s Action Limit:**	-29.13
Sigma:	36.03	**CV:**	45.60%	**+2s Warning Limit:**	151	**+3s Action Limit:**	187

Quality Control Data

Point	Year	Month	Day	Time	QC Data	Delta	Sigma	Warning	Action	Test ID	Analysis ID
1	2019	Nov	21	16:35	67.63	-11.33	-0.3144			04-2957-0529	12-8998-8134
2	2020	Jan	10	17:05	102.3	23.3	0.6467			16-9789-6682	06-6624-2910
3		May	27	16:35	55.05	-23.91	-0.6636			16-5231-1352	08-0130-7710
4		Jun	30	16:25	137.6	58.59	1.626			20-8582-5673	01-3539-9114
5		Jul	15	16:00	28.87	-50.09	-1.39			02-8717-8563	15-0846-2862
6		Aug	27	11:55	19.21	-59.75	-1.658			21-1958-4827	04-0829-1325
7			31	12:20	114.5	35.54	0.9864			04-4264-5870	08-1199-0475
8		Sep	1	18:00	106.8	27.86	0.7732			05-5925-4870	11-8222-6308
9		Oct	2	14:35	94.56	15.6	0.4329			10-6788-7581	10-0094-1709
10			14	15:55	108.9	29.95	0.8313			16-9476-4319	04-8332-8963
11		Nov	10	15:50	79.05	0.09013	0.002502			10-0925-3953	05-0925-4459
12	2021	Jan	12	16:10	93.54	14.58	0.4047			10-2818-5435	19-4959-1498
13		Feb	23	16:00	37.5	-41.46	-1.151			00-7897-7348	07-5099-8101
14		Mar	11	16:25	52.64	-26.32	-0.7306			20-0307-6488	03-1985-7497
15		Jun	15	17:10	47.63	-31.33	-0.8697			13-1662-1659	03-5455-1927
16		Jul	28	17:30	75.92	-3.043	-0.08446			04-8837-0734	00-2418-4039
17		Aug	3	15:30	133.2	54.22	1.505			01-5905-1678	06-9846-1307
18		Oct	27	17:55	41.65	-37.31	-1.036			04-8454-9323	21-2291-3266
19		Nov	2	14:55	126.6	47.61	1.321			02-5381-8973	13-3748-9296
20	2022	Jan	19	14:00	56.14	-22.82	-0.6333			20-2049-9334	07-9545-0483
21		Feb	24	16:10	32.6	-46.36	-1.287			17-0760-7068	11-1555-4113

96-hour Freshwater Acute Bioassay
Static-Renewal Conditions
DF-006

Water Quality Measurements
& Test Organism Survival

Client: Internal
Sample ID: $CuCl_2$
Test No.: 220224ppra

Test Species: *P. promelas*
Start Date/Time: 2/24/2022 1610
End Date/Time: 2/28/2022 1505

	Tech Initials				
	0	24	48	72	96
Counts:	RT	RT	YL	KD	GM
Readings:	HH	RT	HH	KD	KD
Dilutions made by:	GM	—	HH	—	—
High conc. made (µg/L):	240	–	240	–	–
Vol. Cu stock added (mL):	5.1	–	5.1	–	–
Final Volume (mL):	2000	–	2000	–	–

Cu stock concentration (µg/L): 94,000

Concentration µg/L	RAND #	Number of Live Organisms					Conductivity (µmhos/cm)					Temperature (°C)					Dissolved Oxygen (mg/L)					pH (units)				
		0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96
Lab Control	19	10	10	10	10	9	192	194	186	196	218	19.3	19.5	19.1	19.6	19.7	8.8	6.7	8.8	8.7	8.3	8.06	7.84	8.29	7.13	7.83
	4	10	10	10	10	10			199					19.6				8.5	8.5					7.96		
	21	10	10	10	10	10																				
	24	10	10	10	10	10												(A)								
15	11	10	10	9	9	8	192	189	186	189	193	19.3	19.7	19.4	19.6	19.9	8.9	6.7	8.2	8.5	8.3	8.10	7.88	8.29	8.01	7.87
	13	10	9	9	8	6			194					19.5				8.4	8.6					7.98		
	20	10	9	8	8	7																				
	10	10	9	9	9	8												(A)								
30	18	10	9	8	7	7	192	190	186	189	192	19.3	19.6	19.1	19.5	19.8	9.0	6.7	8.6	8.5	8.5	8.11	7.89	8.30	8.02	7.96
	3	10	8	5	4	3			195					19.5				8.2	8.6					7.98		
	8	10	10	8	8	8																				
	15	10	10	9	7	5												(A)							(B) 8.12	
60	2	10	9	2	2	1	192	192	187	190	194	19.3	19.5	19.4	19.6	20.0	9.0	6.8	8.4	8.7	8.6	8.12	7.90	8.21	8.12	8.03
	14	10	10	2	2	1			191					19.5				8.2	8.7					7.99		
	22	10	10	3	3	3																				
	16	10	8	3	3	2												(A)								
120	12	10	7	2	1	0	191	192	186	189	193	19.4	19.7	19.8	19.6	19.9	9.0	6.7	8.3	8.6	8.7	8.11	7.91	8.21	8.12	8.04
	6	10	7	3	1	0			198					19.5				8.2	8.5					7.99		
	1	10	6	2	0	–																				
	23	10	4	2	0	–												(A)								
240	9	10	1	1	1	0	191	190	188	188	191	19.3	19.8	20.9	19.7	19.9	9.0	6.9	8.2	8.6	8.7	8.10	7.93	8.21	8.12	8.04
	5	10	(A) 30	–	–	–			195					19.6				8.3	8.1					7.94		
	7	10	3	2	1	0																				
	17	10	3	1	1	0																				

Rand # QC: RT
Counts QC'd by: GM/CL
Initiated by: RT

Environmental Chamber: C.

Animal Source/Date Received: ABS 2/23/22
Age at Initiation: 6d

Animal Acclimation Qualifiers (circle all that apply): Q22 / Q23 / Q24 / none (C)

Feeding Times	0	24	48	72	96
AM:			1850		
PM:					

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

Organisms fed prior to initiation, circle one (y) / n) (A) Q18 RT 2/25/22 (B) Q18 KD 2/27/22
(C) Q18 ABS 3/9/22

QC Check: JL 3/2/22

Final Review: AIS 3/9/22

CETIS Summary Report

Report Date: 24 Feb-22 12:35 (p 1 of 2)
Test Code: 220215cdra | 19-8470-526

Ceriodaphnia 96-h Acute Survival Test — Nautilus Environmental (CA)

Batch ID:	16-1839-8403	**Test Type:**	Survival (96h)	**Analyst:**	
Start Date:	15 Feb-22 15:20	**Protocol:**	EPA/821/R-02-012 (2002)	**Diluent:**	Diluted Mineral Water (8:2)
Ending Date:	19 Feb-22 14:45	**Species:**	Ceriodaphnia dubia	**Brine:**	Not Applicable
Duration:	95h	**Source:**	In-House Culture	**Age:**	<24h

Sample ID:	01-9095-4535	**Code:**	220215cdra	**Client:**	Internal
Sample Date:	15 Feb-22	**Material:**	Copper chloride	**Project:**	
Receive Date:	15 Feb-22	**Source:**	Reference Toxicant		
Sample Age:	15h	**Station:**	Copper Chloride		

Comparison Summary

Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method
11-9844-5534	48h Survival Rate	10	20	14.14	17.5%		Steel Many-One Rank Sum Test
00-3579-6983	96h Survival Rate	5	10	7.071	20.8%		Dunnett Multiple Comparison Test

Point Estimate Summary

Analysis ID	Endpoint	Level	µg/L	95% LCL	95% UCL	TU	Method
11-1474-8411	48h Survival Rate	EC50	16.25	13.35	19.76		Spearman-Kärber
12-1776-6242	96h Survival Rate	EC50	12.91	10.46	15.92		Trimmed Spearman-Kärber

Test Acceptability

Analysis ID	Endpoint	Attribute	Test Stat	TAC Limits	Overlap	Decision
11-1474-8411	48h Survival Rate	Control Resp	1	0.9 - NL	Yes	Passes Acceptability Criteria
11-9844-5534	48h Survival Rate	Control Resp	1	0.9 - NL	Yes	Passes Acceptability Criteria
00-3579-6983	96h Survival Rate	Control Resp	1	0.9 - NL	Yes	Passes Acceptability Criteria
12-1776-6242	96h Survival Rate	Control Resp	1	0.9 - NL	Yes	Passes Acceptability Criteria

48h Survival Rate Summary

C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Lab Control	4	1	1	1	1	1	0	0	0.0%	0.0%
5		4	1	1	1	1	1	0	0	0.0%	0.0%
10		4	0.8	0.5402	1	0.6	1	0.08165	0.1633	20.41%	20.0%
20		4	0.4	0.1402	0.6598	0.2	0.6	0.08165	0.1633	40.82%	60.0%
40		4	0	0	0	0	0	0	0		100.0%
80		4	0	0	0	0	0	0	0		100.0%

96h Survival Rate Summary

C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Lab Control	4	1	1	1	1	1	0	0	0.0%	0.0%
5		4	0.95	0.7909	1	0.8	1	0.05	0.1	10.53%	5.0%
10		4	0.7	0.3818	1	0.4	0.8	0.1	0.2	28.57%	30.0%
20		4	0.2	0	0.4598	0	0.4	0.08165	0.1633	81.65%	80.0%
40		4	0	0	0	0	0	0	0		100.0%
80		4	0	0	0	0	0	0	0		100.0%

CETIS Summary Report

Report Date: 24 Feb-22 12:35 (p 2 of 2)
Test Code: 220215cdra | 19-8470-526

Ceriodaphnia 96-h Acute Survival Test — Nautilus Environmental (CA)

48h Survival Rate Detail

C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Control	1	1	1	1
5		1	1	1	1
10		0.8	0.6	1	0.8
20		0.2	0.6	0.4	0.4
40		0	0	0	0
80		0	0	0	0

96h Survival Rate Detail

C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Control	1	1	1	1
5		1	1	0.8	1
10		0.8	0.4	0.8	0.8
20		0.2	0.2	0	0.4
40		0	0	0	0
80		0	0	0	0

CETIS Analytical Report

Report Date: 22 Feb-22 09:15 (p 1 of 2)
Test Code: 220215cdra | 19-8470-526

Ceriodaphnia 96-h Acute Survival Test — Nautilus Environmental (CA)

Analysis ID:	00-3579-6983	**Endpoint:**	96h Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	22 Feb-22 9:14	**Analysis:**	Parametric-Control vs Treatments	**Official Results:**	Yes

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	NOEL	LOEL	TOEL	TU
Angular (Corrected)	NA	C > T	NA	NA	20.8%	5	10	7.071	

Dunnett Multiple Comparison Test

Control	vs	C-µg/L	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
Lab Control		5	0.5493	2.287	0.248	6	0.5242	CDF	Non-Significant Effect
		10*	3.172	2.287	0.248	6	0.0104	CDF	Significant Effect
		20*	8.175	2.287	0.248	6	<0.0001	CDF	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	1.964117	0.6547057	3	27.87	<0.0001	Significant Effect
Error	0.2818737	0.02348948	12			
Total	2.245991		15			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Mod Levene Equality of Variance	0.5783	5.953	0.6403	Equal Variances
Variances	Levene Equality of Variance	2.276	5.953	0.1319	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.8729	0.8408	0.0302	Normal Distribution

96h Survival Rate Summary

C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Lab Control	4	1	1	1	1	1	1	0	0.0%	0.0%
5		4	0.95	0.7909	1	1	0.8	1	0.05	10.53%	5.0%
10		4	0.7	0.3818	1	0.8	0.4	0.8	0.1	28.57%	30.0%
20		4	0.2	0	0.4598	0.2	0	0.4	0.08165	81.65%	80.0%
40		4	0	0	0	0	0	0	0		100.0%
80		4	0	0	0	0	0	0	0		100.0%

Angular (Corrected) Transformed Summary

C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Lab Control	4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
5		4	1.286	1.096	1.475	1.345	1.107	1.345	0.05953	9.26%	4.43%
10		4	1.002	0.6655	1.338	1.107	0.6847	1.107	0.1056	21.09%	25.55%
20		4	0.4594	0.161	0.7578	0.4636	0.2255	0.6847	0.09377	40.82%	65.85%
40		4	0.2255	0.2255	0.2256	0.2255	0.2255	0.2255	0	0.0%	83.24%
80		4	0.2255	0.2255	0.2256	0.2255	0.2255	0.2255	0	0.0%	83.24%

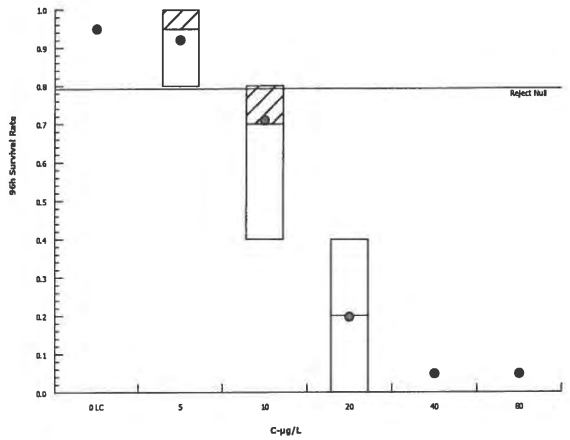
CETIS Analytical Report

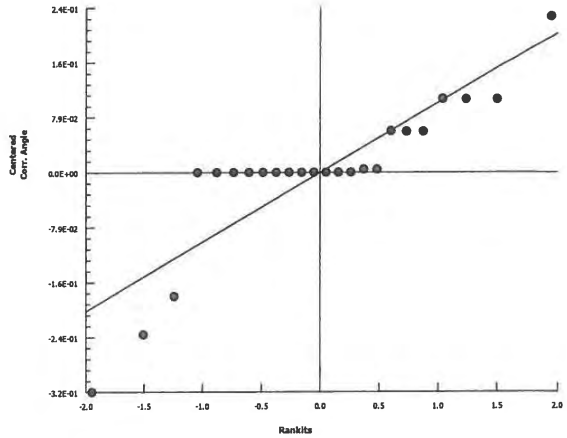
Report Date: 22 Feb-22 09:15 (p 2 of 2)
Test Code: 220215cdra | 19-8470-526

Ceriodaphnia 96-h Acute Survival Test — **Nautilus Environmental (CA)**

Analysis ID:	00-3579-6983	**Endpoint:**	96h Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	22 Feb-22 9:14	**Analysis:**	Parametric-Control vs Treatments	**Official Results:**	Yes

Graphics





CETIS Analytical Report

Report Date: 24 Feb-22 12:35 (p 1 of 2)
Test Code: 220215cdra | 19-8470-526

Ceriodaphnia 96-h Acute Survival Test — Nautilus Environmental (CA)

Analysis ID:	11-9844-5534	**Endpoint:**	48h Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	24 Feb-22 12:35	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	NOEL	LOEL	TOEL	TU
Angular (Corrected)	NA	C > T	NA	NA	17.5%	10	20	14.14	

Steel Many-One Rank Sum Test

Control	vs	C-µg/L	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)
Lab Control		5	18	10	1	6	0.7500	Asymp	Non-Significant Effect
		10	12	10	1	6	0.1003	Asymp	Non-Significant Effect
		20*	10	10	0	6	0.0276	Asymp	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	1.181448	0.3938158	3	24.26	<0.0001	Significant Effect
Error	0.1948283	0.01623569	12			
Total	1.376276		15			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Mod Levene Equality of Variance	1.997	5.953	0.1684	Equal Variances
Variances	Levene Equality of Variance	2.175	5.953	0.1440	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.7235	0.8408	0.0003	Non-normal Distribution

48h Survival Rate Summary

C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Lab Control	4	1	1	1	1	1	1	0	0.0%	0.0%
5		4	1	1	1	1	1	1	0	0.0%	0.0%
10		4	0.8	0.5402	1	0.8	0.6	1	0.08165	20.41%	20.0%
20		4	0.4	0.1402	0.6598	0.4	0.2	0.6	0.08165	40.82%	60.0%
40		4	0	0	0	0	0	0	0		100.0%
80		4	0	0	0	0	0	0	0		100.0%

Angular (Corrected) Transformed Summary

C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Lab Control	4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
5		4	1.345	1.345	1.346	1.345	1.345	1.345	0	0.0%	0.0%
10		4	1.111	0.813	1.41	1.107	0.8861	1.345	0.09377	16.87%	17.38%
20		4	0.6798	0.4052	0.9544	0.6847	0.4636	0.8861	0.08628	25.38%	49.47%
40		4	0.2255	0.2255	0.2256	0.2255	0.2255	0.2255	0	0.0%	83.24%
80		4	0.2255	0.2255	0.2256	0.2255	0.2255	0.2255	0	0.0%	83.24%

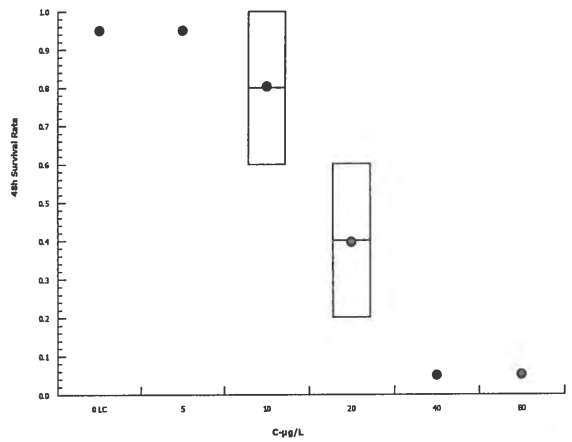
CETIS Analytical Report

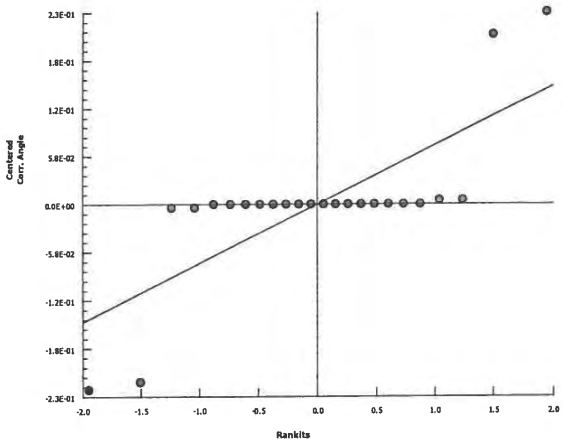
Report Date: 24 Feb-22 12:35 (p 2 of 2)
Test Code: 220215cdra | 19-8470-526

Ceriodaphnia 96-h Acute Survival Test — Nautilus Environmental (CA)

Analysis ID:	11-9844-5534	**Endpoint:**	48h Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	24 Feb-22 12:35	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Graphics





CETIS Analytical Report

Report Date: 22 Feb-22 09:15 (p 1 of 1)
Test Code: 220215cdra | 19-8470-526

Ceriodaphnia 96-h Acute Survival Test — **Nautilus Environmental (CA)**

Analysis ID:	12-1776-6242	**Endpoint:**	96h Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	22 Feb-22 9:14	**Analysis:**	Trimmed Spearman-Kärber	**Official Results:**	Yes

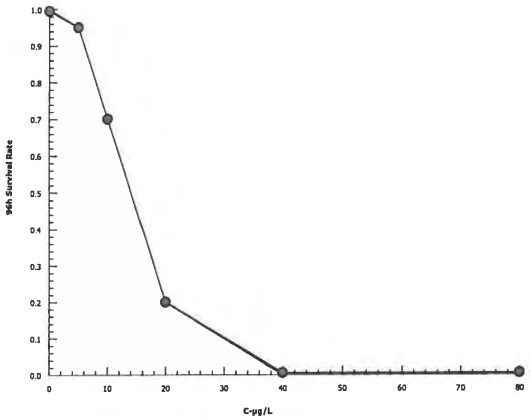
Trimmed Spearman-Kärber Estimates

Threshold Option	Threshold	Trim	Mu	Sigma	EC50	95% LCL	95% UCL
Control Threshold	0	5.00%	1.111	0.04562	12.91	10.46	15.92

96h Survival Rate Summary

			Calculated Variate(A/B)								
C-µg/L	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
0	Lab Control	4	1	1	1	0	0	0.0%	0.0%	20	20
5		4	0.95	0.8	1	0.05	0.1	10.53%	5.0%	19	20
10		4	0.7	0.4	0.8	0.1	0.2	28.57%	30.0%	14	20
20		4	0.2	0	0.4	0.08165	0.1633	81.65%	80.0%	4	20
40		4	0	0	0	0	0		100.0%	0	20
80		4	0	0	0	0	0		100.0%	0	20

Graphics



CETIS Analytical Report

Report Date: 24 Feb-22 12:35 (p 1 of 1)
Test Code: 220215cdra | 19-8470-526

Ceriodaphnia 96-h Acute Survival Test — Nautilus Environmental (CA)

Analysis ID:	11-1474-8411	**Endpoint:**	48h Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	24 Feb-22 12:35	**Analysis:**	Untrimmed Spearman-Kärber	**Official Results:**	Yes

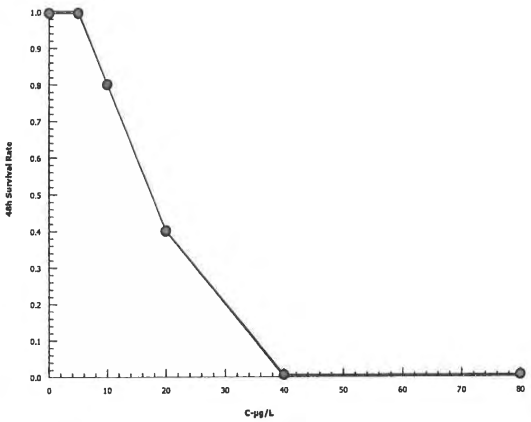
Spearman-Kärber Estimates

Threshold Option	Threshold	Trim	Mu	Sigma	EC50	95% LCL	95% UCL
Control Threshold	0	0.00%	1.211	0.04257	16.25	13.35	19.76

48h Survival Rate Summary

										Calculated Variate(A/B)	
C-µg/L	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
0	Lab Control	4	1	1	1	0	0	0.0%	0.0%	20	20
5		4	1	1	1	0	0	0.0%	0.0%	20	20
10		4	0.8	0.6	1	0.08165	0.1633	20.41%	20.0%	16	20
20		4	0.4	0.2	0.6	0.08165	0.1633	40.82%	60.0%	8	20
40		4	0	0	0	0	0		100.0%	0	20
80		4	0	0	0	0	0		100.0%	0	20

Graphics

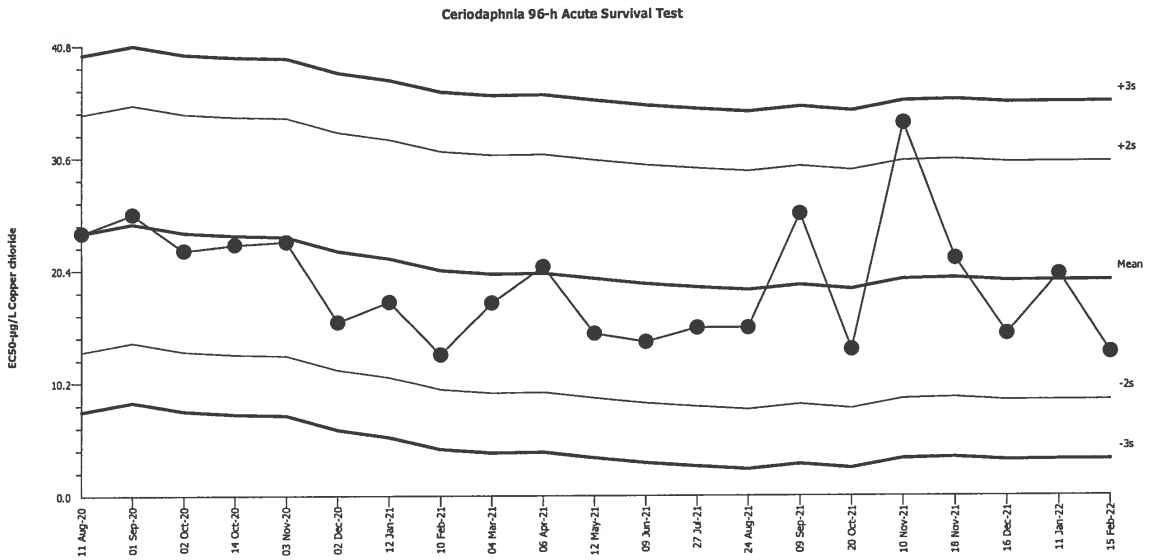


CETIS QC Plot

Report Date: 22 Feb-22 09:15 (1 of 1)

Ceriodaphnia 96-h Acute Survival Test — **Nautilus Environmental (CA)**

Test Type:	Survival (96h)	**Organism:**	Ceriodaphnia dubia (Water Flea)	**Material:**	Copper chloride
Protocol:	EPA/821/R-02-012 (2002)	**Endpoint:**	96h Survival Rate	**Source:**	Reference Toxicant-REF



Mean:	19.43	**Count:**	20	**-2s Warning Limit:**	8.643	**-3s Action Limit:**	3.252
Sigma:	5.391	**CV:**	27.70%	**+2s Warning Limit:**	30.21	**+3s Action Limit:**	35.6

Quality Control Data

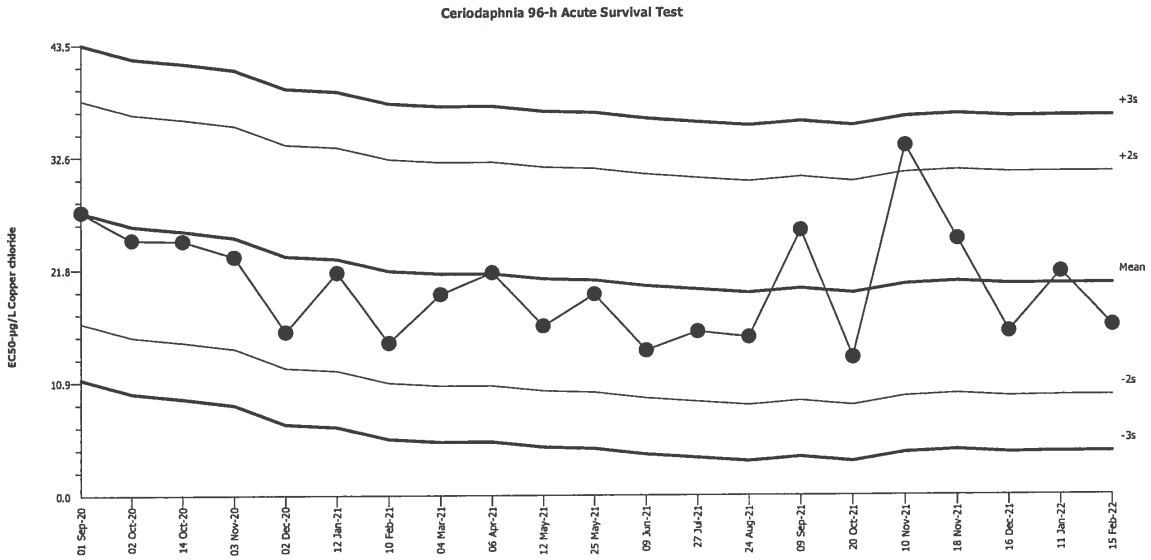
Point	Year	Month	Day	Time	QC Data	Delta	Sigma	Warning	Action	Test ID	Analysis ID
1	2020	Aug	11	14:10	23.78	4.354	0.8077			10-2942-2946	03-2270-9930
2		Sep	1	16:40	25.49	6.061	1.124			08-0309-6057	08-6836-5081
3		Oct	2	13:20	22.19	2.761	0.5122			17-6681-3422	06-7614-6503
4			14	14:35	22.72	3.294	0.611			16-2893-4303	19-0938-0140
5		Nov	3	15:55	22.97	3.544	0.6574			21-1104-6548	14-3781-8992
6		Dec	2	15:10	15.69	-3.738	-0.6934			05-6044-5446	17-1353-5910
7	2021	Jan	12	15:20	17.51	-1.918	-0.3558			04-7387-5530	19-1299-4588
8		Feb	10	13:55	12.75	-6.684	-1.24			08-3148-4658	06-6989-2045
9		Mar	4	16:25	17.41	-2.019	-0.3745			15-8568-0690	17-8564-8570
10		Apr	6	15:50	20.71	1.275	0.2366			08-3369-8973	05-2050-6997
11		May	12	15:10	14.64	-4.789	-0.8884			10-4472-6774	07-9301-5016
12		Jun	9	14:45	13.89	-5.543	-1.028			11-5497-5585	09-4665-0689
13		Jul	27	15:25	15.16	-4.273	-0.7926			11-0452-3526	16-6097-3734
14		Aug	24	14:30	15.16	-4.273	-0.7926			16-7751-9851	12-8178-8398
15		Sep	9	16:10	25.49	6.061	1.124			20-4067-7008	08-9042-7975
16		Oct	20	15:35	13.2	-6.235	-1.157			05-1097-3999	04-4068-7551
17		Nov	10	16:15	33.71	14.28	2.649	(+)		13-9846-9861	13-7049-3150
18			18	14:30	21.44	2.005	0.372			17-9444-3715	09-3342-3577
19		Dec	16	17:20	14.6	-4.827	-0.8953			14-6159-9603	07-8985-1975
20	2022	Jan	11	15:00	20	0.57	0.1057			16-5501-6237	05-0045-3257
21		Feb	15	15:20	12.91	-6.524	-1.21			19-8470-5266	12-1776-6242

CETIS QC Plot

Report Date: 24 Feb-22 12:37 (1 of 1)

Ceriodaphnia 96-h Acute Survival Test — **Nautilus Environmental (CA)**

Test Type:	Survival (96h)	**Organism:**	Ceriodaphnia dubia (Water Flea)	**Material:**	Copper chloride
Protocol:	EPA/821/R-02-012 (2002)	**Endpoint:**	48h Survival Rate	**Source:**	Reference Toxicant-REF



Mean:	20.32	**Count:**	20	**-2s Warning Limit:**	9.528	**-3s Action Limit:**	4.134
Sigma:	5.394	**CV:**	26.50%	**+2s Warning Limit:**	31.1	**+3s Action Limit:**	36.5

Quality Control Data

Point	Year	Month	Day	Time	QC Data	Delta	Sigma	Warning	Action	Test ID	Analysis ID
1	2020	Sep	1	16:40	27.32	7.001	1.298			08-0309-6057	13-4550-4645
2		Oct	2	13:20	24.62	4.303	0.7977			17-6681-3422	21-0962-5743
3			14	14:35	24.54	4.216	0.7815			16-2893-4303	07-1974-0332
4		Nov	3	15:55	22.97	2.654	0.492			21-1104-6548	13-5395-5599
5		Dec	2	15:10	15.69	-4.628	-0.858			05-6044-5446	02-4199-0259
6	2021	Jan	12	15:20	21.44	1.115	0.2068			04-7387-5530	04-5942-7585
7		Feb	10	13:55	14.64	-5.679	-1.053			08-3148-4658	06-6270-1363
8		Mar	4	16:25	19.32	-1.001	-0.1856			15-8568-0690	04-7282-9173
9		Apr	6	15:50	21.44	1.115	0.2068			08-3369-8973	15-7062-8367
10		May	12	15:10	16.25	-4.075	-0.7555			10-4472-6774	18-7863-4495
11			25	13:40	19.32	-1.001	-0.1856			21-4130-2067	13-1005-5541
12		Jun	9	14:45	13.89	-6.433	-1.193			11-5497-5585	19-7551-0075
13		Jul	27	15:25	15.69	-4.628	-0.858			11-0452-3526	09-9143-0934
14		Aug	24	14:30	15.16	-5.163	-0.9571			16-7751-9851	03-4371-5491
15		Sep	9	16:10	25.49	5.171	0.9587			20-4067-7008	00-6621-1485
16		Oct	20	15:35	13.2	-7.125	-1.321			05-1097-3999	02-5784-0896
17		Nov	10	16:15	33.64	13.32	2.469	(+)		13-9846-9861	12-8053-6292
18			18	14:30	24.62	4.303	0.7977			17-9444-3715	07-0881-4173
19		Dec	16	17:20	15.67	-4.65	-0.862			14-6159-9603	17-4700-6976
20	2022	Jan	11	15:00	21.44	1.115	0.2068			16-5501-6237	11-4992-7582
21		Feb	15	15:20	16.25	-4.075	-0.7555			19-8470-5266	11-1474-8411

96-hour Freshwater Acute Bioassay
Static-Renewal Conditions
DF-002

Water Quality Measurement & Test Organism Survi

Client: Internal
Sample ID: $CuCl_2$
Test No.: 220215cdra

Test Species: *C. dubia*
Start Date/Time: 2/15/2022 1520
End Date/Time: 2/19/2022 1445

	Tech Initials				
	0	24	48	72	96
Counts:	GM	GM	GM	KL	RT
Readings:	KL	GM	GM	RT	RT
Dilutions made by:	GM	--	GM	--	--
High conc. made (µg/L):	80	--	20	--	--
Vol. Cu stock added (mL):	3.2	--	0.8	--	--
Final Volume (mL):	400	--	400	--	--

Cu stock concentration (µg/L): 10,000

Concentration µg/L	Rand #	Number of Live Organisms					Conductivity (µmhos/cm)					Temperature (°C)					Dissolved Oxygen (mg/L) GM					pH (units)				
		0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96
Lab Control	6	5	5	5	5	5	187	194	i195	182	210	20.7	20.4	i19.6	20.7	19.7	8.8	9.0	f8.7	9.0	8.9	8.15	8.13	f8.16	8.24	8.33
	16	5	5	5	5	5			f215					f20.1					f9.6					f7.89		
	5	5	5	5	5	5												(B)	f9.3							
	15	5	5	5	5	5																				
5	24	5	5	5	5	5	187	196	i191	182	211	20.7	20.4	i19.6	20.8	19.7	8.8	8.9	f9.2	9.0	8.9	8.18	8.15	f8.2	8.23	8.32
	21	5	5	5	5	5			f215					f20.1					f9.5					f7.89		
	9	5	5	5	4	4																				
	1	5	5	5	5	5																				
10	2	5	5	4	4	4	187	194	i191	181	211	20.6	20.6	i19.6	20.7	19.7	8.9	8.9	f9.2	9.0	9.0	8.18	8.12	f8.22	8.22	8.31
	4	5	5	3	3	2			f215					f20.1					f9.2					f7.90		
	13	5	5	5	5	4																				
	12	5	5	4	4	4																				
20	22	5	3	1	1	1	187	193	i191	180	204	20.6	20.6	i19.7	20.3	19.7	8.9	8.8	f9.1	9.0	9.0	8.20	8.15	f8.23	8.21	8.32
	17	5	4	3	2	1			f205					f20.1					f9.2					f7.92		
	10	5	4	2	1	0																				
	20	5	3	2	2	2																				
40	23	5	0				187	192	i –	–	–	20.6	20.6	i –	–	–	8.8	8.8	i –	–	–	8.18	8.15	i –	–	–
	11	5	0				(A)	203	f –			(A)	20.2	f –			(A)	9.0	f –			(A)	7.80	f –		
	18	5	0																							
	8	5	0																							
80	19	5	0				186	193	i –	–	–	20.6	20.5	i –	–	–	8.9	8.8	i –	–	–	8.18	8.16	i –	–	–
	7	5	0				(A)	201	f –			(A)	19.9	f –			(A)	9.3	f –			(A)	7.82	f –		
	3	5	0																							
	14	5	0																							

Rand # QC: GM
Initial Count QC'd by: HM

Environmental Chamber: C.

Animal Source/Date Received: Internal / NA

Age at Initiation: < 24 hr

	Feeding Times				
	0	24	48	72	96
AM:	--	--	1510	--	--
PM:	--	--	--	--	--

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

Organisms fed prior to initiation, circle one (y / n) (A) Q18 GM 2/16/22 (B) Q18 GM 2/17/22

QC Check: RT 2/19/22

Final Review: AES 2/24/22

Enthalpy Analytical. 4340 Vandever Avenue. San Diego, CA 92120.

FINAL
OPERATIONS AND MAINTENANCE (O&M) MANUAL
for
OUTFALL 029 – BIOLOGICAL WASTEWATER TREATMENT PLANT

BAE SYSTEMS OSI
RADFORD ARMY AMMUNITON PLANT
RADFORD, VIRGINIA

Original Prepared by URS: September 2000

Revised by BAE: September 2020

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete, i am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Michael Bocek
Name

Signature

General Manager, BAE Systems
Title

OCTOBER 20, 2020
Date

Anthony J. Kazor
Name

Signature

Lieutenant Colonel, US Army, Commanding Radford Army Ammunition Plant
Title

10 NOV 2020
Date

TABLE OF CONTENTS

1.0 INTRODUCTION 5

1.1 TITLE PAGE 5
1.2 TABLE OF CONTENTS 5
1.3 PURPOSE OF MANUAL 5

2.0 DESCRIPTION OF WASTES AND TREATMENT FACILITIES 9

2.1 BRIEF DESCRIPTION OF WASTE GENERATION 9
2.2 CHARACTERIZATION OF WASTES 9
2.3 BRIEF DESCRIPTION OF TREATMENT TYPE 9
2.4 DESCRIPTION OF PURPOSE AND FUNCTION OF INDIVIDUAL TREATMENT 9
2.4.1 Bar Screen and Lift Station 9
2.4.2 Equalization Basins 9
2.4.3 Rotating Biological Contactors 10
2.4.4 Clarifiers 10
2.4.5 Thickener 10
2.4.6 Aerobic Digesters 10
2.4.7 Conditioning Tank and Mix Tank 11
2.4.8 Sludge Press 11
2.4.9 Sludge Holding Tanks 11
2.5 FLOW DIAGRAMS SHOWING TREATMENT COMPONENTS 11

3.0 PERMITS AND STANDARDS 15

3.1 IDENTIFICATION OF PERMITS 15
3.1.1 Purpose of Permit with Reference to Copy in Appendix 15
3.1.2 Permitting Authority 15
3.1.3 Permit Number 15
3.1.4 Brief Description of Permit Requirements 15
3.2 SPILL PROCEDURES 16
3.2.1 Outline of Regulations for Spills 16
3.2.2 Spill Reporting Requirements 16

4.0 OPERATION AND CONTROL OF TREATMNT FACILITIES 17

4.1 GENERAL INFORMATION FOR EACH UNIT PROCESS 17
4.1.1 Bar Screen and Lift Station 17
4.1.2 Equalization Basins 19
4.1.3 Rotating Biological Contactors 20
4.1.4 Clarifiers 22
4.1.5 Thickener 23
4.1.6 Aerobic Digesters 24
4.1.7 Conditioning Tank and Mix Tank 26
4.2 SPECIFIC INFORMATION FOR EACH UNIT PROCESS 28
4.2.1 Bar Screen and Lift Station 28
4.2.2 Equalization Basins 29

4.2.3 Rotating Biological Contactors *30*
4.2.4 Clarifiers *30*
4.2.5 Thickener *31*
4.2.6 Aerobic Digesters *32*
4.2.7 Conditioning Tank and Mix Tank *32*
4.2.8 Sludge Press *33*

5.0 FACILITY MAINTENANCE 33

5.1 CONCEPTUAL DESCRIPTION OF MAINTENACE PROGRAM 33
5.2 PLANNING AND SCHEDULING 34
5.2.1 Preventive Maintenance Schedules *34*
5.2.2 Work Order System *36*
5.3 EQUIPMENT RECORD SYSTEM 36
5.3.3 Discussion and Example of Equipment Numbering System *36*
5.3.2 Discussion of Nameplate Data Cards for All Major Equipment *36*
5.3.3 Discussion of Maintenance Records for Major Equipment *37*
5.4 STOREROOM AND INVENTORY SYSTEM 37
5.4.1 List of Spare Parts *37*
5.4.2 Procedures for Stockroom Inventory including Example Forms and Records *37*
5.4.3 List of Tools *37*
5.4.4 Procedures for Tool Use Control *38*

6.0 LABORATORY TESTING 38

6.1 DISCUSSION OF PURPOSE OF SAMPLING AND TESTING PROGRAM 38
6.2 OUTLINE OF SAMPLING AND TESTING PROGRAM 38
6.2.1 Collection of Samples *38*
6.2.2 Discussion of Testing *47*
6.3 DISCUSSION OF LABORATORY RECORDS 58

7.0 RECORDS AND REPORTING 59

7.1 DISCUSSION OF RECORD KEEPING AND REPORTING REQUIREMENTS 59
7.2 REFERENCE EXAMPLES OF RECORDS IN APPENDIX 59
7.2.1 Building 470 Checklists *59*
7.2.2 Sampling and Analysis Forms *59*
7.2.3 Bioplant Daily Log *60*
7.3 DISCUSSION OF MAINTENANCE AND AVAILABILITY OF RECORDS 60
7.3.1 Discharge Monitoring Reports *60*
7.3.2 Building 470 Checklists *60*
7.3.3 Sampling and Analysis Forms *60*
7.3.4 Bioplant Daily Log *60*
7.3.5 Treatment Plant Environmental Management Inspection Form *61*

8.0 EMERGENCY OPERATION PLAN 62

8.1 DESCRIPTION OF EMERGENCY OPERATING PLAN 62
8.2 ANALYSIS OF VULNERABILITY 62

8.3 LISTING OF EMERGENCY EQUIPMENT AND LOCATION 63
8.3.1 Materials 63

8.3.2 Equipment 63
8.4 DESCRIPTION OF MUTUAL AID PROGRAM WITH PARTICIPANT IDENTIFICATION, TYPE OF AID AND PHONE NUMBER 64
8.5 DESCRIPTION OF POLICE AND FIRE COORDINATION WITH PHONE NUMBERS 64

9.0 PERSONNEL 65

9.1 ORGANIZATIONAL STAFFING CHART 65
9.2 OUTLINE OF RESPONSIBILITIES OF ALL OPERATIONAL AND SUPERVISORY PERSONNEL 65
9.2.1 Waste Water Chief Operator 65
9.2.2 Waste Water Operator 65
9.2.3 Utilities Operator B 67
9.2.4 Utilities Operator Trainee 67
9.3 REQUIRED QUALIFICATIONS OF PERSONNEL 68
9.3.1 Waste Water Chief Operator 68
9.3.2 Waste Water Operator 68
9.3.3 Utilities Operator B 68
9.3.4 Utilities Operator Trainee 68
9.4 ATTENDANCE REQUIREMENTS CHART 68
9.5 ROUTINE WORK SCHEDULES 68
9.6 DESCRIPTION OF TRAINING NEEDS AND PROGRAMS 68

10.0 SAFETY 70

10.1 BRIEF DESCRIPTION OF SAFETY PROGRAM 70
10.2 DESCRIPTION OF SAFETY HAZARDS INVOLVED WITH THE OPERATION OF EACH COMPONENT 70
10.2.1 Electrical Hazards 70
10.2.2 Mechanical Equipment Hazards 71
10.2.3 Explosion and Fire Hazards 71
10.2.4 Bacterial Infection 71
10.2.5 Oxygen Deficiency and Noxious Gases 72
10.3 DESCRIPTION AND REQUIREMENTS FOR AN ONGOING PREVENTIVE SAFETY PROGRAM INCLUDING EDUCATION IN SAFETY PROCEDURES AND TRAINING IN FIRST AID AND EMERGENCY PRODURES 72
10.4 LISTING OF ALL EMERGENCY PHONE NUMBERS 72
10.5 LISTING OF ALL AVAILABLE SAFETY EQUIPMENT AND LOCATION 73
10.6 LISITING OF NUMBER AND LOCATION OF FIRST AID KITS AND MANUAL 73
10.7 LISTING OF SAFETY RULES 73
10.8 DISCUSSION OF IMPORTANCE OF GOOD HOUSEKEEPING 75
10.9 DISCUSSION OF ACCIDENT REPORTING 75

11.0 PLANT UTILITIES 76

11.1 LISTING OF UTILITIES SERVICING FACILITY WITH CONTACT -NAME,

ADDRESS AND PHONE NUMBER 76
11.2 EMERGENCY CUT-OFF PROCEDURES 76

11.3 RELIABILITY OF ELECTRICAL SERVICE AND EFFECT ON CONTINUOUS OPERATION 76

APPENDIX A: COPY OF CURRENT PERMIT 77

APPENDIX B: EQUIPMENT MANUALS 82

1.0 INTRODUCTION

1.1 TITLE PAGE

As required by the Virginia Department of Environmental Quality (DEQ) Regulations, a title page is provided on the cover of this manual.

1.2 TABLE OF CONTENTS

As required by the Virginia DEQ Regulations, a table of contents is provided on page i of this manual.

1.3 PURPOSE OF MANUAL

The Radford Army Ammunition Plant (RFAAP) is located west of Route 114 in Montgomery County, Virginia. Route 114 is located off of U.S. 460 in Christiansburg, Virginia. RFAAP is situated north of Interstate 81 in Southwestern Virginia, 46 miles from Roanoke to the northeast and 108 miles from Bristol, Tennessee, to the southwest.

Property belonging to RFAAP totals 6,881 acres. The main explosive manufacturing area, comprised of 4,080 acres, is located in Pulaski and Montgomery counties (see Figure 1). The New River separates the two counties.

RFAAP is a Government-owned, industrial installation whose mission is to manufacture propellants and explosives as needed. RFAAP has both Government and contractor organizations. In March 1995, Alliant Techsystems acquired the Facilities Use Contract to operate RFAAP.

RFAAP has been issued Virginia Pollution Discharge Elimination System (VPDES) Permit Number VA0000248 by the Virginia DEQ regulating discharges to public water from the site. As stated in the permit, Virginia DEQ Regulation 9 VAC 25-31-190 E and 40 CFR 122.41 (e) require proper operation and maintenance of the permitted facility. Compliance with an approved Operations and Maintenance (O&M) Manual ensures this. Section 401 of the Clean Water Act (CWA) requires the permittee to provide opportunity for the State to review the proposed operations of the facility. Each treatment unit must be addressed in an O&M manual. This O&M manual serves Outfall 029 - Biological Waste Water Treatment Plant (Bioplant). The

location of the Bioplant is shown on Figure 2. The O&M manual for Outfall 029 - Industrial Waste Water Pretreatment Appurtenances and Pretreatment Facilities, which comprise the Bioplant Collection System, has been prepared under separate cover.

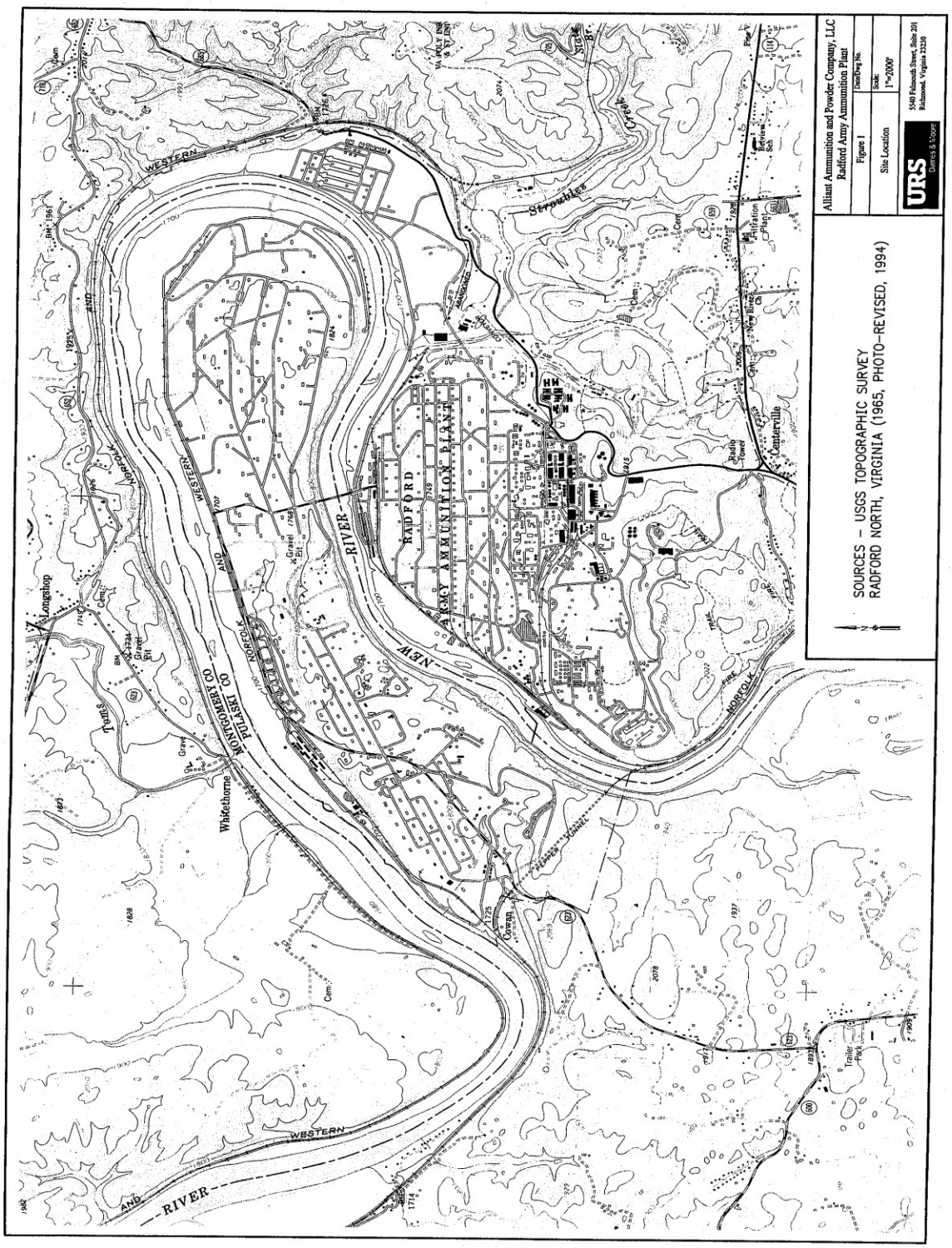


Figure 1: Main RFAAP Manufacturing Location

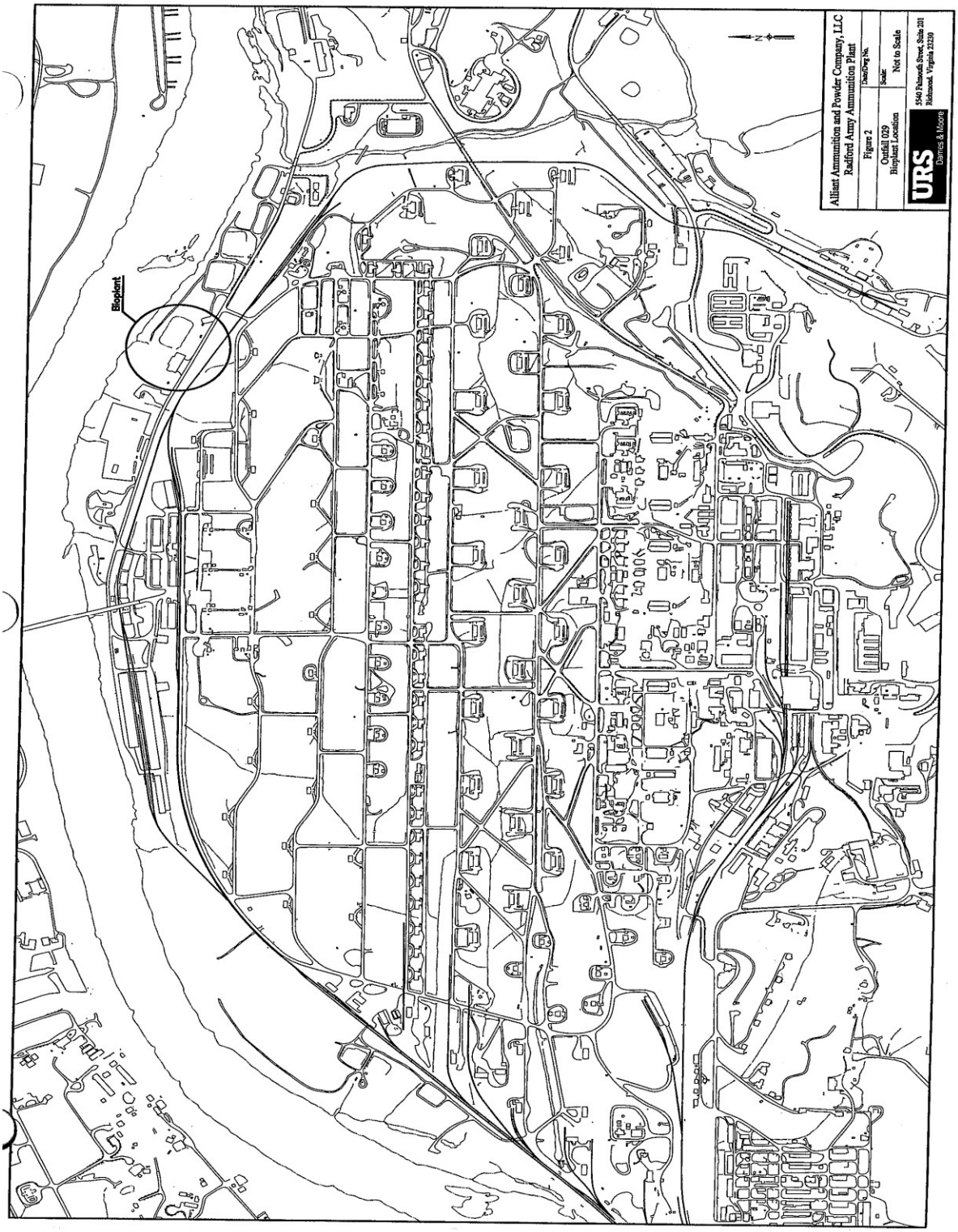


Figure 2: Location of Bioplant

2.0 DESCRIPTION OF WASTES AND TREATMENT FACILITIES

2.1 BRIEF DESCRIPTION OF WASTE GENERATION

The Outfall 029 - Bioplant treats wastewater from the Bioplant Collection System, which receives waste water from the manufacture of nitroglycerin (NG), propellants, munitions manufacturing, still bottoms from solvent recovery.

2.2 CHARACTERIZATION OF WASTES

The waste waters collected by Outfall 029 - Bioplant are characterized as mixed industrial process waste waters from the manufacture of NG, propellants, munitions, and still bottoms from solvent recovery.

2.3 BRIEF DESCRIPTION OF TREATMENT TYPE

Outfall 029 - Bioplant receives both untreated and pretreated waste water from manufacturing processes. The Bioplant utilizes equalization, Rotating Biological Contactors (RBCs), and clarification in the treatment of the wastewater. The biological sludge that is produced is thickened, aerobically digested, and pressed. The sludge is a solid waste and is disposed off-plant by an approved vendor.

2.4 DESCRIPTION OF PURPOSE AND FUNCTION OF INDIVIDUAL TREATMENT COMPONENTS

2.4.1 Bar Screen and Lift Station

The Lift Station receives the wastewater from the Bioplant Collection System, screens out debris, and pumps the water to the Equalization Basin. Chemicals (including phosphoric acid, nutrients, and commercial bioaugmentation products to enhance biological treatment, and sulfuric acid, nitric acid, soda ash, or sodium hydroxide for pH adjustment) are added to the influent waste water stream.

2.4.2 Equalization Basins

The two 3.6 million gallon Equalization Basins mix and begin treating the wastewater using recirculation pumps and aerators to achieve equalization of flow and biological and physical

treatment processes. The effluent wastewater is pumped to the RBCs, but can also be

recycled to the Equalization Basin influent line based on system needs as determined by the operator.

When COD levels in the waste water are low (generally during times of low production or holidays), a supplemental carbon source like solvents such as ethanol and acetone or other readily degradable chemicals can be added prior to the stream entering the EQ basin.

2.4.3 Rotating Biological Contactors

The Bioplant contains fours trains of four RBC units, three of which are currently in use. The RBCs are an aerobic attached-growth biological treatment process used to remove organic matter from the wastewater.. Polyaluminum chloride (PAC) is added to the waste water stream after it leaves the RBCs to assist with the coagulation of the settleable solids in the clarifiers.

2.4.4 Clarifiers

Two 110,000-gallon circular clarifiers are utilized to remove settleable solids prior to discharging the wastewater to the New River. The wastewater can also be returned to the Equalization Basin influent or the RBC influent lines based on system needs as determined by the operator. The sludge collected in the bottom of the clarifiers is pumped to the Thickener.

2.4.5 Thickener

The Thickener consists of a 15,000 gallon circular clarifier that enables further settling of solids. The effluent wastewater is returned to the Equalization Basin influent or the RBC influent lines based on system needs as determined by the operator. The sludge collected in the bottom of the Thickener and the scum collected from the top of the Thickener are normally pumped to the Aerobic Digesters. The sludge can also be pumped to the Sludge Holding Tanks.

2.4.6 Aerobic Digesters

The Aerobic Digesters consist of two 355,000 gallon basins equipped with four aerators each. The sludge is aerated to allow for oxidation of the microorganisms in the sludge, subsequently reducing the volume and increasing the density of the sludge. The effluent wastewater decanted from the digesters is returned to the Equalization Basin influent or the RBC influent lines based on system needs as determined by the operator. The sludge is pumped to the

Conditioning Tank and Mix Tank. The sludge can also be pumped to the three Sludge Holding Tanks (decommissioned former digester units) for temporary storage.

2.4.7 Conditioning Tank and Mix Tank

The Conditioning Tank and Mix Tank work in concert to prepare the sludge for the sludge press. Ferric chloride and lime slurry are added to the sludge in the baffled Conditioning Tank. The sludge is then further mixed with an agitator in the Mix Tank. The conditioned sludge is pumped to the Sludge Press.

2.4.8 Sludge Press

The Sludge Press consists of two recessed plate filter presses. Dewatering of the sludge is achieved by forcing the water from the sludge under high pressure. The effluent water is discharged to either the Equalization Basin influent line or the RBC influent line. The sludge is disposed off-site as a solid waste.

2.4.9 Sludge Holding Tanks

Three decommissioned aerobic digesters (83,000 gallons each) are used as Sludge Holding Tanks. Sludge can be pumped from the thickener to the Sludge Holding Tanks if the digesters are not available to receive fresh sludge. Following storage in the holding tanks, sludge can be pumped to the Aerobic digesters using flexible piping or to the conditioning tanks using existing piping for pressing. If sludge stored in the holding tanks develops a supernatant liquid layer, that layer can be decanted back to the thickener.

2.5 FLOW DIAGRAMS SHOWING TREATMENT COMPONENTS

The layout of the Bioplant treatment area is provided as Figure 3. A flow chart of treatment components is provided as Figure 4. A flow diagram of the Bioplant treatment process is provided as Figure 5.

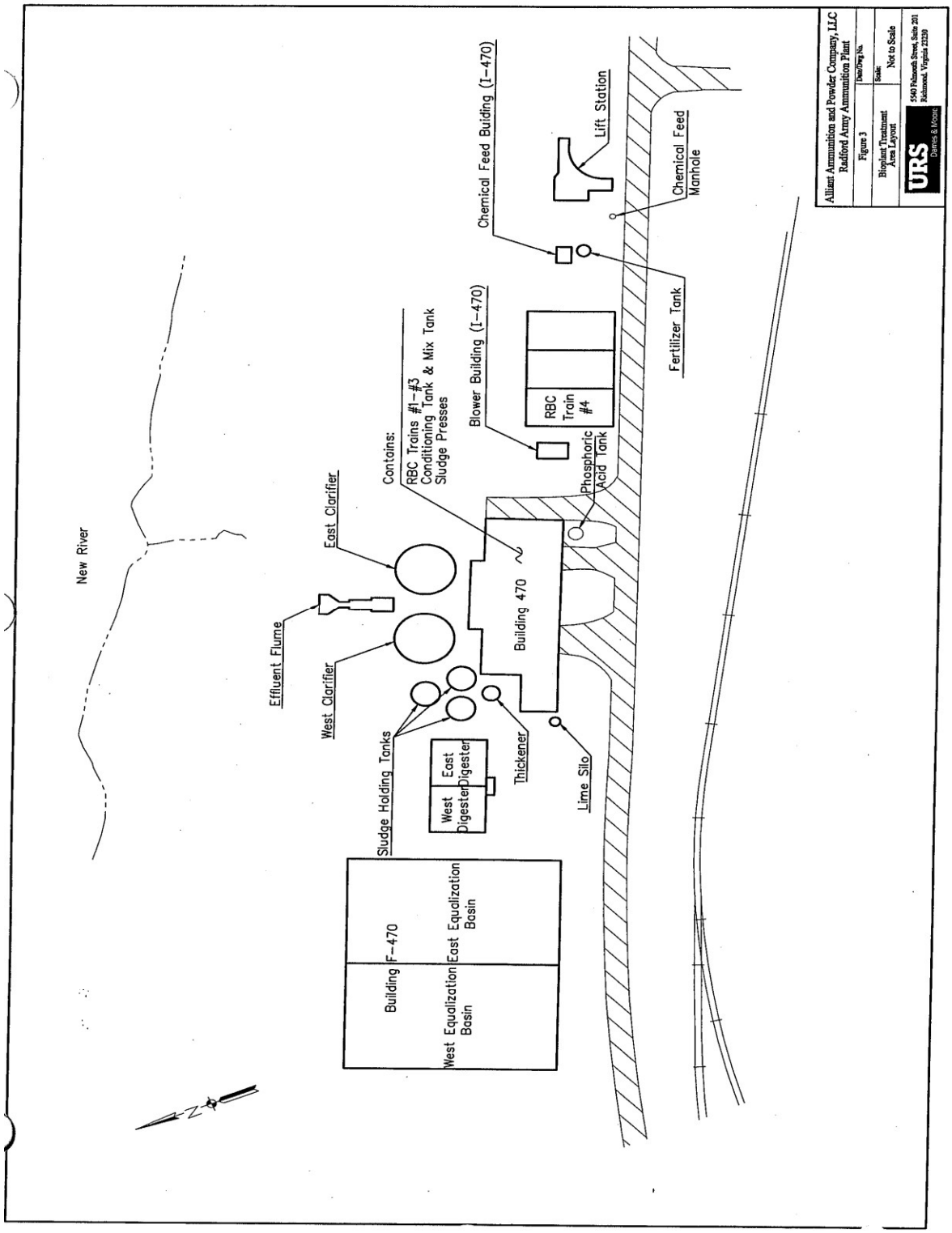


Figure 3: Bioplant Layout

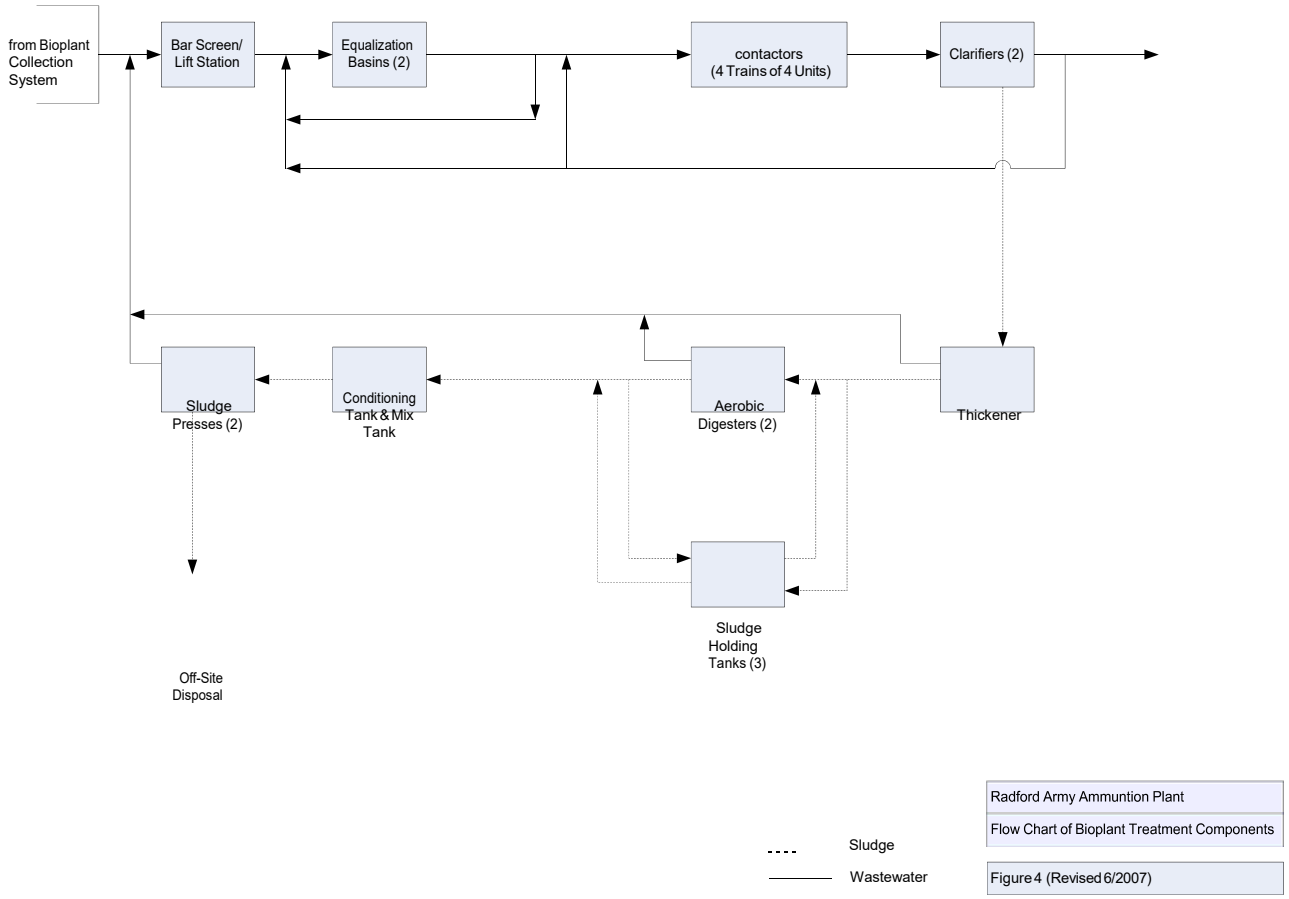


Figure 4: Flow Chart of Treatment Components

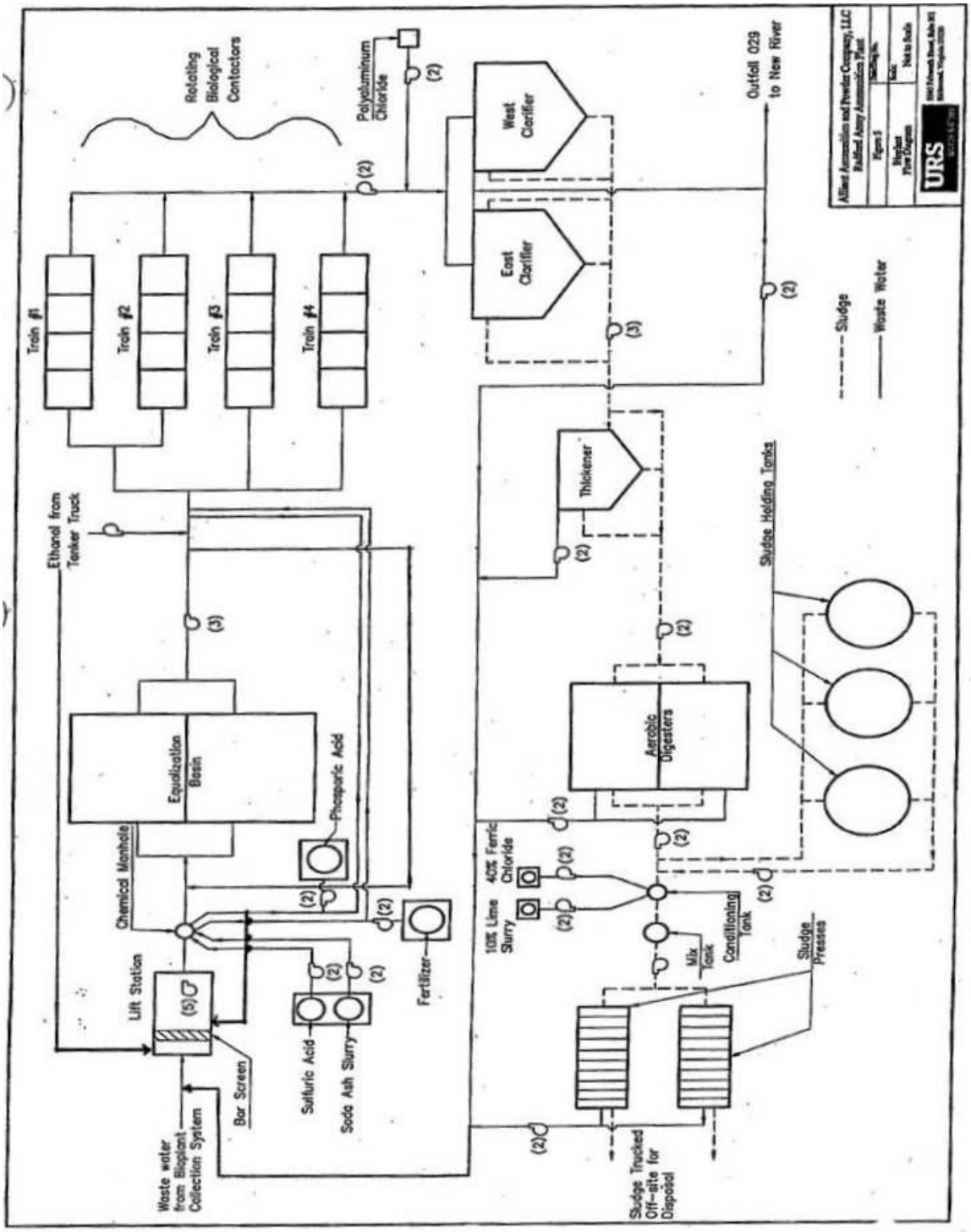


Figure 5: Flow Diagram of the Bioplant Treatment Process

3.0 PERMITS AND STANDARDS

3.1 IDENTIFICATION OF PERMITS

3.1.1 Purpose of Permit with Reference to Copy in Appendix

The purpose of the permit is to define the requirements for the facility to comply with VPDES and CWA regulations. A copy of the permit is provided in Appendix A.

3.1.2 Permitting Authority

The permitted authority for this facility is:

Commonwealth of Virginia

Department of Environmental Quality

Blue Ridge Regional Office

901 Russell Drive
Salem, VA 24153
Telephone (540) 562-6700

Fax (540) 562-6725

3.1.3 Permit Number

The VPDES Permit Number for the facility is VA0000248.

3.1.4 Brief Description of Permit Requirements

The facility permit defines the following requirements for compliance with the permit:

- Industrial effluent limitations;
- Monitoring requirements;
- Reporting requirements;
- Development of a O&M manual;
- Operator requirements;
- Groundwater assessment and monitoring;

- Inspection requirements; and
- Storm water management requirements/pollution prevention.

This document serves as the O&M manual for Outfall 029 - Bioplant. The O&M manual for Outfall 029 - Industrial Waste Water Pretreatment Appurtenances and Pretreatment Facilities, which comprise the Bioplant Collection System, has been prepared under separate cover.

3.2 SPILL PROCEDURES

Spill procedures are maintained in Alliant Techsystems Management Manual Number 3- 1.01, "Environmental, Quality, and Safety Incident Reporting." This manual is updated and maintained on a regular basis. Therefore, to minimize duplication of updating site contacts, phone numbers and other applicable data in numerous documents, this manual can be found in the document control system.

3.2.1 Outline of Regulations for Spills

Please refer to Management Manual, Number 3-1.01, "Environmental, Quality, and Safety Incident Reporting."

3.2.2 Spill Reporting Requirements

Please refer to Management Manual, Number 3-1.01, "Environmental, Quality, and Safety Incident Reporting."

4.0 OPERATION AND CONTROL OF TREATMNT FACILITIES

4.1 GENERAL INFORMATION FOR EACH UNIT PROCESS

General information on the operation of the Bioplant is provided in Standard Procedure Title: 4-42-205, "Biological Wastewater Treatment Plant General Safety Rules." RFAAP will operate in accordance with the most current revision of the procedures; the revisions that are current can be found in the Document Control System.

A computer system is used to control many of the processes, including the operation of pumps and valves and the monitoring of parameters (waste water levels, pH, temperature, etc.). Detailed information on the computer system can be found in Standard 4-42-205: “Biological Wastewater Treatment Plant General Safety Rules,". The most current revision can be found in the Document Control System.

General information and guidelines regarding the sampling, monitoring, and analysis of the Bioplant system to enable appropriate system control can be found in 4-42-205: “Biological Wastewater Treatment Plant General Safety Rules”. The most current revision can be found in the Document Control System.

4.1.1 Bar Screen and Lift Station

4.1.1.1 Physical Description, Function, Flow Routing and Design Efficiency

A lift station is necessary in the Bioplant system to move wastewater from the Bioplant Collection System to the Bioplant. A bar screen prevents the entry of debris that may foul pumps, lines, or valves or damage treatment plant equipment. Five electrically driven pumps under automatic control move the wastewater to the Bioplant. Phosphorous in the form of 75% phosphoric acid and nitrogen in the form of fertilizer (composed of 30% nitrogen) are added to the waste water stream to the encourage the growth of wastewater treatment microorganisms in the Equalization Tanks. Sulfuric acid or nitric acid and soda ash slurry or sodium hydroxide can be added for pH adjustment.

4.1.1.2 Listing of Major Components and Mechanical Equipment

The major components of the Bar Screen and Lift Station include:

- A bar screen with a rake mechanism on a timed cycle;

- Sluice gate and bypass piping;
- Four vertical turbine pumps;
- One vertical turbine pump for emergency use;
- Emergency generator;
- Phosphoric acid tank and two associated metering pumps;
- Fertilizer tank (6,000 gallons);
- Sulfuric acid tank(200 gallons);
- Soda ash tank (100 gallons);
- Chemical manhole.

4.1.1.3 Relationship to Adjacent Units

The Bar Screen and Lift Station receives waste water from the Bioplant Collection System and pumps it to the Equalization Basins.

4.1.1.4 Methods of Control of Unit Process

The rake mechanism on the bar screens operate on a timed cycle. The four active pumps cycle to maintain a preset water level in the pump pit. The pumps are controlled automatically by computer.

4.1.1.5 Discussion of Monitoring

A daily composite sample is analyzed for pH, chemical oxygen demand (COD), and total suspended solids (TSS). Grab samples are taken every four hours and analyzed for pH and DO. The pH, total carbon (TC), and influent water level are monitored continuously by the computer system. Once monthly, the influent flow is sampled for analysis for five-day biological oxygen demand (BOD-5).

4.1.1.6 Discussion of Common Operating Problems and Control

The rake mechanism will halt if the rake becomes jammed. This can be rectified by turning the rake mechanism off and removing the cause of the jam. If necessary and with care, the rake may be reversed to clear the jam.

4.1.2 Equalization Basins

4.1.2.1 Physical Description, Function, Flow Routing and Design Efficiency

The Bioplant contains two covered concrete Equalization Basins (labeled East Equalization Basin and West Equalization Basin) with a volume of approximately 3.6 million gallons each. Use of the basins varies depending upon the plant conditions and treatment level needed.

The Equalization Basins receive raw influent from the Bar Screen and Lift Station. Recirculation pumps and aerators work in concert to achieve complete mixing and equalization of flow. Growth of microorganisms is encouraged by the addition of phosphoric acid. Wastewater is pumped from the basins to the RBCs. The effluent wastewater may also be recycled to the Equalization Basin influent.

4.1.2.2 Listing of Major Components and Mechanical Equipment

The major components of the Equalization Basins include:

- Eight submersible recirculation pumps (four in each basin)
- Five blower-type aerators (two for each basin and one that can be used for either basin
- Three discharge pumps (one for each basin and one that can be used for either basin)

4.1.2.3 Relationship to Adjacent Units

The Equalization Basins receive waste water from the Bar Screen and Lift Station and discharge waste water to the RBCs. The wastewater can also be recycled to the Equalization Basin influent.

4.1.2.4 Methods of Control of Unit Process

The aerators, recirculation pumps, and discharge pumps are manually or automatically controlled by the computer system.

4.1.2.5 Discussion of Monitoring

The pH and total carbon (TC) are monitored continuously by the computer system. Effluent flow from the EQ basin is grab composited and analyzed for pH, and COD. A grab sample of EQ effluent is collected every four hours and tested for pH and dissolved oxygen.

4.1.2.6 Discussion of Common Operating Problems and Control

To prevent air lock in the recirculation pumps, the aerators are not activated prior to activating the pumps. If air does become trapped in the pump discharge, the pumps may have to be air vented.

4.1.3 Rotating Biological Contactors

4.1.3.1 Physical Description, Function, Flow Routing and Design Efficiency

The Bioplant contains four trains of four RBCs units. Three RBCs are currently in use, with the forth available as backup. RBCs are an aerobic attached-growth biological treatment process used to remove organic matter from the wastewater. The rotating biological contactors consist of a series of closely spaced circular disks of high-density polyethylene with carbon black added for ultraviolet resistance. The approximately twelve-foot diameter disks are slowly rotated through the wastewater, allowing the biological growth on the disks to come in contact with the organic matter in the wastewater and the oxygen in the atmosphere.

Surface Area of RBC Unit

	Surface Area for each RBC Unit (ft)	# RBC units	Total Surface Area of Train (ft^2)
Train 1	87,000	4	348,000
Train 2	87,000	4	348,000
Train 3[1]	72,000	4	288,000

Train 4	96,800	4	387,200

[1]Train 3 is not currently in use

If phosphorous and/or nitrogen levels in the waste water are low, phosphoric acid and/or fertilizer can also be added prior to the stream entering the RBCs. When COD levels in the wastewater are low (generally during times of low production or holidays), supplemental solvents or other carbon sources can be added prior to the stream entering the RBCs.

Polyaluminum chloride (PAC or PAX) is added to the wastewater stream after it leaves the RBCs. PAX assists with the coagulation of the settleable solids in the clarifiers.

4.1.3.2 Listing of Major Components and Mechanical Equipment

The major components of the RBCs include:

- Three air spargers (one shared by Trains 1, 2, and 3, and two for Train 4);
- Two ethanol metering pumps; and
- PAC storage containers and two associated metering pumps.

4.1.3.3 Relationship to Adjacent Units

The RBCs receive wastewater from the Equalization Basins and discharge waste water to the Clarifiers.

4.1.3.4 Methods of Control of Unit Process

Operation of the RBCs is computer controlled as discussed in Standard Procedure Title: 4-27-205: “Biological Wastewater Treatment Plant General Safety Rules,". The most current revision can be found in the Document Control System.

4.1.3.5 Discussion of Monitoring

The pH and total carbon (TC) are monitored continuously by the computer system. A grab sample of RBC effluent is collected every four hours and tested for pH and dissolved oxygen.

4.1.3.6 Discussion of Common Operating Problems and Control

The most common problem associated with the RBCs is biomass overgrowth on the RBCs. The air spargers should be used to strip excess biomass from the RBCs along with reversing rotation.

4.1.4 Clarifiers

4.1.4.1 Physical Description, Function, Flow Routing and Design Efficiency

Two 110,000-gallon concrete circular clarifiers (labeled East Clarifier and West Clarifier) are used to remove settleable solids, particularly the floc-like material formed by the biological action of the RBCs. The Clarifiers work on the sedimentation principal. Sludge accumulated on the tank floor is moved by a rake to the center of the tank and continuously pumped to the Thickener. Scum that accumulates on top of the wastewater is moved by rotating surface skimmers to a collection box, where it flows to a scum pit and is pumped to the Thickener. The scum and the sludge can also be pumped directly to the digesters. Effluent water is discharged to the New River.

4.1.4.2 Listing of Major Components and Mechanical Equipment

The major components of the Clarifiers include:

- Three sludge discharge pumps; and
- Two scum pumps.

4.1.4.3 Relationship to Adjacent Units

The Clarifiers receive wastewater from the RBCs. The sludge and scum from the Clarifiers is pumped to the Thickener, though it can also be pumped directly to the Digesters, bypassing the Thickener. Effluent water from the Clarifiers flows to Outfall 029 and is discharged to the New River. The Clarifier effluent can also be recycled to the Equalization Basin influent or the RBC influent lines.

4.1.4.4 Methods of Control of Unit Process

The sludge discharge pumps are controlled by the operator via the computer system.

4.1.4.5 Discussion of Monitoring

A daily composite sample is analyzed for pH, COD, phosphates, and TSS from the west clarifier effluent. The pH and total carbon (TC) are monitored continuously by the computer system.

4.1.4.6 Discussion of Common Operating Problems and Control

Operators should watch for floating sludge, which is caused by gas entrapped in the sludge. The gas is produced by anaerobic reactions and is a result of sludge that is allowed to remain in the digester for too long. The problem can be minimized by the proper continuous pumping of the sludge from the clarifier.

4.1.5 Thickener

4.1.5.1 Physical Description, Function, Flow Routing and Design Efficiency

The Thickener consists of a single circular concrete clarifier of approximately 15,000 gallons that serves to further dewater the sludge. This clarifier also works on the sedimentation principal. Sludge accumulated on the tank floor is moved by a rake to the center of the tank and is periodically or continually pumped to the Aerobic Digesters. Liquid effluent is discharged to either the Equalization Basin influent line or the RBC influent line. Scum that accumulates on top of the wastewater is moved by rotating surface skimmers to a collection box, where it flows to a scum pit and is pumped to the Aerobic Digesters. If needed the sludge can also be pumped to sludge holding tanks.

4.1.5.2 Listing of Major Components and Mechanical Equipment

The major components of the Thickener include:

- Two sludge discharge pumps; and
- Two scum pumps.

4.1.5.3 Relationship to Adjacent Units

The Thickener receives sludge from the Clarifiers and pumps it to the Aerobic Digesters. Liquid effluent is discharged to either the Equalization Basin influent line or the RBC influent line.

Alternatively the thickener sludge can be pumped to the sludge holding tanks. If necessary liquid layer can be decanted from the sludge holding tanks back to the thickener.

Also if additional biomass is needed in the treatment system the thickener sludge can be allowed to overflow back to a manhole before the lift station.

4.1.5.4 Methods of Control of Unit Process

The sludge discharge pumps are controlled by the operator via computer.

4.1.5.5 Discussion of Monitoring

The sludge level in the tank is regularly checked by the operator.

4.1.5.6 Discussion of Common Operating Problems and Control

Common operating problems and control are discussed in Standard Procedure Title: 4-42-205: “Biological Wastewater Treatment Plant General Safety Rules". The most current revision can be found in the Document Control System.

4.1.8 Aerobic Digesters

4.1.6.1 Physical Description, Function, Flow Routing and Design Efficiency

The Aerobic Digesters consist of two 355,000-gallon concrete basins (labeled East Digester and West Digester) equipped with four aerators each. The sludge is aerated for an extended period of time to allow for oxidation of the microorganisms in the sludge, subsequently reducing the volume and increasing the density of the sludge. The Digesters are periodically decanted, allowing the effluent water to discharge to either the Equalization Basin influent line. The sludge level in the basins is monitored and the sludge is periodically pumped to the Conditioning Tank and Mix Tank. The sludge can also be pumped to three sludge holding tanks (decommissioned digester tanks) for temporary

storage if the plant throughput is greater than the capacity of the filter press.

4.1.6.2 Listing of Major Components and Mechanical Equipment

The major components of the Aerobic Digesters include:

- Eight aerators (four for each Digester);
- Two discharge pumps;
- Two video cameras and monitors.

4.1.6.3 Relationship to Adjacent Units

The Aerobic Digesters receives sludge from the Thickener and discharges it to the Conditioning Tank and Mix Tank. The decanted water is discharged to the Lift Station.

4.1.6.4 Methods of Control of Unit Process

The aerators are controlled by the computer system, while the discharge pumps are manually controlled by the operator. Video cameras transmit a continuous image of the surface of each digester to the operator to assist with monitoring the foam depth.

4.1.6.5 Discussion of Monitoring

A weekly grab sample of the Digester is analyzed for pH, DO, total suspended solid and volatile suspended solids.

4.1.6.6 Discussion of Common Operating Problems and Control

The operators should monitor the degree of foaming in the Digester. The aerator operation (frequency, length, and units in use) should be controlled to prevent the foam from exceeding the digester height. The foam height should be maintained to provide approximately one foot of free board in the digester. If operational controls are not sufficient commercial anti-foam additives may be used to prevent excess foaming.

4.1.8 Conditioning Tank and Mix Tank

4.1.7.1 Physical Description, Function, Flow Routing and Design Efficiency

The Conditioning Tank consists of a 470-gallon fiberglass tank with a baffle-type mixer and the Mix Tank consists of a 4,000-gallon fiberglass tank with an agitator. The sludge enters the Conditioning Tank from the Aerobic Digesters. Ferric chloride (40%) and lime slurry (10%) are added to the sludge in the Conditioning Tank to improve the coalescing properties of the sludge in the Sludge Press.

4.1.7.2 Listing of Major Components and Mechanical Equipment

The major components of the Conditioning Tank and Mix Tank include:

- Ferric chloride tank (and two associated metering pumps);
- Lime silo (Building G-470: includes dry lime storage, lime slaker, lime slurry tank, and two associated metering pumps); and
- Three sludge feed pumps;

4.1.7.3 Relationship to Adjacent Units

The Conditioning Tank and Mix Tank receive sludge from the Aerobic Digesters or thickener and discharge to the Sludge Press.

4.1.7.4 Methods of Control of Unit Process

The operation of the Conditioning Tank and Mix Tank is controlled by the sludge processing computer system.

4.1.7.5 Discussion of Monitoring

The sludge levels in the Conditioning Tank and Mix Tank are monitored by the sludge processing computer system.

4.1.7.6 Discussion of Common Operating Problems and Control

No common problems are associated with the Conditioning Tank and Mix Tank.

4.1.8 Sludge Press

4.1.8.1 Physical Description, Function, Flow Routing and Design Efficiency

The Sludge Press consists of two fixed-volume, recessed plate filter presses. The first press has a filter area of 683 square feet while the second press has been expanded to contain a total of 1171 square feet of filter area. Dewatering of the sludge is achieved by forcing the water from the sludge under high pressure. The effluent water is discharged to Bioplant influent line. The dewatered sludge is allowed to drop into a roll-off container and disposed off-site. The sludge is managed under a Sludge Management Plan which is maintained the Environmental Department Files.

4.1.8.2 Listing of Major Components and Mechanical Equipment

The major components of the Sludge Press include:

- Filtered water storage tanks;
- Three diaphragm squeeze water pumps;
- High pressure cloth wash pump;
- 785-gallon tank for 6% HCl (and associated pump);
- Roll-off container;

4.1.8.3 Relationship to Adjacent Units

The Sludge Press receives sludge from the Conditioning Tank and Mix Tank and discharges effluent water to the Bioplant influent line. The dewatered sludge is disposed off-site.

4.1.8.4 Methods of Control of Unit Process

The Sludge Press is controlled by the Sludge Press computer system.

4.1.8.5 Discussion of Monitoring

The Sludge Press computer system continuously monitors the status of the press process.

4.1.8.6 Discussion of Common Operating Problems and Control

Common operating problems are discussed in Standard Procedure Title:4-42-353,"Bioplant Sludge Processing." The most current revision can be found in the Document Control System.

4.2 SPECIFIC INFORMATION FOR EACH UNIT PROCESS

4.2.1 Bar Screen and Lift Station

4.2.1.1 Normal Operation

The Bar Screen and Lift Station serve to screen and then pump the wastewater from the Bioplant Collection System to the Equalization Basins in the Bioplant. Use of the five pumps is rotated to provide for equal wear of the mechanical parts. The container that collects debris from the screens should be emptied on a regular basis.

Phosphoric acid (75%) and fertilizer (with a 30% nitrogen content) are added to the raw wastewater in the chemical manhole when needed to provide phosphorous and nitrogen, respectively, to augment the biological activity in the Equalization Basin and on the RBC's.

The pH of the wastewater is normally appropriate for the biological activity in the Equalization Basin and other unit processes, but sulfuric acid or soda ash can be added in the lift station to adjust the pH if necessary. Standard operational modes are discussed in further, detail in Standard Procedure Title: 4-42-205: "Biological Wastewater Treatment Plant General Safety Rules." The most current revision can be found in the Document Control System. The addition of nutrients is discussed in further detail in Standard Procedure Title: 4-42-205: "Biological Wastewater Treatment Plant General Safety Rules." The most current revision can be found in the Document Control System.

4.2.1.2 Alternate Operational Modes

If the bar screen malfunctions, gate valves can be adjusted to bypass the screen. If one of the pumps becomes inoperable, the other pumps can be used until the broken pump is repaired.

Other alternate operational modes are discussed in Standard Procedure Title: 4-42-205: "Biological Wastewater Treatment Plant General Safety Rules." The most current revision can be found in the Document Control System.

4.2.1.3 Emergency Operational Modes and Fail-Safe Features

If the bar screen malfunctions, gate valves can be adjusted to bypass the screen. If one of the pumps becomes inoperable, the other pumps can be used until the broken pump is repaired.

Additional emergency operational modes and fail-safe features are discussed in Standard Procedure Title: 4-42-205: "Biological Wastewater Treatment Plant General Safety Rules." The most current revision can be found in the Document Control System.

4.2.2 Equalization Basins

4.2.2.1 Normal Operation

The Equalization Basins are a continuous unit process that is controlled by the operators via the computer system. The aerators and recirculation pumps are controlled by the operators based on the DO levels that are measured every four hours in the basin effluent.

Operators may not enter further than four feet into the covered Equalization Basin area without a Confined Entry Permit from the operating supervisor and RFAAP Safety Office.

Standard operational modes are discussed in further detail in Standard Procedure Title: 4-27-205: "Biological Wastewater Treatment Plant General Safety Rules." The most current revision can be found in the Document Control System.

4.2.2.2 Alternate Operational Modes

In the event of a problem with the primary Equalization Basin, increased flow, or increased organic content, the wastewater can be diverted to the off-line Equalization Basin if the basins are being operated in series. The valves can also be adjusted to recycle the effluent wastewater back to either Equalization Basin if necessary.

Manual operation of the equalization and other alternate operational modes are discussed in Standard Procedure Title: 4-42-205: "Biological Wastewater Treatment Plant General Safety Rules." The most current revision can be found in the Document Control System.

4.2.2.3 Emergency Operational Modes and Fail-Safe Features

In the event of a problem with the primary Equalization Basin, increased flow, or increased organic content, the wastewater can be diverted to the off-line Equalization Basin if the basins are being operated in series. The valves can also be adjusted to recycle the effluent wastewater back to either Equalization Basin if necessary.

Additional emergency operational modes and fail-safe features are discussed in Standard Procedure Title: 4-42-205: "Biological Wastewater Treatment Plant General Safety Rules. " The most current revision can be found in the Document Control System.

4.2.3 Rotating Biological Contactors

4.2.3.1 Normal Operation

The RBCs are a continuous unit process with the flow controlled by the operators via computer. Detailed discussion of normal operations of the RBCs can be found in Standard Procedure Title: 4-42-205: "Biological Wastewater Treatment Plant General Safety Rules. " The most current revision can be found in the Document Control System.

4.2.3.2 Alternate Operational Modes

Solvents such as ethanol or acetone or other readily degradable carbon source can be added to the waste water prior to entering the RBCs if the COD levels in the waste water are not adequate. Additional alternate operational modes are discussed in Standard Procedure Title: 4-42-205: "Biological Wastewater Treatment Plant General Safety Rules." The most current revision can be found in the Document Control System.

4.2.3.3 Emergency Operational Modes and Fail-Safe Features

Emergency operational modes and fail-safe features are discussed in Standard Procedure Title: 4-42-205: "Biological Wastewater Treatment Plant General Safety Rules," The most current revision can be found in the Document Control System.

4.2.4 Clarifiers

4.2.4.1 Normal Operation

Detailed discussion of normal operations of the Clarifiers can be found in Standard Procedure Title: 4-42-205: "Biological Wastewater Treatment Plant General Safety Rules. " The most current revision can be found in the Document Control System.

4.2.4.2 Alternate Operational Modes

Alternate operational modes are discussed in Standard Procedure Title: 4-42-205: "Biological Wastewater Treatment Plant General Safety Rules." The most current revision can be found in the Document Control System.

4.2.4.3 Emergency Operational Modes and Fail-Safe Features

Emergency operational modes and fail-safe features are discussed in Standard Procedure Title: 4-42-205: "Biological Wastewater Treatment Plant General Safety Rules." The most current revision can be found in the Document Control System.

4.2.5 Thickener

4.2.5.1 Normal Operation

The Thickener receives sludge from the Clarifiers and pumps it to the Aerobic Digesters. Liquid effluent is discharged to a manhole in the collection system prior to the Lift Station.

Detailed discussion of normal operations of the Thickener can be found in Standard Procedure Title: 4-42-205: "Biological Wastewater Treatment Plant General Safety Rules. " The most current revision can be found in the Document Control System.

4.2.5.2 Alternate Operational Modes

Sludge can be pumped from the thickener to the holding tanks if the digesters are not available to receive fresh sludge. Following storage in the holding tanks, sludge can be pumped to the Aerobic digesters or to the conditioning tanks for pressing. If sludge stored in the holding tanks develops a supernatant liquid layer, that layer can be decanted back to the thickener.

Also, if additional biomass is needed in the treatment system, the thickener sludge can be allowed to overflow to a manhole in the collection system prior to the Lift Station.

Alternate operational modes are discussed in Standard Procedure Title: 4-42-205: "Biological Wastewater Treatment Plant General Safety Rules." The most current revision can be found in the Document Control System.

4.2.5.3 Emergency Operational Modes and Fail-Safe Features

Emergency operational modes and fail-safe features are discussed in Standard Procedure Title: 4-42-205: "Biological Wastewater Treatment Plant General Safety Rules. " The most current revision can be found in the Document Control System.

4.2.6 Aerobic Digesters

4.2.6.1 Normal Operation

Detailed discussion of normal operations of the Aerobic Digesters can be found in Standard Procedure Title: 4-42-205: "Biological Wastewater Treatment Plant General Safety Rules." The most current revision can be found in the Document Control System.

4.2.6.2 Alternate Operational Modes

A defoaming agent can be manually added to the digesters if excessive foaming is observed.

Additional alternate operational modes are discussed in Standard Procedure Title: 4-42-205: "Biological Wastewater Treatment Plant General Safety Rules." The most current revision can be found in the Document Control System.

4.2.6.3 Emergency Operational Modes and Fail-Safe Features

Emergency operational modes and fail-safe features are discussed in Standard Procedure Title: 4-42-205: "Biological Wastewater Treatment Plant General Safety Rules," The most current revision can be found in the Document Control System.

4.2.7 Conditioning Tank and Mix Tank

4.2.7.1 Normal Operation

Detailed discussion of normal operations of the Conditioning Tank and Mix Tank can be found in Standard Procedure Title: 4-42-205: "Biological Wastewater Treatment Plant General Safety Rules." The most current revision can be found in the Document Control System.

4.2.7.2 Alternate Operational Modes

Alternate operational modes are discussed in Standard Procedure Title: 4-42-205: "Biological Wastewater Treatment Plant General Safety Rules."

4.2.7.3 Emergency Operational Modes and Fail-Safe Features

Emergency operational modes and fail-safe features are discussed in Standard Procedure Title: 4-42-205: "Biological Wastewater Treatment Plant General Safety Rules." The most current revision can be found in the Document Control System.

4.2.8 Sludge Press

4.2.8.1 Normal Operation

Once the sludge has been conditioned, the pump to fill the Sludge Press chambers can be activated. Both presses may operate simultaneously. The Sludge Press process is automated and involves filling diaphragms in each plate with water to apply pressure to the sludge. Once the sludge is dewatered in this fashion, the press is opened and the pressed sludge falls into a roll-off container. Detailed discussion of normal operations of the Sludge Press can be found in Standard Procedure Title: 4-42-353, "Bioplant Sludge Processing." The most current revision can be found in the Document Control System.

4.2.8.2 Alternate Operational Modes

Alternate operational modes are discussed in Standard Procedure Title: 4-42-353, "Bioplant Sludge Processing." The most current revision can be found in the Document Control System.

4.2.8.3 Emergency Operational Modes and Fail-Safe Features

The Sludge Press system is equipped with optical sensors that shut down an operating press if a person enters the active areas of the Press. The Press can be restarted by pushing the reset button once the areas are clear. Additional emergency operational modes and fail-safe features are discussed in Standard Procedure Title: 4-42-353, "Bioplant Sludge Processing. " The most current revision can be found in the Document Control System.

5.0 FACILITY MAINTENANCE

5.1 CONCEPTUAL DESCRIPTION OF MAINTENACE PROGRAM

The RFAAP Procedure Title: 4-27-091 "Preventative Maintenance (PM) Program" defines the purposes and objectives, responsibilities, and procedures for preparing and performing preventive maintenance.

The objective of each preventive maintenance procedure (PM) consists of one or a combination of the following:

- Provide for a safe operation and reduce maintenance cost by detection and correction of defects before they develop into major problems;
- Reduce the frequency of service calls;
- Avoid excessive unexpected shutdowns and delays; and
- Assure the reliability level necessary for production schedules.

If at any time the operator feels that any safety/quality requirements are not being met, they have authority to stop operations and notify supervision immediately.

The facility maintenance program is performed through a task reporting system. Task reports define the maintenance requirements, maintenance frequency, and serve as a record of maintenance activities as defined in the task reporting system. The following schedule and work order system is utilized for system maintenance.

5.2 PLANNING AND SCHEDULING

5.2.1 Preventive Maintenance Schedules

The following preventative maintenance schedule is incorporated by the task report system. RFAAP will operate in accordance with the most current revision of these records and reports; the revisions that are current (as of the submittal of this O&M manual) are included here as examples.

Table 5-1
Building 470/Biological Treatment Plant

System	Task Number	Equipment	Frequency
RBCs	750196-I W	• TC Analyzer	1.00 Week(s)
EQ Basin	940058-1M	• Tank	1.00 Month(s)
EQ Basin	940053-1M	• Pumps	1.00 Month(s)
EQ Basin	940066-1M	• Blower	1.00 Month(s)
Bioplant	750192-1M	• Hydrogen Sulfide Analyzers	1.00 Month(s)

Outfall	750197-1M	• Sampler	1.00 Month(s)
EQ Basin	940054-2M	• Pumps	2.00 Month(s)
EQ Basin	940066-2M	• Blower	2.00 Month(s)
EQ Basin	940058-2M	• Tank	2.00 Month(s)
Sludge Press	940051-2M	• Sludge Press	2.00 Month(s)
EQ Basin	940059-3M	• Pump	3.00 Month(s)
EQ Basin	940065-3M	• Pumps	3.00 Month(s)
Bioplant	940071-3M	• Pump	3.00 Month(s)
Bioplant	940050-3M	• Blower	3.00 Month(s)
Bioplant	940049-3M	• RBCs	3.00 Month(s)
EQ Basin	940059-4M	• Pump	4.00 Month(s)
Bioplant	760047-4M	• Scale	4.00 Month(s)
Bioplant	940050-4M	• Blower	4.00 Month(s)
Emergency Lights	710291-6M	• Critical Defect Tags	6.00 Month(s)
Clarifier	940060-6M	• Pump	6.00 Month(s)
Clarifiers	940056-6M	• Clarifiers	6.00 Month(s)
Thickener	940068-6M	• Pumps	6.00 Month(s)
Thickener	940062-6M	• Pump	6.00 Month(s)
Thickener	940070-6M	• Agitator	6.00 Month(s)
Digester	750191-6M	• Flow Meters	6.00 Month(s)
Digester	940063-6M	• Pump	6.00 Month(s)
Digester	740'108-3M	• Closed Circuit TV	6.00 Month(s)
Sludge Holding Tank	940067-6M	• Pumps	6.00 Month(s)
Sludge Holding Tank	940061-6M	• Pump	6.00 Month(s)
Bioplant	250004-6M	• Hazardous Chemical Tanks and Containment Dikes	6.00 Month(s)
Bioplant	751507-6M	• Monitoring Equipment	6.00 Month(s)
Bioplant	940052-6M	• Blower	6.00 Month(s)
Bioplant	940064-6M	• Pump	6.00 Month(s)
Lift Station	940055-3M	• Pumps	1.00 Year(s)
Lift Station	940055-6M	• Pumps	1.00 Year(s)
RBCs	940052-3M	• Blowers	1.00 Year(s)
RBCs	940057-1Y	• RBCs	1.00 Year(s)
Bioplant	760046-1Y	• Scale	1.00 Year(s)
Bioplant	940071-1M	• Pumps	1.00 Year(s)
Bioplant	710292-1Y	• Critical Defect Tags	1.00 Year(s)

Bioplant	670198-1Y	• Backflow Prevention Devices	1.00 Year(s)
Bioplant	751505-1Y	• Instruments	1.00 Year(s)
Bioplant	71093-1Y	• Critical Defect Tags	1.00 Year(s)
Bioplant	750193-1Y	• Gauges • Regulators	1.00 Year(s)
Bioplant	530032-2Y	• Lifting Devices	2.00 Year(s)
Bioplant	530032-2Y-V	• Lifting Devices	2.00 Year(s)
Lightning Protection	710290-2Y	• Critical Defect Tags	2.00 Year(s)
Bioplant	750194-3Y	• Respirator	3.00 Year(s)
Bioplant	750194-15Y	• Respirator	15.00 Year(s)

5.2.2 Work Order System

The Task Reports serve as the work order and record of maintenance. Staff perform the inspection and complete the PM work sheet by indicating the appropriate blank spaces that the items inspected were "ok" as defined in the task report by the use of check mark, or that the item had a defect found by the use of an X mark.

5.3 EQUIPMENT RECORD SYSTEM

5.3.3 Discussion and Example of Equipment Numbering System

Each of the pumps and valves are numbered sequentially: P-1, P-2, P-3, etc. for the pumps and V-1, V-2, V-3, etc. for the valves. The numbering of the Bioplant equipment is discussed in detail in the following Standard Procedures, which are included in as appendices:

- 4-42-205: Biological Wastewater Treatment Plant General Safety Rules;
- 4-42-207: Daily Equalization Basin Inspection;
- 4-42-357: Bioplant EQ Basin Operation;
- 4-42-353: Bioplant Sludge Processing.

5.3.2 Discussion of Nameplate Data Cards for All Major Equipment

Nameplate data cards are provided on equipment in accordance with the equipment

numbering system discussed above.

5.3.3 Discussion of Maintenance Records for Major Equipment

Maintenance records are discussed in Section 5.2.2.

5.4 STOREROOM AND INVENTORY SYSTEM

5.4.1 List of Spare Parts

Spare parts are available throughout the RFAAP facility. Readily available spare parts include:

- Pumps; • Samplers; • pH meters;
- Temperature meters; and
- Flow meters.

5.4.2 Procedures for Stockroom Inventory including Example Forms and Records

Procedures for stockroom inventory are defined in the operational Standard Procedures provided in Appendices C.

5.4.3 List of Tools

Common tools used in the maintenance of waste water treatment systems are maintained onsite, including:

- pH meters;
- Hand carts;
- Sample buckets;
- Hoses;
- Hose connections;
- Rubber gloves.

5.4.4 Procedures for Tool Use Control

All tools and equipment shall be returned to designated place of storage when not being used.

6.0 LABORATORY TESTING

6.1 DISCUSSION OF PURPOSE OF SAMPLING AND TESTING PROGRAM

Laboratory testing of the wastewater is completed in accordance with and to fulfill the requirements of the VPDES permit. It is critical to the efficient operation and the maintenance of the effluent limits that the testing program provides accurate results.

6.2 OUTLINE OF SAMPLING AND TESTING PROGRAM

6.2.1 Collection of Samples

The purpose of sampling is the collection of a representative portion of the wastewater stream for accurate analysis. There are three primary types of samples: continuous, grab, and composite.

Continuous sampling involves the ongoing monitoring of specific parameters. The parameters for which Outfall 029 is continuously sampled are flow, pH, and temperature. The parameter limits and monitoring requirements are listed in Table 6-1.

Grab samples are collected at a specific time and represent the condition of the wastewater only at that time. Composite samples consist of the combination of samples collected at predetermined intervals over a period of time. Composite samples represent the characteristics of the wastewater over the period of collection.

The weekly, monthly, quarterly, annual, and one-time sampling requirements involve both grab and composite sampling. Tables 6-2, 6-3, 6-5, and 6-6 respectively, outline the sampling parameters and their respective limits, monitoring requirements, and sampling techniques.

Table 6-1 **Outfall 029** **Continuous Sampling**					
Parameter	**Monthly Average**	**Minimum**	**Maximum**	**Monitoring Requirements**	
				Frequency	**Sample Type**
Flow (MGD)	NL	NA	NL	Continuous	Recorded
pH (SU)	NA	6.0	9.0	Continuous	Recorded
Temperature[1]	NA	NA	NL	Continuous	Recorded
Heat Rejected (BTU/Day)[1]	NA	NA	291 million	1/D	Calculated

[1] Heat rejected shall be calculated daily in BTU/day MGD = millions of gallons per day

SU = standard units NA = not applicable NL = no limit

Table 6-2 **Outfall 029** **Weekly Sampling**							
Parameter	**Monthly Average**		**Minimum**	**Maximum**		**Monitoring Requirements**	
						Frequency	**Sample Type**
Biochemical Oxygen Demand (BOD), 5 day	60 mg/l	91.2 kg/d	NA	120 mg/l	243.6 kg/d	1/Week	24 HC
Chemical Oxygen Demand (COD)	200 mg/l	319.3 kg/d	NA	290 mg/l	852.6 kg/d	1/Week	24 HC
Total Suspended Solids (mg/l)	NL	149.1 kg/d	NA	NL	484.2 kg/d	1/Week	24 HC
Oxidized Nitrogen	NA	NA	NA	NL	NA	1/Week	24 HC
2,4-Dinitrotoluene, mg/l	NA	0.41 kg/d	NA	NA	1.04 kg/d	1/Week	Grab

mg/l = milligrams per liter

kg/d = kilograms per day

NA = not applicable

Table 6-3

Outfall 029

Monthly Sampling

Parameter	Monthly Average		Minimum	Maxim			equirements
						Frequency	
Sulfate	NL	3,000 kg/d	NA	NL	6,000 kg/d	1/Month	
COD, influent	NA	NA	NA	NL	NA	1/Month	
BOD, 5 day, influent	NA	NA	NA	NL	NA	1/Month	
TSS, influent	NA	NA	NA	NL	NA	1/Month	

mg/l = milligrams per liter

NA = not applicable

NL = no limit

Table 6-4 Outfall 029 Quarterly Monitoring							
Parameter	**Monthly Average**		**Minimum**	**Maximum**		**Monitoring Requirements**	
						Frequency	**Sample Type**
Acute Whole Effluent Toxicity (WET)	NA		NA	1.0 TUa		1/3 Months	24 HC
Total Chromium	NA	4.05 kg/d	NA	NA	10.1 kg/d	1/3 Months	24 HC
Total Copper	NA	5.30 kg/d	NA	NA	12.3 kg/d	1/3 Months	24 HC
Total Lead	NA	1.17 kg/d	NA	NA	2.52 kg/d	1/3 Months	24 HC
Total Nickel	NA	6.17 kg/d	NA	NA	14.55 kg/d	1/3 Months	24 HC
Total Zinc	NA	3.83 kg/d	NA	NA	9.54 kg/d	1/3 Months	24 HC
Di-n-butyl phthalate	NA	0.099 kg/d	NA	NA	0.20 kg/d	1/3 Months	Grab

ug/l = micrograms per liter

kg/d = kilograms per day

mg/l = milligrams per liter

TUa = Toxic Units Acute

NA = not applicable

Table 6-5
Outfall 029
Annual Monitoring

Parameter	Monthly Average		Minimum	Maximum		Monitoring Requirements	
						Frequency	Sample Type
1,1,1-Trichloroethane	NA	0.077 kg/d	NA	NA	0.19 kg/d	1/Year	Grab
1,1,2-Trichloroethane	NA	0.077 kg/d	NA	NA	0.19 kg/d	1/Year	Grab
1,1-Dichloroethane	NA	0.080 kg/d	NA	NA	0.21 kg/d	1/Year	Grab
1,1-Dichloroethylene	NA	0.059 kg/d	NA	NA	0.091 kg/d	1/Year	Grab
1,2,4-Trichlorobenzene	NA	0.24 kg/d	NA	NA	0.51 kg/d	1/Year	Grab
1,2-Dichlorobenzene	NA	0.28 kg/d	NA	NA	0.59 kg/d	1/Year	Grab
1,2-Dichloroethane	NA	0.24 kg/d	NA	NA	0.77 kg/d	1/Year	Grab
1,2-Dichloropropane	NA	0.55 kg/d	NA	NA	0.84 kg/d	1/Year	Grab
1,2-trans-Dichloroethylene	NA	0.077 kg/d	NA	NA	0.19 kg/d	1/Year	Grab
1,3-Dichlorobenzene	NA	0.11 kg/d	NA	NA	0.16 kg/d	1/Year	Grab
1,3-Dichloropropylene	NA	0.10 kg/d	NA	NA	0.16 kg/d	1/Year	Grab
1,4-Dichlorobenzene	NA	0.055 kg/d	NA	NA	0.10 kg/d	1/Year	Grab
2,4-Dichlorophenol	NA	0.14 kg/d	NA	NA	0.41 kg/d	1/Year	Grab
2,4-Dimethylphenol	NA	0.066 kg/d	NA	NA	0.13 kg/d	1/Year	Grab
2,4-Dinitrophenol	NA	0.26 kg/d	NA	NA	0.45 kg/d	1/Year	Grab

Table 6-5
Outfall 029
Annual Monitoring

Parameter	Monthly Average		Minimum	Maximum		Monitoring Requirements	
						Frequency	Sample Type
2,6-Dinitrotoluene	NA	0.93 kg/d	NA	NA	2.34 kg/d	1/Year	Grab
2-Chlorophenol	NA	0.11 kg/d	NA	NA	0.35 kg/d	1/Year	Grab
2-Nitrophenol	NA	0.15 kg/d	NA	NA	0.25 kg/d	1/Year	Grab
3,4-Benzofluoranthene	NA	0.084 kg/d	NA	NA	0.22 kg/d	1/Year	Grab
4,6-Dinitro-o-cresol	NA	0.28 kg/d	NA	NA	1.01 kg/d	1/Year	Grab
4-Nitrophenol	NA	0.26 kg/d	NA	NA	0.45 kg/d	1/Year	Grab
Acenaphthene	NA	0.08 kg/d	NA	NA	0.21 kg/d	1/Year	Grab
Acenaphtylene	NA	0.08 kg/d	NA	NA	0.21 kg/d	1/Year	Grab
Acrylonitrile	NA	0.35 kg/d	NA	NA	0.88 kg/d	1/Year	Grab
Anthracene	NA	0.080 kg/d	NA	NA	0.21 kg/d	1/Year	Grab
Benzene	NA	0.13 kg/d	NA	NA	0.49 kg/d	1/Year	Grab
Benzo(a)anthracene	NA	NL	NA	NA	NL	1/Year	Grab
Benzo(a)pryene	NA	NL	NA	NA	NL	1/Year	Grab
Benzo(k)fluoranthene	NA	NL	NA	NA	NL	1/Year	Grab
Bis(2-ethylhexyl)phthalate	NA	0.37 kg/d	NA	NA	1.02 kg/d	1/Year	Grab
Carbon tetrachloride	NA	0.066 kg/d	NA	NA	0.13 kg/d	1/Year	Grab
Chlorobenzene	NA	0.055 kg/d	NA	NA	0.10 kg/d	1/Year	Grab

Table 6-5
Outfall 029
Annual Monitoring

Parameter	Monthly Average		Minimum	Maximum		Monitoring Requirements	
						Frequency	Sample Type
Chloroethane	NA	0.38 kg/d	NA	NA	0.98 kg/d	1/Year	Grab
Chloroform	NA	0.077 kg/d	NA	NA	0.16 kg/d	1/Year	Grab
Chrysene	NA	NL	NA	NA	NL	1/Year	Grab
Diethyl phthalate	NA	0.29 kg/d	NA	NA	0.74 kg/d	1/Year	Grab
Dimethyl phthalate	NA	0.069 kg/d	NA	NA	0.17 kg/d	1/Year	Grab
Ethylbenzene	NA	0.11 kg/d	NA	NA	0.39 kg/d	1/Year	Grab
Fluoranthene	NA	0.091 kg/d	NA	NA	0.24 kg/d	1/Year	Grab
Fluorene	NA	0.080 kg/d	NA	NA	0.21 kg/d	1/Year	Grab
Hexachlorobenzene	NA	NL	NA	NA	NL	1/Year	Grab
Hexachlorobutadiene	NA	0.073 kg/d	NA	NA	0.17 kg/d	1/Year	Grab
Hexachloroethane	NA	0.077 kg/d	NA	NA	0.19 kg/d	1/Year	Grab
Methyl Chloride	NA	0.31 kg/d	NA	NA	0.69 kg/d	1/Year	Grab
Methylene Chloride	NA	0.14 kg/d	NA	NA	0.32 kg/d	1/Year	Grab
Naphthalene	NA	0.080 kg/d	NA	NA	0.21 kg/d	1/Year	Grab
Nitrobenzene	NA	0.099 kg/d	NA	NA	0.24 kg/d	1/Year	Grab
N-nitroso-diphenylamine	NA		NA	NL		1/Year	24 HC
Phenanthrene	NA	0.080 kg/d	NA	NA	0.21 kg/d	1/Year	Grab

Phenol	NA	0.055 kg/d	NA	NA	0.095 kg/d	1/Year	Grab

Table 6-5
Outfall 029
Annual Monitoring

Parameter	Monthly Average		Minimum	Maximum		Monitoring Requirements	
						Frequency	Sample Type
Pyrene	NA	0.091 kg/d	NA	NA	0.24 kg/d	1/Year	Grab
Tetrachloroethylene	NA	0.080 kg/d	NA	NA	0.20 kg/d	1/Year	Grab
Toluene	NA	0.095 kg/d	NA	NA	0.29 kg/d	1/Year	Grab
Total Cyanide	NA	1.53 kg/d	NA	NA	4.38 kg/d	1/Year	Grab
Trichloroethylene	NA	0.077 kg/d	NA	NA	0.19 kg/d	1/Year	Grab
Vinyl Chloride	NA	NL	NA	NA	NL	1/Year	Grab

ug/l = micrograms per liter

mg/l = milligrams per liter

NA = not applicable

It is crucial to the accuracy of the results that the following guidelines are observed when grab samples are collected:

- The sample should be taken at or near the same time for each sampling event;
- The waste water at the sampling point should be well mixed and homogeneous;
- Nonrepresentative material, including particles greater than 0.25 inches in diameter, should be excluded from the sample; and
- Preservation guidelines for each test should be followed. Records of monitoring information should include:
- The date, exact place, and time of sampling or measurements;
- The individual(s) who performed the sampling or measurements;
- The date(s) and time(s) analyses were performed;
- The individual(s) who performed the analyses;
- The analytical techniques or methods used;
- The results of such analyses.

The U.S. Environmental Protection Agency (EPA) Method Number and bottle, preservation method and holding time requirements for each parameter are outlined for the weekly, monthly, quarterly, annual and one-time sampling requirements in Tables 6-7, 6-8, 6-9, 6-10 and 6-11 respectively.

Sampling should be conducted in accordance with the guidelines in the respective tables. A chain of custody form should be completed at the time of sampling.

6.2.2 Discussion of Testing

Laboratory testing is completed in accordance with the U.S. EPA Test Method for each parameter as outlined in Tables 6-7, 6-8, 6-9, and 6-10.

Table 6-7

Outfall 029

Weekly Monitoring Requirements

Parameter	Bottle	Preservation	Holding Time
Biochemical Oxygen Demand (BOD), 5 day	P, G	Cool to 6° C	48 hrs
Chemical Oxygen Demand	P,G	Cool to 6° C H_2SO_4 to pH < 2	28 days
Total Suspended Solids	P, G	Cool to 6° C	7 days
Oxidized Nitrogen	P, G	Cool to 6° C	48 hours
2,4-Dinitrotoluene	G, T	Cool to 6° C 0.008% $Na_2S_2O_3$ store in dark	7 days until extraction, 40 days after extraction

Bottle type: .....

P = Polyethylene

G = Glass

Table 6-8

Outfall 029

Monthly Monitoring Requirements

Parameter	Bottle	Preservation	Holding Time
Sulfate	P, G	Cool to 6° C	28 days
COD, influent	P,G	Cool to 6° C H_2SO_4 to pH < 2	28 days
BOD, influent	P, G	Cool to 6° C	48 hrs
TSS, influent	P, G	Cool to 6° C	7 days

Bottle type:

P = Polyethylene

G = Glass
T = Teflon-lined septum

Table 6-9

Outfall 029

Quarterly Monitoring Requirements

Parameter	Bottle	Preservation	Holding Time
Acute Whole Effluent Toxicity (WET)	P, G	Cool to 6° C	36 hours
Total Chromium	P, G	HNO_3 to pH < 2	6 months
Total Copper	P, G	HNO_3 to pH < 2	6 months
Total Lead	P, G	HNO_3 to pH < 2	6 months
Total Nickel	P, G	HNO_3 to pH < 2	6 months
Total Zinc	P, G	HNO_3 to pH < 2	6 months
Di-n-butyl phthalate	G, T	Cool to 6° C	7 days until extraction, 40 days after extraction

Bottle type: P = Polyethylene

G = Glass
T = Teflon-lined septum

Table 6-10

Outfall 029

Annual Monitoring Requirements

Parameter	Bottle	Preservative	Holding Time
N-nitroso-diphenylamine	G, T	Cool to 6° C 0.008% $Na_2S_2O_3$ store in dark	7 days until extraction, 40 days after extraction
2-Nitrophenol	G, T	Cool to 6° C 0.008% $Na_2S_2O_3$	7 days until extraction, 40 days after extraction
2-Chlorophenol	G, T	Cool to 6° C 0.008% $Na_2S_2O_3$	7 days until extraction, 40 days after extraction
4-Nitrophenol	G, T	Cool to 6° C 0.008% $Na_2S_2O_3$	7 days until extraction, 40 days after extraction
1,1-Dichloroethane	G, T	Cool to 6° C 0.008% $Na_2S_2O_3$	14 days
1,2-Dichloroethane	G, T	Cool to 6° C 0.008% $Na_2S_2O_3$	14 days
1,2-trans-Dichloroethylene	G, T	Cool to 6° C 0.008% $Na_2S_2O_3$	14 days
1,1-Dichloroethylene	G, T	Cool to 6° C 0.008% $Na_2S_2O_3$	14 days
1,2-Dichlorobenzene	G, T	Cool to 6° C 0.008% $Na_2S_2O_3$	14 days

Table 6-10

Outfall 029

Annual Monitoring Requirements

Parameter	Bottle	Preservative	Holding Time
1,3-Dichlorobenzene	G, T	Cool to 6° C 0.008% $Na_2S_2O_3$	14 days
1,4-Dichlorobenzene	G, T	Cool to 6° C 0.008% $Na_2S_2O_3$	14 days
1,2-Dichloropropane	G, T	Cool to 6° C 0.008% $Na_2S_2O_3$	14 days
1,3-Dichloropropylene	G, T	Cool to 6° C 0.008% $Na_2S_2O_3$	14 days
2,4-Dichlorophenol	G, T	Cool to 6° C 0.008% $Na_2S_2O_3$	7 days until extraction, 40 days after extraction
2,4-Dimethylphenol	G, T	Cool to 6° C 0.008% $Na_2S_2O_3$	7 days until extraction, 40 days after extraction
2,4-Dinitrophenol	G, T	Cool to 6° C 0.008% $Na_2S_2O_3$	7 days until extraction, 40 days after extraction
4,6-Dinitro-o-cresol	G, T	Cool to 6° C 0.008% $Na_2S_2O_3$	14 days
1,1,1-Trichloroethane	G, T	Cool to 6° C 0.008% $Na_2S_2O_3$	14 days
1,1,2-Trichloroethane	G, T	Cool to 6° C 0.008% $Na_2S_2O_3$	14 days

Table 6-10
Outfall 029
Annual Monitoring Requirements

Parameter	Bottle	Preservative	Holding Time
1,3-Dichlorobenzene	G, T	Cool to 6° C 0.008% $Na_2S_2O_3$	14 days
1,2,4-Trichlorobenzene	G, T	Cool to 6° C	14 days
Acenaphthene	G, T	Cool to 6° C 0.008% $Na_2S_2O_3$ store in dark	14 days
Acenaphthylene	G, T	Cool to 6° C 0.008% $Na_2S_2O_3$ store in dark	14 days
Acrylonitrile	G	Cool to 6° C 0.008% $Na_2S_2O_3$ to pH 4-5	14 days
Anthracene	G, T	Cool to 6° C 0.008% $Na_2S_2O_3$ store in dark	14 days
Benzene	G, T	Cool to 6° C 0.008% $Na_2S_2O_3$ / HCl to pH < 2	14 days
Benzo(a)anthracene	G, T	Cool to 6° C 0.008% $Na_2S_2O_3$ store in dark	7 days until extraction, 40 days after extraction

Table 6-10

Outfall 029

Annual Monitoring Requirements

Parameter	Bottle	Preservative	Holding Time
3,4-Benzofluoranthene	G, T	Cool to 6° C 0.008% $Na_2S_2O_3$ store in dark	7 days until extraction, 40 days after extraction
Benzo(a)pryene	G, T	Cool to 6° C 0.008% $Na_2S_2O_3$ store in dark	7 days until extraction, 40 days after extraction
Benzo(k)fluoranthene	G, T	Cool to 6° C 0.008% $Na_2S_2O_3$ store in dark	7 days until extraction, 40 days after extraction
Bis(2-ethylhexyl)phthalate	G, T	Cool to 6° C	7 days until extraction, 40 days after extraction
Carbon tetrachloride	G, T	Cool to 6° C 0.008% $Na_2S_2O_3$	14 days
Chlorobenzene	G, T	Cool to 6° C 0.008% $Na_2S_2O_3$	14 days
Chloroethane	G, T	Cool to 6° C 0.008% $Na_2S_2O_3$	14 days
Chloroform	G, T	Cool to 6° C 0.008% $Na_2S_2O_3$	14 days

Table 6-10

Outfall 029

Annual Monitoring Requirements

Parameter	Bottle	Preservative	Holding Time
Chrysene	G, T	Cool to 6° C 0.008% $Na_2S_2O_3$ store in dark	7 days until extraction, 40 days after extraction
Diethyl phthalate	G, T	Cool to 6° C	7 days until extraction, 40 days after extraction
Dimethyl phthalate	G, T	Cool to 6° C	7 days until extraction, 40 days after extraction
Ethylbenzene	G, T	Cool to 6° C 0.008% $Na_2S_2O_3$ & HCl to pH < 2	14 days
Fluoranthene	G, T	Cool to 6° C 0.008% $Na_2S_2O_3$ store in dark	7 days until extraction, 40 days after extraction
Fluorene	G, T	Cool to 6° C 0.008% $Na_2S_2O_3$ store in dark	7 days until extraction, 40 days after extraction
Hexachlorobenzene	G, T	Cool to 6° C	7 days until extraction, 40 days after extraction
Hexachlorobutadiene	G, T	Cool to 6° C	7 days until extraction, 40 days after extraction
Hexachloroethane	G, T	Cool to 6° C	7 days until extraction, 40 days after extraction

Table 6-10
Outfall 029
Annual Monitoring Requirements

Parameter	Bottle	Preservative	Holding Time
Methyl Chloride	G, T	Cool to 6° C 0.008% $Na_2S_2O_3$	14 days
Methylene Chloride	G, T	Cool to 6° C 0.008% $Na_2S_2O_3$	14 days
Naphthalene	G, T	Cool to 6° C 0.008% $Na_2S_2O_3$ store in dark	7 days until extraction, 40 days after extraction
Nitrobenzene	G, T	Cool to 6° C 0.008% $Na_2S_2O_3$ /store in dark	7 days until extraction, 40 days after extraction
Phenanthrene	G, T	Cool to 6° C 0.008% $Na_2S_2O_3$ / store in dark	7 days until extraction, 40 days after extraction
Phenol	G, T	Cool to 6° C 0.008% $Na_2S_2O_3$	7 days until extraction, 40 days after extraction
Pyrene	G, T	Cool to 6° C 0.008% $Na_2S_2O_3$ / store in dark	7 days until extraction, 40 days after extraction
Tetrachloroethylene	G, T	Cool to 6° C 0.008% $Na_2S_2O_3$	14 days
Toluene	G, T	Cool to 6° C 0.008% $Na_2S_2O_3$ / HCl to pH < 2	14 days

Table 6-10

Outfall 029

Annual Monitoring Requirements

Parameter	Bottle	Preservative	Holding Time
Total Cyanide	P, G	Cool to 6° C NaOH to pH > 12 0.6 g ascorbic acid	14 days
Trichloroethylene	G, T	Cool to 6° C 0.008% $Na_2S_2O_3$	14 days
Vinyl Chloride	G, T	Cool to 6° C 0.008% $Na_2S_2O_3$	14 days

Bottle type: P = Polyethylene
G = Glass
T = Teflon-lined septum

6.3 DISCUSSION OF LABORATORY RECORDS

The maintenance of laboratory records allows both for quality assurance reviews of procedures and the review of historical data to ensure compliance with VPDES permit requirements. RFAAP maintains the following information:

- Summaries of all tests;
- Record of chain of custody of samples, including the staff who obtained the sample, the date and time of the sampling, the staff involved with the laboratory testing, and the date and time of the testing;
- Reagents, procedures, and equipment used to perform testing done on plant;
- and Equipment calibration.

7.0 RECORDS AND REPORTING

7.1 DISCUSSION OF RECORD KEEPING AND REPORTING REQUIREMENTS

The maintenance of accurate operational records assists in the efficient operation of a waste water treatment system. The review and compilation of historical data allows the identification of trends, problem areas, and successes. Specifically, preventive maintenance schedules and records encourage inspection and maintenance, optimizing performance and extending the life of equipment.

The VPDES permit requires that the Discharge Monitoring Report (DMR) from Outfall 029, outlining the results of the wastewater sampling, be submitted to DEQ-Water Division's Regional Office in the month following performance of sampling. The DMR will be submitted to:

Commonwealth of Virginia
Department of Environmental Quality Blue
Ridge Regional Office
901 Russell Drive
Salem, VA 24153
Telephone (540) 562-6700, Fax (540) 562-6725
Electronic Submission via eDMR System

7.2 REFERENCE EXAMPLES OF RECORDS

7.2.1 Building 470 Checklists

Operators are required record the results of inspections of specific areas in the Bioplant each shift on the following forms:

- Main Building Checklist (Form DUP-8598);
- EQ Basin and Blower Building Checklist (Form DUP-8599); and
- Lift Station and Chemical Feed Area Checklist (Form DUP-8600).

Examples of these forms can be found in the Document Control System.

7.2.2 Sampling and Analysis Forms

Operators are required to complete the following forms as noted.

- Composite Sampler Log - Sheet (Form DUP-7820): complete weekly when stopping and re-starting the composite sampler;
- Chain of Custody (Form DUP-8075): complete when collecting samples for analysis; and
- Biological Waste Treatment Plant - Building 470, Quality Assurance Analytical Results, Waste Water and Sludge Samples (Form DUP-7160): results of daily laboratory analysis.

Examples of these forms can be found in the Document Control System.

7.2.3 Bioplant Daily Log

Operators are required to record specific information on parameters of the waste water and sludge, the daily chemical usage, and the sludge flow on Form DUP-6130, found in the Document Control System.

7.3 DISCUSSION OF MAINTENANCE AND AVAILABILITY OF RECORDS

Records related to the maintenance of the treatment system for Outfall 029 are maintained at the locations as described below.

7.3.1 Discharge Monitoring Reports

DMRs are maintained in the Environmental Department in Building 220. DMRs can be accessed by contacting the Environmental Department.

7.3.2 Building 470 Checklists

Copies of forms DUP-8598, DUP-8599, and DUP-8600 are maintained in Building 470.

7.3.3 Sampling and Analysis Forms

Copies of forms DUP-7820, DUP-8075, and DUP-7160 are maintained in Building 470.

7.3.4 Bioplant Daily Log

Copies of the Bioplant Daily Log are maintained in Building 470.

7.3.5 Treatment Plant Environmental Management Inspection Form

Copies of the Inspection Form are maintained in the Environmental Department in Building 220.

8.0 EMERGENCY OPERATION PLAN

8.1 DESCRIPTION OF EMERGENCY OPERATING PLAN

RFAAP maintains and implements a Hazardous Materials Emergency Response Plan in accordance with 29 CFR 1910.120 and a Disaster Control Plan for responding to hazardous substance releases. The plans include drills for responding to discharges.

Each operating area at this facility has trained personnel in spill control and/or HAZMAT I and have had area training with regards to the specific equipment and processes applicable to the Oil Discharge Contingency (ODC) and Spill Prevention Control and Countermeasure (SPCC) plans. The Roads and Grounds Department has trained personnel capable of responding to releases. Plant personnel are trained to handle various chemical spills under General Operating Procedure 4-27-269; "Chemical and Solvent Spills.

8.2 ANALYSIS OF VULNERABILITY

Most of the southern half of the main Radford plant area drains into Stroubles Creek and ultimately into the New River. The northern half of the main plant area and the horseshoe drain directly to the, New River through a stormwater drainage system. Both Stroubles Creek and the New River are considered state waters. It is not anticipated that accidental discharge would result in impact to these waters due to the implementation of rapid emergency response.

Although a discharge from treatment operations would not normally result in a direct discharge to state waters, there is a minimal, although unlikely, potential that an accident could occur, resulting in discharge to the New River. That would constitute a violation of water quality standards.

Outside of the RFAAP facility, there are no other downstream facilities or services that have drinking water intakes from the New River within five miles of the plant.

8.3 LISTING OF EMERGENCY EQUIPMENT AND LOCATION

8.3.1 Materials

The Roads and Grounds Department of RFAAP maintains the following inventories of materials and equipment for containment and cleanup of spills at Building 407. Spill material inventories are set up by RFAAP's Materials Management Department to assure that minimum quantities of all materials are maintained on plant at all times to respond to spills.

- Oil booms;
- Bags of absorbent materials located at Building 1908; and
- Absorbent pads and absorbent pillows.

The following emergency materials are available onsite:

- Soda Ash/Alum Chemicals;
- Solvents;
- Sand;
- Sawdust; and
- Absorb-all.

8.3.2 Equipment

Backhoes, gradealls, front-end loaders, and 275-gallon or 550-gallon oil tank trailers are kept at Building 7217 and are accessible within 15 minutes during normal work hours and within one hour during off shift hours.

The following emergency equipment is available onsite.

- Shovels, non-sparking;
- Waste containers;
- Broom;

- Dustpan;
- Respirators;
- Rubber gloves or impervious gloves;
- Leather gloves;
- Rubber apron;
- Safety goggles or glasses;
- Rubber boots;

8.4 DESCRIPTION OF MUTUAL AID PROGRAM WITH PARTICIPANT IDENTIFICATION, TYPE OF AID AND PHONE NUMBER

Mutual assistance agreements are established with the Cities and Towns of Blacksburg, Christiansburg, Dublin, Pulaski Radford, the Communities of Fairlawn, Long Shop/McCoy, Riner, and the Regional Emergency Medical Service (**REMSI)** in Pulaski County. The agreements state that mutual emergency medical team and/or firefighting assistance will be provided by and for RFAPP and the respective communities as conditions permit. Mutual assistance is authorized by the Fire Chief or Commanding Officer at RFAAP and the Fire Chief or Mayor of the respective community. The Fire Chief at RFAAP can be reached at phone number 7233.

8.5 DESCRIPTION OF POLICE AND FIRE COORDINATION WITH PHONE NUMBERS

RFAAP maintains a contract with Centerra for security and emergency response services. Centerra can be reached on the facility at phone number 7323. In the event backup police response is required, the Montgomery County Sheriffs office can be reached at (540) 382-2951 or 911.

RFAAP maintains fire response personnel on the facility. Fire response can be reached at phone number 16 or 7233.

9.0 PERSONNEL

9.1 ORGANIZATIONAL STAFFING CHART

An organizational chart is provided as Table 9-1.

9.2 OUTLINE OF RESPONSIBILITIES OF ALL OPERATIONAL AND SUPERVISORY PERSONNEL

9.2.1 Waste Water Chief Operator

The Waste Water Chief Operator (WWCO) reports to supervision and oversees the operation of plant-wide industrial waste water treatment facility, the WWCO will also:

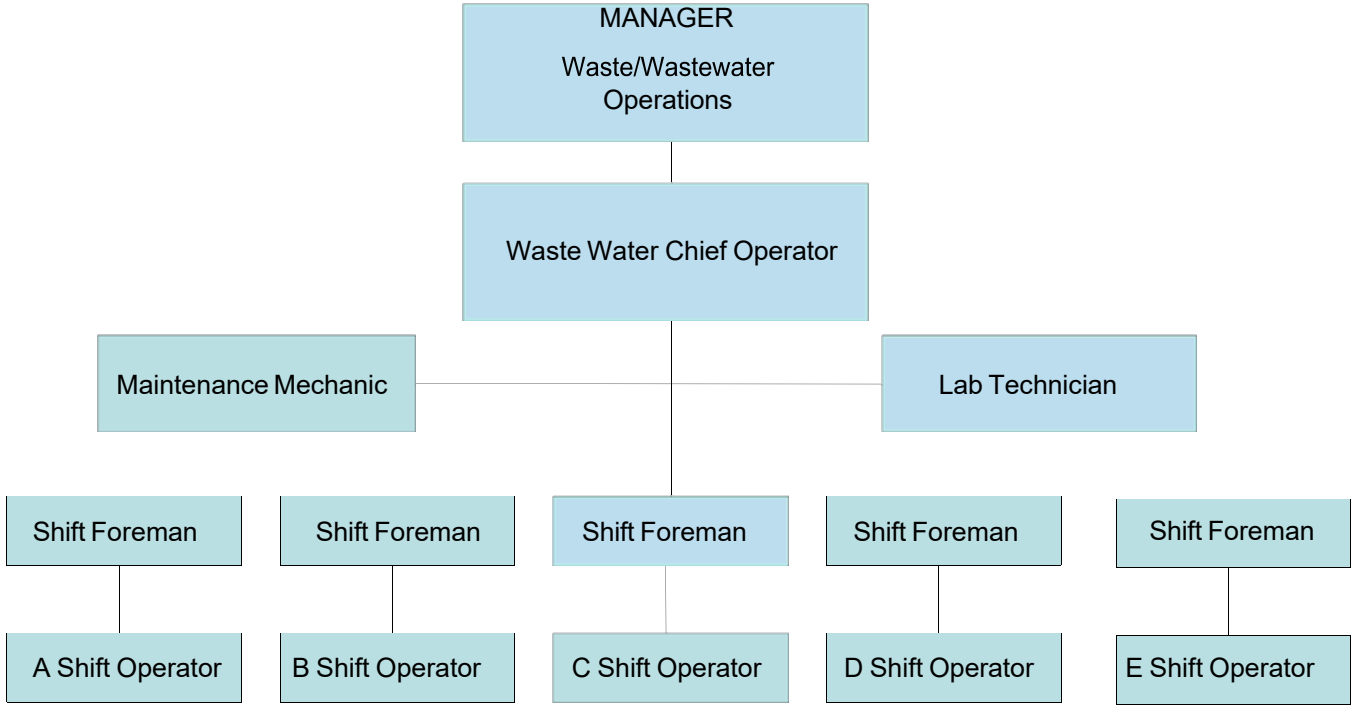
- Collect waste water samples for analysis in accordance with the guidelines outlined in Section 6.0 of this Manual;
- Provide operational support to assist maintenance personnel in repairing equipment and data collection and control systems; and
- Monitor plant-wide wastewater flows via the RFAAP computer-based monitoring system to ensure discharges are within permitted limits.

9.2.2 Waste Water Operator

The Wastewater Operator (WWOP) reports to supervision and generally supports the operation of the wastewater treatment systems. The WWOP will also:

Table 9-1

Organizational Chart



- Treat and control industrial waste disposal requirements;
- Determine chemical feed rate and introduce chemicals into the

waste; • Direct Utilities Operators to assist in system operation;

- Detect control problems, flow blockage, and sludge ratio and determine correct action if needed; and
- Perform laboratory analysis for various chemical and physical properties of waste at raw, internal, and discharge points.
- Performing duties required of the operation to comply with discharge permits;
- Performing control tests and other operations in accordance with established operating procedures, safety regulations, and housekeeping rules;

9.2.3 Utilities Operator B

Reporting to the Shift Supervisor, the responsibilities of Utilities Operator B (UTOB) include:

- Performing checker duties in the Utilities Area;
- Maintenance of chemical inventory in silos and tanks.
- Performing routine preventive maintenance checks on pump stations and storage tanks;
- Taking samples at outfalls and performing analyses; and
- Performing control tests and other operations in accordance with established operating procedures, safety regulations, and housekeeping rules.

9.2.4 Utilities Operator Trainee

Reporting to the Shift Supervisor, the responsibilities of Utilities Operator Trainee (UTOT) include:

- Working with the higher level waste water operators for training purposes; •

Learning the duties and responsibilities of Utilities Operator classifications;

- Learning established operating procedures, safety regulations, and housekeeping rules; and

- Other responsibilities as assigned by the WWCO, WWOP, UTOA, and UTOB.

9.3 REQUIRED QUALIFICATIONS OF PERSONNEL

9.3.1 Waste Water Chief Operator

The WWCO must have a high school diploma or equivalent and have a minimum of a Waste Water Class II license. The WWCO must also qualify in lower waste water operator classifications.

9.3.2 Waste Water Operator

The WWOP must have a high school diploma or equivalent.

9.3.3 Utilities Operator B

The UTOB must have a high school diploma or equivalent.

9.3.4 Utilities Operator Trainee

The UTOT must have a high school diploma or equivalent.

9.4 ATTENDANCE REQUIREMENTS CHART

Each shift will be staffed with a sufficient number of qualified operators to ensure that necessary controls are being maintained. Relief operators are available to substitute for absent operators as necessary.

9.5 ROUTINE WORK SCHEDULES

The Outfall 029 facility is staffed 24 hours per day and 365 days per year. The facility is staffed by the personnel defined in Table 9-1.

9.6 DESCRIPTION OF TRAINING NEEDS AND PROGRAMS

RFAAP recognizes that effective employee training is essential to improving the quality and efficiency of operations, as well as to reducing environmental, health, and safety hazards. The Training Department maintains the master Training Plan for RFAAP, which

includes a list of all jobs and the requirements for each job classification and is available for all employees to review. The Training Department automatically schedules training classes for staff based on their job assignments and notifies the individual of the class. Supervisors are notified when individuals under their direction have expired training certifications.

10.0 SAFETY

10.1 BRIEF DESCRIPTION OF SAFETY PROGRAM

According to the Alliant Techsystems Management Manual, the RFAAP safety program provides:

- Effective and practical safety control of all operations;
- Delineation of individual and organizational responsibilities for safety matters; and
- Centralized control of all safety program activities.

All managers and supervisors are expected to implement the safety program within their areas. Training and guidance are provided by the Safety Department.

10.2 DESCRIPTION OF SAFETY HAZARDS INVOLVED WITH THE OPERATION OF EACH COMPONENT

10.2.1 Electrical Hazards

All equipment that is known to or may potentially pose an electrical hazard should be treated with caution. Standard 110-volt current can easily kill or maim, but lower voltage and higher amperage current can also cause severe damage to the nervous system.

Individuals injured by an electricity-related accident should be freed from live conductors using insulated or non-conductive material (i.e., wood). It is critical that bare hands are not used to remove a live wire. CPR or other artificial respiration should be applied until breathing is restored.

Guidelines for safe conduct near live electric equipment include:

- Take caution to not ground yourself;
- Only authorized and experienced staff should perform work or maintenance on electrical equipment;
- Maintain electrical controls;

- Do not use metal ladders or un-insulated tools around electrical equipment;
- Always assume a circuit is live unless it has been confirmed dead;
- Do not remove guards or bypass protective devices;
- Follow lock-out procedures when working with electric equipment; and
- Ensure portable electrical tools are either double-insulated or equipped with a separate electrical conductor.

10.2.2 Mechanical Equipment Hazards

Maintenance of mechanical equipment should be conducted by qualified personnel and should be completed with the necessary materials at the site the work is to be completed. Lockout procedures should be followed to ensure personnel safety.

Lifting equipment should be equipped with safety latches and should be used only for its intended purpose. Only qualified operators should be permitted to use lifting equipment.

10.2.3 Explosion and Fire Hazards

Explosions are possible when oxygen and an oxidizing reagent (including flammable gas, chlorine, or fertilizer) are present in the proper proportions and exposed to a source of ignition (open lights, sparks, and hot filaments). All personnel should be aware of these criteria and should make an effort to reduce or eliminate potential for explosion.

Flammable gases in the wastewater present one of the greatest explosion and fire hazards at the treatment system facilities, necessitating the storage of flammable material in flammable cabinets. Further, a combustible gas indicator should be used if there is concern of too great a concentration of those gases. Smoking and open flames are prohibited in the Limited Area of RFAAP, and are therefore also prohibited at the wastewater treatment facilities.

10.2.4 Bacterial Infection

Contact with waste water may expose workers to waterborne disease, including typhoid fever, amoebic dysentery, infection jaundice, and other intestinal infections, as well as risk of

tetanus and skin infections. Workers who are regularly exposed to waste water should ensure their vaccinations are current. Workers should also wear protective clothing and should regularly wash their face, hands, and arms. The system operators should also ensure than potable water is not contaminated by waste water through cross-connections or other means.

10.2.5 Oxygen Deficiency and Noxious Gases

Certain areas within the treatment system facilities contain noxious or toxic gases and vapors, and associated oxygen deficiencies, including sewers, sewer manholes, covered tanks, enclosed rooms, and underground structures. Techniques available for detecting the presence of the more dangerous atmospheric conditions include:

- Combustible gas indicator - a device that detects the concentration of combustibles present as a percentage of the lower explosive limit;
- Acetate ampule - changes color when broken in cotton to indicate the presence of hydrogen sulfide;
- Palladium chloride ampule - changes color when broken in cotton to indicate the presence of carbon monoxide; and
- Oxygen detector - notification when the atmosphere contains less than 19.5% oxygen.

10.3 DESCRIPTION AND REQUIREMENTS FOR AN ONGOING PREVENTIVE SAFETY PROGRAM INCLUDING EDUCATION IN SAFETY PROCEDURES AND TRAINING IN FIRST AID AND EMERGENCY PRODURES

The preventive safety program begins with the training of new employees, when the specific safety and health hazards of each process, emergency operations (including shutdown procedures), and other safe work practices are stressed during the initial training sessions. The preventive safety program continues with the inclusion of maintenance of sound health and safety practices in the job description for each level of waste water operator. Relevant refresher training is provided to each operator at least every three years to ensure maintenance of health and safety practices throughout the plant.

10.4 LISTING OF ALL EMERGENCY PHONE NUMBERS

In the event of an emergency onsite, the following emergency phone numbers shall be utilized:

Facility:

- Hospital 7123
- Fire 911
- Ambulance 7163
- Guard HQ 7526
- Safety Department 7374

Local:

- Montgomery County Local Emergency Planning Committee 540-808-6329
- Pulaski County Local Emergency Planning Committee 540-980-7801

State:

- Virginia Department of Emergency Management 800-468-8892

10.5 LISTING OF ALL AVAILABLE SAFETY EQUIPMENT AND LOCATION

The following safety equipment is available onsite:

- Safety showers;
- Eye wash stations;
- Respirators;
- Rubber or impervious gloves
- Leather gloves;
- Rubber apron;
- Safety goggles or glasses;
- Rubber boots;
- Fire extinguishers; and

10.6 LISITING OF NUMBER AND LOCATION OF FIRST AID KITS AND MANUAL

RFAAP does not maintain first aid kits at site specific locations. In the event of a minor

accident or injury, RFAAP maintains a hospital onsite during normal working hours. In the event of a major accident or injury, RFAAP maintains an ambulance service with EMTs 24hours per day, seven days per week. The ambulance service can be reached by telephone at 7163. EMT personnel will administer first aid onsite.

10.7 LISTING OF SAFETY RULES

As defined in Standard Procedure 4-42-205, "Biological Waste Treatment Plant General Safety Rules," the following safety rules apply:

- Comply with Maintenance "Lockout" Procedure 4-27-66 when any equipment is "down" for repairs or to be examined by Maintenance or Operating personnel.
- Leather, rubber or vinyl gloves shall be worn when performing any duties in this operation.
- A high standard of housekeeping shall be maintained inside and outside of this facility at all times.
- Personnel entering the facility shall wear safety shoes and safety glasses at all times.
- Handrails shall be used when climbing up or down stairs.
- Personnel shall be particularly cautious when climbing tank ladders. Hold on to the ladder with both hands.
- A safety harness shall be worn where no handrail exists around area of work above ground.
- Walkways shall be kept clear of obstructions.
- Personnel shall not climb onto or lean over handrails.
- Extreme care shall be taken when walking on wet floors to prevent injury by slipping or falling; walk, DO NOT RUN.

- Oil spills/leaks shall be cleaned up
- Oil shall not be washed into drains.
- When lids are open on lime slaker to check lime slurry, agitation, or cleaning inside of lime slaker, operator must wear hard hat with full face shield and safety glasses.
- Electric breakers shall be physically locked out before any work is performed on equipment.
- Procedure 4-27-66 shall be followed when locking out equipment.
- All approved tools and equipment shall be retained in the designated storage area when not being used.

In addition, Standard Procedures 4-42-357, 4-42-207, 4-42-378, 4-42-390, and 4-42-353 provide detailed safety rules for each of the unit operations associated with the Bioplant.

10.8 DISCUSSION OF IMPORTANCE OF GOOD HOUSEKEEPING

As defined in Standard Procedures 4-42-205, 4-42-357, and 4-42-353, good housekeeping inside and outside of all buildings shall be maintained at all times by the operator on duty.

10.9 DISCUSSION OF ACCIDENT REPORTING

Employees are required to report all injuries to their direct supervisor, who will subsequently complete Forms DUP 8408A, 8408B and 8408C for submission to the Safety Department.

11.0 PLANT UTILITIES

11.1 LISTING OF UTILITIES SERVICING FACILITY WITH CONTACT -NAME, ADDRESS AND PHONE NUMBER

The primary electrical service is provided by RFAAP:

Address: Building 400, RFAAP

Contacts:Area Engineer, 540-639-7162

Shift Foreman, 540-639-7133

Backup power is provided by American Electric Power:

Address: P.O. Box 2021

Roanoke, VA

Phone:540-985-2761

Contact:Shift Supervisor

11.2 EMERGENCY CUT-OFF PROCEDURES

In the event of an emergency, the power to each system can be shut down by a switch located on the control panels adjacent to each major piece of equipment.

Emergency shutdown procedures for the Bioplant are outlined in Standard Procedures 4-42-205, 4-42-357, and 4-42-353.

11.3 RELIABILITY OF ELECTRICAL SERVICE AND EFFECT ON CONTINUOUS OPERATION

The RFAAP electrical service is typically reliable. The Bioplant is on the RFAAP Power. House Priority List; every effort is made to maintain power during emergency situations

O&M Manual

OUTFALL 029 – INDUSTRIAL WASTE WATER PRETREATMENT APPERTENANCES AND PRETREATMENT FACILITIES

ORDNANCE SYSTEMS INC.
RADFORD ARMY AMMUNITON PLANT
RADFORD, VIRGINIA

Original Prepared by URS: September 2000

Revised by BAE: September 2020

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete, i am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Michael Bocek
Name

Signature

General Manager, BAE Systems
Title

OCTOBER 29, 2020
Date

Anthony J. Kazor
Name

Signature

Lieutenant Colonel, US Army, Commanding Radford Army Ammunition Plant
Title

10 NOV 2020
Date

TABLE OF CONTENTS

1.0 INTRODUCTION....7
1.1 TITLE PAGE.... 7
1.2 TABLE OF CONTENTS.... 7
1.3 PURPOSE OF MANUAL.... 7
2.0 DESCRIPTION OF WASTES AND TREATMENT FACILITIES....10
2.1 BRIEF DESCRIPTION OF WASTE GENERATION.... 10
2.2 CHARACTERIZATION OF WASTES.... 10
2.3 BRIEF DESCRIPTION OF TREATMENT TYPE.... 10
2.3.1 Pump Stations.... 11
2.3.2 Upstream Monitoring Stations.... 11
2.3.3 Mobile Granulated Activated Carbon Unit.... 11
2.3.4 NG-1 Pretreatment Plant.... 11
2.3.5 NG-2 Pretreatment Plant.... 14
2.3.6 TNT pretreatment Plant.... 14
2.3.7 Nitrocellulose (NC) Hydrolysis treatment.... 14
2.4 DESCRIPTION OF PURPOSE AND FUNCTION OF INDIVIDUAL TREATMENT COMPONENTS.... 15
2.4.1 Pump Stations.... 15
2.4.2 Monitoring Stations.... 15
2.4.3 Mobile GAC Unit.... 15
2.4.4 NG-1 Pretreatment Plant (Not currently in use).... 16
2.4.5 NG-2 Pretreatment Plant.... 17
2.4.6 TNT Pretreatment Plant.... 18
2.4.7 NC Hydrolysis Treatment.... 19
3.0 PERMITS AND STANDARDS....21
3.1 IDENTIFICATION OF PERMITS.... 21
3.1.1 Purpose of Permit with Reference to Copy in Appendix.... 21
3.1.2 Permitting Authority.... 21
3.1.3 Permit Number.... 21
3.1.4 Brief Description of Permit Requirements.... 21

3.2 SPILL PROCEDURES 22
3.2.1 Outline of Regulations for Spills 22
3.2.2 Spill Reporting Requirements 22
4.0 OPERATION AND CONTROL OF TREATMENT FACILITIES 23
4.1 GENERAL INFORMATION FOR EACH UNIT PROCESS 23
4.1.1 Pump Stations 23
4.1.2 Monitoring Stations 25
4.1.3 Mobile GAC Unit 27
4.1.4 NG-1 Pretreatment Plant (Inactive) 28
4.1.5 NG-2 Pretreatment Plant 34
4.1.6 TNT Pretreatment Plant 43
4.1.7 NC hydrolysis 47
4.2 SPECIFIC INFORMATION FOR EACH UNIT PROCESS 49
4.2.1 Pump Stations 49
4.2.2 Monitoring Station 49
4.2.3 Mobile GAC Unit 50
4.2.4 NG-1 Pretreatment Plant 50
4.2.5 NG-2 Pretreatment Plant 52
4.2.6 TNT Pretreatment Plant 56
5.0 FACILITY MAINTENANCE 60
5.1 CONCEPTUAL DESCRIPTION OF MAINTENACE PROGRAM 60
5.2 PLANNING AND SCHEDULING 60
5.2.1 Preventive Maintenance Schedules 60
5.2.2 Work Order System 68
5.3 EQUIPMENT RECORD SYSTEM 68
5.3.1 Discussion and Example of Equipment Numbering System 68
5.3.2 Discussion of Nameplate Data Cards for All Major Equipment 68
5.3.3 Discussion of Maintenance Records for Major Equipment 69
5.4 STOREROOM AND INVENTORY SYSTEM 69
5.4.1 List of Spare Parts 69
5.4.2 Procedures for Stockroom Inventory including Example Forms and Records 69

5.4.3 List of Tools 69
5.4.4 Procedures for Tool Use Control 70
6.0 LABORATORY TESTING 71
6.1 DISCUSSION OF PURPOSE OF SAMPLING AND TESTING PROGRAM 71
6.2 OUTLINE OF SAMPLING AND TESTING PROGRAM 71
6.2.1 Collection of Samples 71
6.3 DISCUSSION OF LABORATORY RECORDS 73
7.0 RECORDS AND REPORTING 75
7.1 DISCUSSION OF RECORD KEEPING AND REPORTING REQUIREMENTS 75
7.2 REFERENCE EXAMPLES OF RECORDS 75
7.2.1 Daily Checker's Sheet 75
7.2.2 Weekly Checker's Sheet 75
7.2.3 Pretreatment Building Batch Make-up Record 76
7.3 DISCUSSION OF MAINTENANCE AND AVAILABILITY OF RECORDS 76
7.3.1 DMRs 76
7.3.2 Checker's Sheets 76
8.0 EMERGENCY OPERATION PLAN 77
8.1 DESCRIPTION OF EMERGENCY OPERATING PLAN 77
8.2 ANALYSIS OF VULNERABILITY 77
8.3 LISTING OF EMERGENCY EQUIPMENT AND LOCATION 78
8.3.1 Materials 78
8.3.2 Equipment 78
8.4 DESCRIPTION OF MUTUAL AID PROGRAM WITH PARTICIPANT IDENTIFICATION, TYPE OF AID AND PHONE NUMBER 79
8.5 DESCRIPTION OF POLICE AND FIRE COORDINATION WITH PHONE NUMBERS 79
9.0 PERSONNEL 80
9.1 ORGANIZATIONAL STAFFING CHART 80
9.2 OUTLINE OF RESPONSIBILITIES OF ALL OPERATIONAL AND SUPERVISORY PERSONNEL 80
9.2.1 Waste Water Chief Operator 80
9.2.2 Waste Water Operator 80

9.2.3 Utilities Operator B 83
9.2.4 Utilities Operator Trainee 83
9.3 REQUIRED QUALIFICATIONS OF PERSONNEL 83
9.3.1 Waste Water Operator 83
9.3.2 Utilities Operator B 84
9.3.3 Utilities Operator Trainee 84
9.4 ATTENDANCE REQUIREMENTS CHART 84
9.5 ROUTINE WORK SCHEDULES 84
9.6 DESCRIPTION OF TRAINING NEEDS AND PROGRAMS 84
10.0 SAFETY 85
10.1 BRIEF DESCRIPTION OF SAFETY PROGRAM 85
10.2 DESCRIPTION OF SAFETY HAZARDS INVOLVED WITH THE OPERATION OF EACH COMPONENT 85
10.2.1 Electrical Hazards 85
10.2.2 Mechanical Equipment Hazards 86
10.2.3 Explosion and Fire Hazards 86
10.2.4 Bacterial Infection 87
10.2.5 Oxygen Deficiency and Noxious Gases 87
10.3 DESCRIPTION AND REQUIREMENTS FOR AN ONGOING PREVENTIVE SAFETY PROGRAM INCLUDING EDUCATION IN SAFETY PROCEDURES AND TRAINING IN FIRST AID AND EMERGENCY PRODURES 87
10.4 LISTING OF ALL EMERGENCY PHONE NUMBERS 88
10.5 LISTING OF ALL AVAILABLE SAFETY EQUIPMENT AND LOCATION 89
10.6 LISITING OF NUMBER AND LOCATION OF FIRST AID KITS AND MANUAL 89
10.7 LISTING OF SAFETY RULES 89
10.8 DISCUSSION OF IMPORTANCE OF GOOD HOUSEKEEPING 91
10.9 DISCUSSION OF ACCIDENT REPORTING 91
11.0 PLANT UTILITIES 92
11.1 LISTING OF UTILITIES SERVICING FACILITY WITH CONTACT NAME, ADDRESS AND PHONE NUMBER 92
11.2 EMERGENCY CUT-OFF PROCEDURES 92

11.3 RELIABILITY OF ELECTRICAL SERVICE AND EFFECT ON CONTINUOUS OPERATION 92

12.0 APPENDIX A- COPY OF CURRENT PERMIT 93

13.0 APPENDIX B- EQUIPMENT MANUALS 93

NOTE: Procedures and PM schedules are not provided for NG-1 Pre-treatment. The facility is in inactive status.

1.0 INTRODUCTION

1.1 TITLE PAGE

As required by the Virginia Department of Environmental Quality (DEQ) Regulations, a title page is provided on the cover of this manual.

1.2 TABLE OF CONTENTS

As required by the Virginia DEQ Regulations, a table of contents is provided on page i of this manual.

1.3 PURPOSE OF MANUAL

The Radford Army Ammunition Plant (RFAAP) is located west of Route 114 in Montgomery County, Virginia. Route 114 is located off of U.S. 460 in Christiansburg, Virginia. RFAAP is situated north of Interstate 81 in Southwestern Virginia, 46 miles from Roanoke to the northeast and 108 miles from Bristol, Tennessee, to the southwest.

Property belonging to RFAAP totals 6,881 acres. The main explosive manufacturing area, comprised of 4,080 acres, is located in Pulaski and Montgomery counties (see Figure 1). The New River separates the two counties.

RFAAP is a Government-owned, industrial installation whose mission is to manufacture propellants and explosives as needed. RFAAP has both Government and contractor organizations. In 2012, BAE Systems acquired the Facilities Use Contract to operate RFAAP.

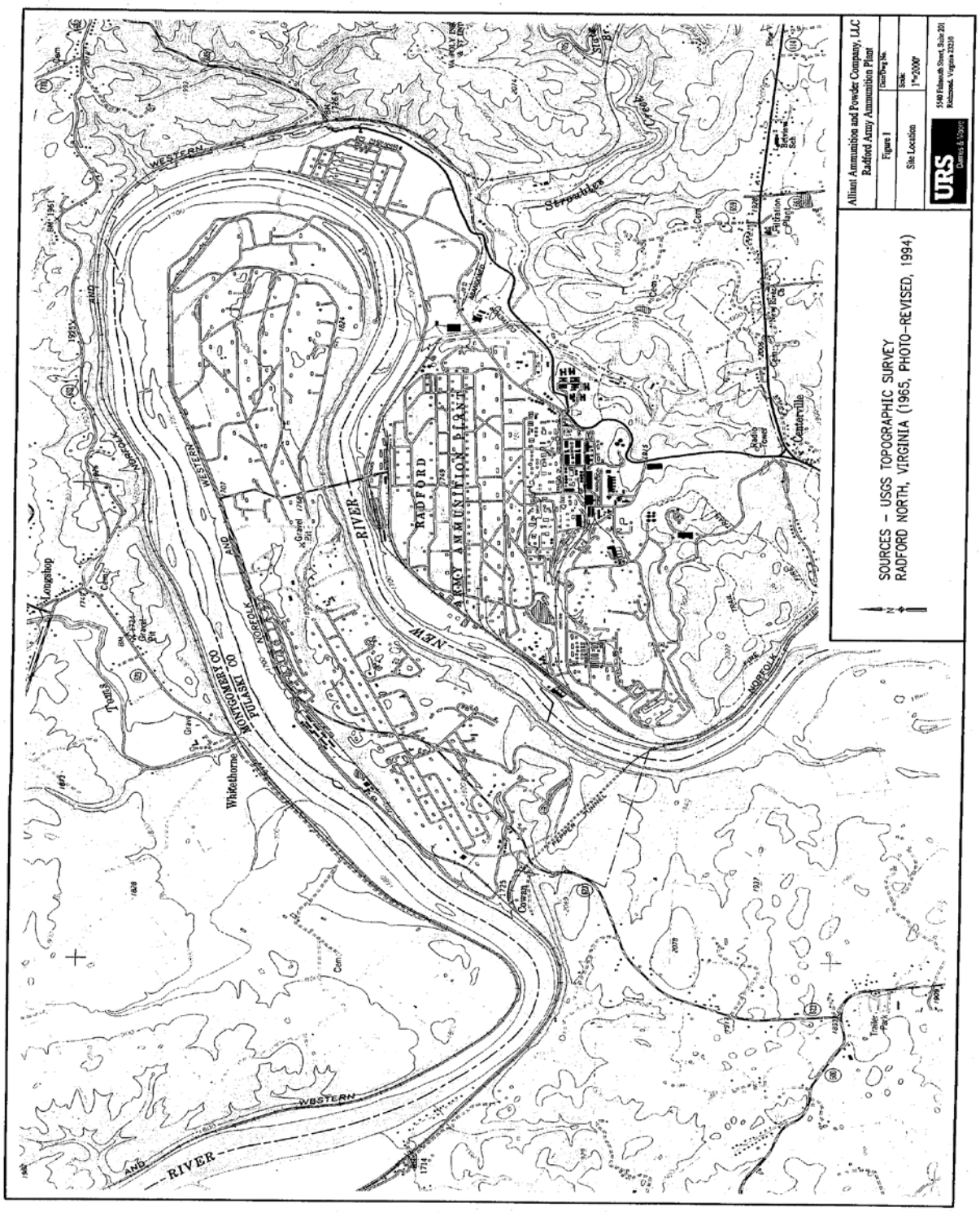


Figure 1: RFAAP Location

RFAAP has been issued Virginia Pollution Discharge Elimination System (VPDES) Permit Number VA0000248 by the Virginia DEQ regulating discharges to public water from the site. As stated in the permit, Virginia DEQ Regulation 9 VAC 25-31-190 E and 40 CFR 122.41 (e) require proper operation and maintenance of the permitted facility. Compliance with an approved Operations and Maintenance (O&M) Manual ensures this. Section 401 of the Clean Water Act (CWA) requires the permittee to provide opportunity for the State to review the proposed operations of the facility. Each treatment unit must be addressed in an O&M manual. This O&M manual serves Outfall 029 – Industrial Waste Water Pretreatment Appurtenances and Pretreatment Facilities, which comprise the Bioplant Collection System. The O&M manual for Outfall 029 – Bioplant has been prepared under separate cover.

2.0 DESCRIPTION OF WASTES AND TREATMENT FACILITIES

2.1 BRIEF DESCRIPTION OF WASTE GENERATION

The Outfall 029 – Industrial Waste Water Pretreatment Appurtenances and Pretreatment Facilities include process wastewater from the manufacture of nitroglycerin (NG), propellants, nitrocellulose hydrolysis, and still bottoms from solvent recovery destined for the Bioplant for treatment. In addition, a mobile granulated activated carbon (GAC) unit is used to pre-treat individual waste streams from the batch drying of propellant containing 2,4-dinitrotoluene (DNT) prior to discharge to the Bioplant Collection System.

2.2 CHARACTERIZATION OF WASTES

The pre-treated wastewaters collected by Outfall 029 are characterized as mixed industrial process waste waters from the manufacture of NG, TNT, Nitrocellulose, propellants and still bottoms from solvent recovery.

The waste treated in the Nitroglycerin-1 (NG-1) and Nitroglycerin-2 (NG-2) Waste Water Pretreatment Plants are primarily wastewater with concentrations of nitrate esters. The NG-1 Area is in inactive status at this time, and the NG-2 pre-treatment plant is not currently being used. Nitrate esters are biologically degradable, making NG Pretreatment a safety measure only.

2.3 BRIEF DESCRIPTION OF TREATMENT TYPE

Outfall 029 collects both untreated and pretreated wastewater from manufacturing processes and transfers the waste streams to the Bioplant via the Bioplant collection system. Pretreatment processes include the mobile GAC unit, two NG pretreatment plants (if used), Nitrocellulose hydrolysis wastewater, and GAC treatment of TNT wastewater and still bottoms. The major components of the Bioplant collection system are pump stations and monitoring stations.

2.3.1 Pump Stations

Pump stations are necessary in the RFAAP collection system to move wastewater from the areas lower in elevation than the Bioplant or where hills or other obstructions prevent gravity flow.

2.3.2 Upstream Monitoring Stations

Upstream monitoring stations (UMS) are utilized to collect stream data to optimize the treatment operation in the Bioplant. The locations of the pump stations and monitoring stations are provided in Figure 2.

2.3.3 Mobile Granulated Activated Carbon Unit

A mobile GAC unit is used to pre-treat individual waste streams containing DNT since biological treatment may not completely remove this compound. The GAC unit is mounted on a trailer for transport by truck to the area at which the DNT is processed.

2.3.4 NG-1 Pretreatment Plant

The NG-1 pre-treatment plant is in inactive status at this time, as NG is being produced in the NG-2 Area. When the NG-1 Area pretreatment plant was used, the wastewater was collected in the equalization tanks. Wastewater was then pumped to the denitration tanks in batches, where sodium hydroxide was added to raise the pH to allow decomposition of the nitrate esters. After 90 minutes, the wastewater was pumped to the neutralization mix tank, where sulfuric acid was added to neutralize the wastewater. The wastewater then flowed to the mix tank, where the pH was verified, and discharged to Upstream Monitoring Station 8 (Building 403-22) and Pump Station 906-9, part of the Bioplant collection system.

Wastewater containing diethylene glycol dinitrate (DEGDN), triethylene glycol dinitrate (TEGDN), or trimethylethane trinitrate (TMETN) is treated with sodium hydrosulfide after sodium hydroxide raises the pH of the wastewater. The sodium hydrosulfide increases the rate of the decomposition of the nitrate esters.

Detailed descriptions of the NG-1 Pretreatment Plant components, as well as a flow

diagram, are provided in Section 4.0.

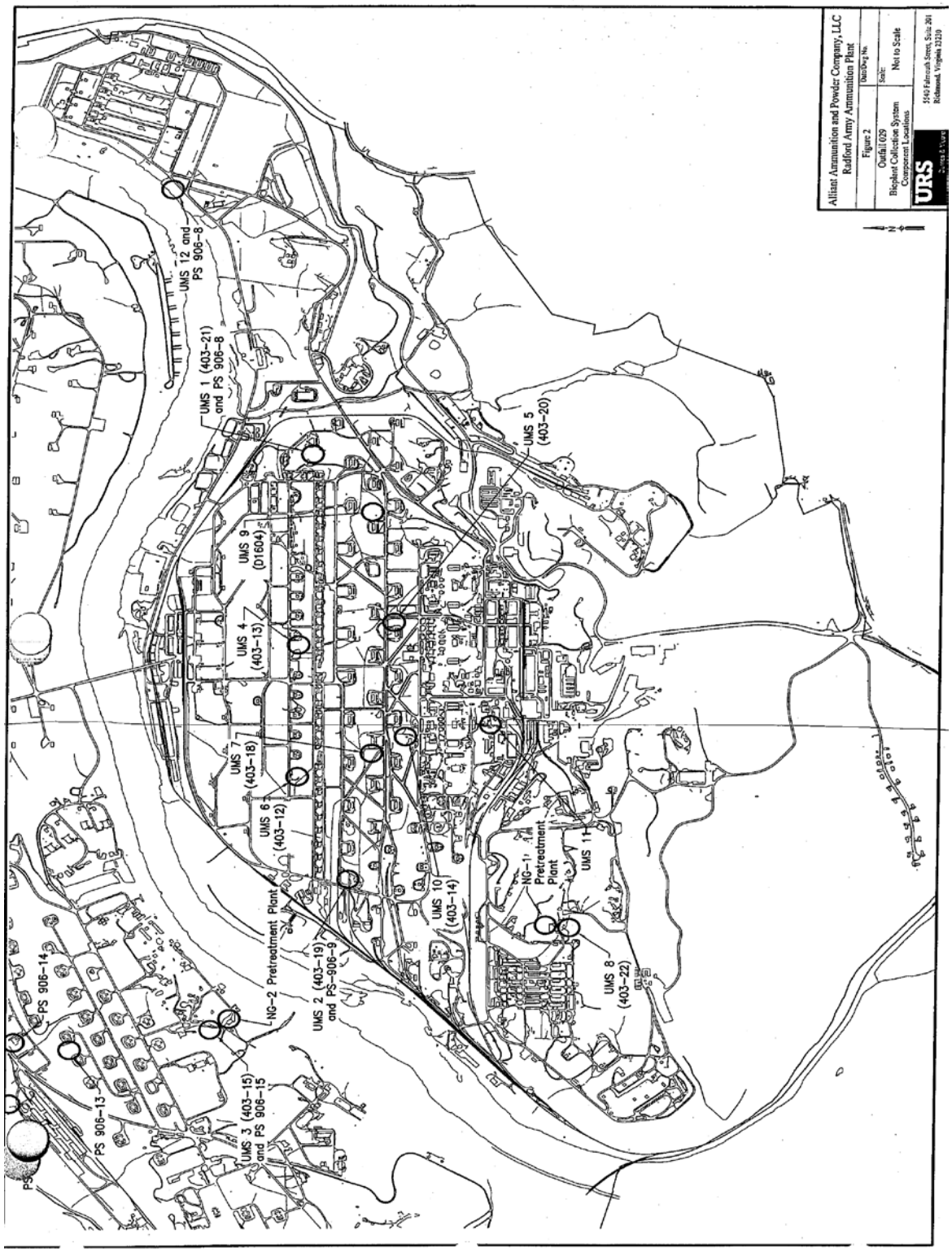


Figure 2: Pump Stations and Monitoring Stations

2.3.5 NG-2 Pretreatment Plant

The NG-2 pre-treatment plant is used to degrade nitroglycerine as needed. Simple neutralization can be done by adding soda ash or sulfuric acid to bring the wastewater into the neutral range. When the plant is used, wastewater is collected in the equalization tanks. The wastewater is then pumped to the denitration tanks in batches, where sodium hydroxide is added to raise the pH to allow decomposition of the nitrate esters. After 90 minutes, sulfuric acid is added to neutralize the wastewater. Wastewater is then pumped to the clarifiers which can also be used as holding tanks, and flows to two tanks at which treatment no longer occurs. Water then flows to pump station 906-15, which is part of the Bioplant collection system.

Wastewater containing DEG or TEG is collected only in equalization tank 2, pumped to denitration tank B, treated (using sodium hydroxide, sodium hydrosulfide, and sulfuric acid as described for DEGDN wastewater), pumped to the wastewater tanks for holding, then pumped to a tanker truck for off-site disposal or treated at the on-site industrial wastewater treatment plant.

Detailed descriptions of the NG-2 Pretreatment Plant components, as well as a flow diagram, are provided in Section 4.0.

2.3.6 TNT pretreatment Plant

Wastewater produced in TNT manufacture is collected in treatment tanks where pH is adjusted. The wastewater is then pumped through Granular Activated Carbon Columns to reduce TNT nitrobodies. The material then goes to a basin to settle out sludge then to a final basin to await discharge to the Bioplant through Internal Outfall 291. At times it may be necessary to treat algal blooms that form in this basin with an algaecide approved by DEQ. Final pH adjustment is made prior to discharging through Outfall 291 and is coordinated with the environmental department.

2.3.7 Nitrocellulose (NC) Hydrolysis treatment

Nitrocellulose is an inorganic ester that is produced by The Radford Army Ammunition Plant (RFAAP) for use in the production of propellants, powders and

explosives. One of the methods employed for disposing of waste NC is by caustic hydrolysis. Nitrocellulose fines that are water wet are combined with sodium hydroxide to destroy the nitrocellulose molecule. The resulting liquid supernatant is then biologically treated to degrade the remaining organics. This process is not being used at this time

2.4 DESCRIPTION OF PURPOSE AND FUNCTION OF INDIVIDUAL TREATMENT COMPONENTS

2.4.1 Pump Stations

Pump stations are necessary in the Bioplant collection system to move wastewater from the areas lower in elevation than the Bioplant. Pump station locations are shown on Figure 2.

Basic construction consists of a sump to collect the flow and electrically driven pumps under automatic control to move the wastewater into force mains that terminate in a common manhole above the elevation of the Bioplant.

The pump stations are operated by bubbler, float type, or ultrasonic level controls. Pumps cycle alternatively during normal flows or run simultaneously at peak flows. The arrangement of the electrical apparatus also allows for manual operation of the pumps.

2.4.2 Monitoring Stations

Each UMS may contain monitoring equipment for the continuous measurement of pH, flow and total organic carbon as needed depending upon the wastewater characteristics going through that station Information collected from the monitoring stations is transmitted to the computer system for optimization of treatment at the Bioplant.

2.4.3 Mobile GAC Unit

The mobile GAC unit removes DNT from batch water used in the solvent dry process. Water is used to remove solvent from batches of DNT propellant by driving off the solvent with 165°F water for 10 to 12 days. The resulting wastewater is typically free of solvents, but may contain low concentrations of DNT, which may be difficult to remove in the Bioplant.

The wastewater is processed through two 250-gallon GAC units to remove the DNT. The resulting wastewater is sampled and analyzed for TC and DNT, then discharged to the Bioplant collection system.

The carbon is changed as needed when DNT concentrations in the wastewater begin to increase. The spent carbon is disposed offsite. Operation and maintenance of the portable GAC unit is provided in Standard Procedure 4-08-029 "Waste Water Adsorption."

2.4.4 NG-1 Pretreatment Plant (Not currently in use)

2.4.4.1 NG-1 Equalization Tanks

The NG-1 equalization tanks T-013 and T-014 formerly served to collect waste from NG-1 Area operations (wastewater and storm water) prior to discharge to the denitration tanks. A third tank (T-015), and the waste stream from New River Energetics operation are both currently locked out. The tanks allow for monitoring of NG presence and for equilibration of the water streams prior to discharge to the denitration tanks.

2.4.4.2 NG-1 Denitration Tanks 024 and 025

The two NG-1 denitration tanks serve to hold the wastewater to allow treatment with 50% sodium hydroxide and 45% sodium hydrosulfide. Following treatment, the waste is pumped to the neutralization mix tank.

2.4.4.3 NG-1 Neutralization Mix Tank 026

The NG-1 neutralization mix tank 026 receives treated waste from denitration tanks 024 and 025. Ninety-three percent sulfuric acid is added to lower the pH of the wastewater to approximately 7.0 standard units (SU) before it is discharged to the mix tank.

2.4.4.4 NG-1 Mix Tank

The mix tank receives wastewater from the neutralization mix tank but serves no treatment purpose. The pH of the waste is confirmed to be between 6.0 and 9.0 SU as it is discharged to Upstream Monitoring Station 8 (Building 403-22) and Pump Station 906-9, part of the Bioplant collection system.

2.4.5 NG-2 Pretreatment Plant

2.4.5.1 NG-2 Equalization Tanks 1 and 2

Equalization tanks 1 and 2 serve to collect all NG-2 Area waste (wastewater and storm water). The NG-2 equalization tanks discharge to the denitration tanks. The two steel tanks are located in a concrete secondary containment pit. The tanks allow for monitoring of NG presence and for equilibration of the water streams prior to discharge to the denitration tanks.

2.4.5.2 NG-2 Denitration Tanks A and B

Two denitration tanks serve to hold the wastewater to allow treatment with 50% sodium hydroxide, 45% sodium hydrosulfide, and 93% sulfuric acid. Following treatment in denitration tank B, DEG and TEG wastewater is pumped to the wastewater tanks, while all other waste from denitration tanks A and B are pumped to the clarifiers.

2.4.5.3 NG-2 Clarifier 1 and 2

The clarifiers receive treated wastewater from denitration tanks A and B for holding until pumped to the flash mix tank. The clarifiers served only as holding tanks.

2.4.5.4 NG-2 Waste Water Tanks A and B

The wastewater tanks receive treated DEG and TEG waste from denitration tank B for holding prior to transfer to tanker truck for offsite disposal.

2.4.5.5 NG-2 Flash Mix Tank/Equalization Tank for Treated Waste Water

The flash mix tank and equalization tank for treated wastewater no longer serve their original purpose in the NG-2 pretreatment process. They are flow-through tanks and are therefore addressed together.

The flash mix tank was previously the point at which acid was added for pH control, but all pH control is now accomplished in the denitration tanks. The pH of the wastewater is monitored at this tank while it is subjected to continuous agitation, but the waste is not subjected to further treatment. The equalization tank for treated wastewater

previously served to provide equalization of the waste following addition of acid in the flash mix tank, but treated waste is no longer held in this tank. The treated wastewater flows via gravity to pump station 906-15.

2.4.5.6 NG-2 Floor Drain Pit

The floor drain pit serves to collect spills in Building 9410 and emergency discharge from the denitration tanks, wastewater tanks, and clarifiers. Waste collected in the floor drain pit is pumped to the denitration tanks for treatment.

2.4.6 TNT Pretreatment Plant

2.4.6.1 Wastewater Tank (T-72)

Wastewater Tank T-72 serves as an initial collection point for wastewater from the acid tank dikes, nitration and denitration, ONT tank dikes, and Isotrioil and finishing. If needed, manual adjustment of pH can occur here. This material is pumped into the Equalization tanks 9546-3.

2.4.6.2 Equalization Tanks (9546-3)

Equalization tank 9546-3 consisits of two basins that collect all TNT area waste water. The tanks allow for the monitoring of nitrobody presence and for equilibration of the water streams prior to discharge to the GAC units.

2.4.6.3 Granular Activated Carbon Treatment and EQ tank 9546-2

The GAC units remove nitrobodies from the TNT wastewater. The wastewater is processed through four 250-gallon GAC units. The resulting wastewater is sampled and analyzed for nitrobidies, then discharged to tank 9546-2 which is a simple holding tank to discharge to 9546-4.

2.4.6.4 The carbon is changed as needed when nitrobody concentrations in the wastewater begin to increase. The spent carbon is disposed offsite. Discharge Tank (9546-4) and Internal Outfall 291

Wastewater after being treated with activated carbon then goes to basin 9546-4 to await discharge to the Industrial wastewater treatment system. There will not be any discharge from 9546-4 while the GAC units are discharging. This wastewater is monitored and pH adjusted as needed to ensure treatability at the industrial waste treatment plant.

2.4.7 NC Hydrolysis Treatment (Not currently in use)

2.4.7.1 Wastewater Tank (B472, 5502, or 472)

Waste Nitrocellulose is added to these tanks for hydrolysis destruction from various sources throughout the plant. Sodium hydroxide in liquid or solid form is added to chemically degrade this waste stream into more readily treatable compounds which are polished at the industrial waste treatment facility.

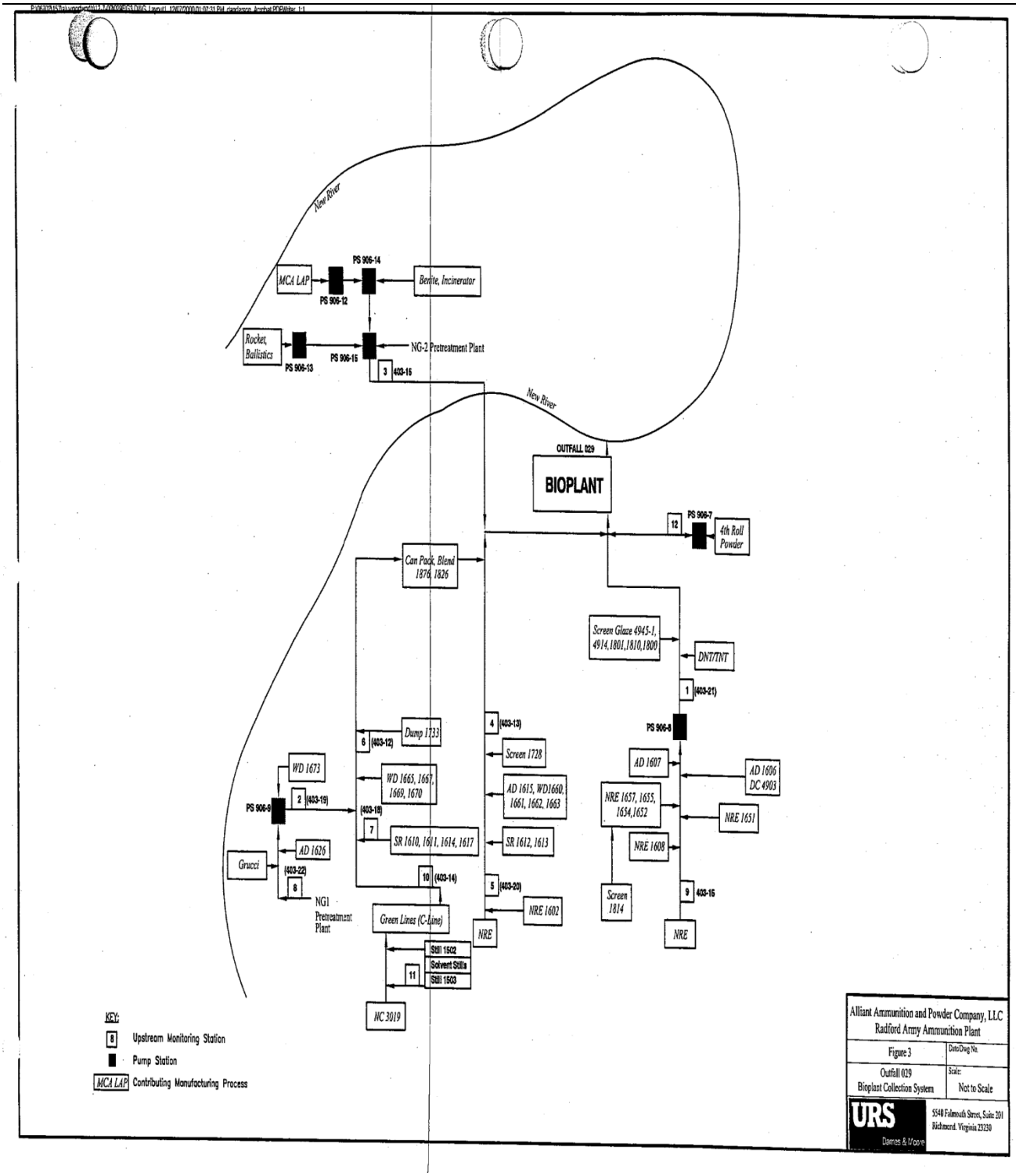


Figure 3: Outfall 029 Flow Diagram

3.0 PERMITS AND STANDARDS

3.1 IDENTIFICATION OF PERMITS

3.1.1 Purpose of Permit with Reference to Copy in Appendix

The purpose of the permit is to define the requirements for the facility to comply with VPDES and CWA regulations. A copy of the permit is provided in Appendix A.

3.1.2 Permitting Authority

The permitted authority for this facility is:

Commonwealth of Virginia
Department of Environmental Quality
Blue Ridge Regional Office
901 Russell Drive, Salem, VA 24153 .....
Telephone (540) 562-6700
Fax (540) 562-6725

3.1.3 Permit Number

The VPDES Permit Number for the facility is VA0000248.

3.1.4 Brief Description of Permit Requirements

The facility permit defines the following requirements for compliance with the permit:

- Industrial effluent limitations;
- Monitoring requirements;
- Reporting requirements;
- Development of a O&M manual;
- Operator requirements;
- Groundwater assessment and monitoring;
- Inspection requirements; and
- Storm water management requirements/pollution prevention.

This document serves as the O&M manual for Outfall 029 – Industrial Waste Water Pretreatment Appurtenances and Pretreatment Facilities.

3.2 SPILL PROCEDURES

Spill procedures are maintained in Management Manual number 3-1.01, "Environmental Quality and Safety Incident Reporting." This manual is updated and maintained on a regular basis. Therefore, to minimize duplication of updating site contacts, phone numbers and other applicable data in numerous documents, this manual is provided in Appendix B. The Appendix to the O&M plan will be updated as the manual is updated.

3.2.1 Outline of Regulations for Spills

Please refer to Management Manual "Environmental Quality and Safety Incident Reporting."

3.2.2 Spill Reporting Requirements

Please refer to Management Manual "Environmental Quality and Safety Incident Reporting."

4.0 OPERATION AND CONTROL OF TREATMENT FACILITIES

4.1 GENERAL INFORMATION FOR EACH UNIT PROCESS

4.1.1 Pump Stations

4.1.1.1 Physical Description, Function, Flow Routing and Design

Seven pump stations are necessary in the RFAAP Bioplant collection system to move wastewater from the areas lower in elevation than the Bioplant. Pump station locations are shown on Figure 2.

Basic construction consists of a sump to collect the flow and electrically driven pumps under automatic control to move the wastewater into force mains that terminate in a common manhole above the elevation of the Bioplant. A diesel generator is maintained at each pump station for backup power.

4.1.1.2 Listing of Major Components and Mechanical Equipment

The major components of the pump stations (PS) include two pumps, electric heater, and float controls with a control panel. Each pump station has a diesel generator for backup power. The following exceptions are noted at the pump stations:

- ..... PS 906-7, two pumps with float controls;
- ..... PS 906-8, bubble system float control with small compressor;
- ..... PS 906-9, three pumps with float controls;
- ..... PS 906-12, bubble system float control with small compressor;
- ..... PS 906-13, bubble system float control with small compressor;
- ..... PS 906-14, bubble system float control with small compressor; and
- ..... PS 906-15, bubble system float control with plant air.

4.1.1.3 Relationship to Adjacent Units

The pump stations collect wastewater from manufacturing areas for discharge to the Bioplant. The following describes the wastewater collected and discharge location:

- PS 906-7, receives wastewater from the Rolled Powder Area for distribution to

the Bioplant.

- PS 906-8, receives wastewater from the following lines for discharge through UMS 1 and to the Bioplant:

- New River Energetics
- Decontamination Oven
- Air Dry Buildings
- Screen House Buildings
- UMS 9

- PS 906-9, receives wastewater from the following lines for discharge through UMS 2 and to the Bioplant:

- Nitrocellulose Production Buildings
- Water Dry Buildings
- Air Dry Buildings
- Fireworks by Grucci Tenant Area
- NG-1 Pretreatment Plant
- UMS 8

- PS 906-12, receives waste water from the following lines for discharge to PS 906-14:

- Medium Caliber Ammunition Load Assemble and Pack (MCA LAP)

- PS 906-13, receives waste water from the following lines for discharge to PS 906-15:

- Rocket, Ballistics

- PS 906-14, receives waste water from the following lines for discharge to PS 906-15:

- Benite, Incinerator, PS 906-12

- PS 906-15, receives wastewater from the following lines for discharge through UMS-3 and to the Bioplant:

- PS 906-12
- PS 906-13
- PS 906-14
- Nitroglycerin Manufacturing
- NG-2 Pretreatment Plant

4.1.1.4 Methods of Control of Unit Process

The pump stations are operated by bubbler or float type level controls. Pumps cycle alternatively during normal flows or run simultaneously at peak flows. The arrangement of the electrical apparatus also allows for manual operation of the pumps.

4.1.1.5 Discussion of Monitoring

Each pump station is inspected daily as defined by Checker Sheet 8620. Each pump station is inspected weekly as defined by Checker Sheet 7698. The latest versions of these documents can be found in the Document Control System.

4.1.1.6 Discussion of Common Operating Problems and Control

No common operating problems are associated with the pump stations.

4.1.2 Monitoring Stations

4.1.2.1 Physical Description, Function, Flow Routing and Design

Twelve upstream monitoring stations maintain monitoring equipment for the continuous measurement of pH, flow and TC of the discharge. An automatic pump collects samples from the discharge line for analysis. The pump operates off a small compressor or plant air. Information collected from the monitoring stations is transmitted to the network for optimization of treatment at the Bioplant. The following exceptions are noted to the typical layout:

- UMS 1 (Building 403-21) – This UMS does not utilize a pneumatic sampling pump.
- UMS 2 (Building 403-19) – This UMS utilizes a magnetic strip flow meter.
- UMS 3 (Building 403-15) – This UMS utilizes a magnetic strip flow meter.
- UMS 4 (Building 403-13) – This UMS utilizes a magnetic strip flow meter.
- UMS 5 (Building 403-20) – This UMS utilizes a magnetic strip flow meter.
- UMS 6 (Building 403-12) – This UMS utilizes a magnetic strip flow meter.
- UMS 7 (Building 403-18) – This UMS utilizes a magnetic strip flow meter.

- UMS 8 (Building 403-22) – This UMS not used.
- UMS 9 (Building D-1604) – This UMS not used.
- UMS 10 (Building 403-14) – This UMS utilizes a magnetic strip flow meter.
- UMS 11 – This UMS not used.
- UMS 12 – This UMS not used.

4.1.2.2 Listing of Major Components and Mechanical Equipment

The major components of the upstream monitoring stations include:

- Flow meter (as applicable);
- Pneumatic pump (as applicable);
- Compressor;
- pH meter; and
- TC analyzer.

4.1.2.3 Relationship to Adjacent Units

- See Section 4.1.1.3

4.1.2.4 Methods of Control of Unit Process

The monitoring stations automatically collect wastewater data and transmits the data to the computer system for optimization of the Bioplant. No other control measures are required.

4.1.2.5 Discussion of Monitoring

The upstream monitoring stations automatically collect waste water data and transmit the data to the computer system for optimization of the Bioplant. No other monitoring is required.

4.1.2.6 Discussion of Common Operating Problems and Control

No common operating problems are associated with monitoring stations.

4.1.3 Mobile GAC Unit

4.1.3.1 Physical Description, Function, Flow Routing and Design

The mobile GAC unit removes DNT from batch water used in the solvent dry process. Water is used to remove solvent from batches of propellant containing DNT by driving off the solvent with 165°F water for 10 to 12 days. The resulting wastewater is typically free of solvents, but may contain low amounts of DNT, which may be difficult to remove in the Bioplant.

The wastewater is processed through two 250-gallon GAC units to remove the DNT. The resulting wastewater is sampled and analyzed for TC, then discharged to the Bioplant collection system for treatment at the Bioplant.

The carbon is changed as needed and disposed offsite. Operation and maintenance of the portable GAC unit is provided in procedure 4-08-029 "Waste Water Adsorption."

4.1.3.2 Listing of Major Components and Mechanical Equipment

The major components of the mobile GAC unit include:

- . Activated carbon adsorption unit;
- . Secondary activated carbon unit; and
- . Portable Platform Ladder.

4.1.3.3 Relationship to Adjacent Units

The mobile GAC unit receives batch wastewater from propellant drying and discharges the wastewater to the sewer system leading to the Bioplant.

4.1.3.4 Methods of Control of Unit Process

Discussion of methods of control of unit processes of the mobile GAC unit is provided in the RFAAP Standard Procedure Title: 4-08-029, "Waste Water Adsorption". RFAAP will operate in accordance with the most current revision of the procedure.

4.1.3.5 Discussion of Monitoring

Monitoring of the mobile GAC unit is provided in Standard Procedure Title: 4-08-029 "Waste Water Adsorption."

4.1.3.6 Discussion of Common Operating Problems and Control

Detailed discussion of common operating problems and control is provided in Standard Procedure Title: 4-08-029 "Waste Water Adsorption."

4.1.4 NG-1 Pretreatment Plant (Inactive)

A flow diagram of the treatment process at NG-1 Pretreatment is included as Figure 4.

4.1.4.1 NG-1 Equalization Tanks 013, 014, and 015

4.1.4.1.1 Physical Description, Function, Flow Routing and Design

The equalization tanks operate independently from each other and serve to collect NG-1 waste prior to discharge to the denitration tanks. The wastewater can be collected in either or both of the two operating tanks (013 and 014). A third tank (015) is currently locked out of the treatment system.

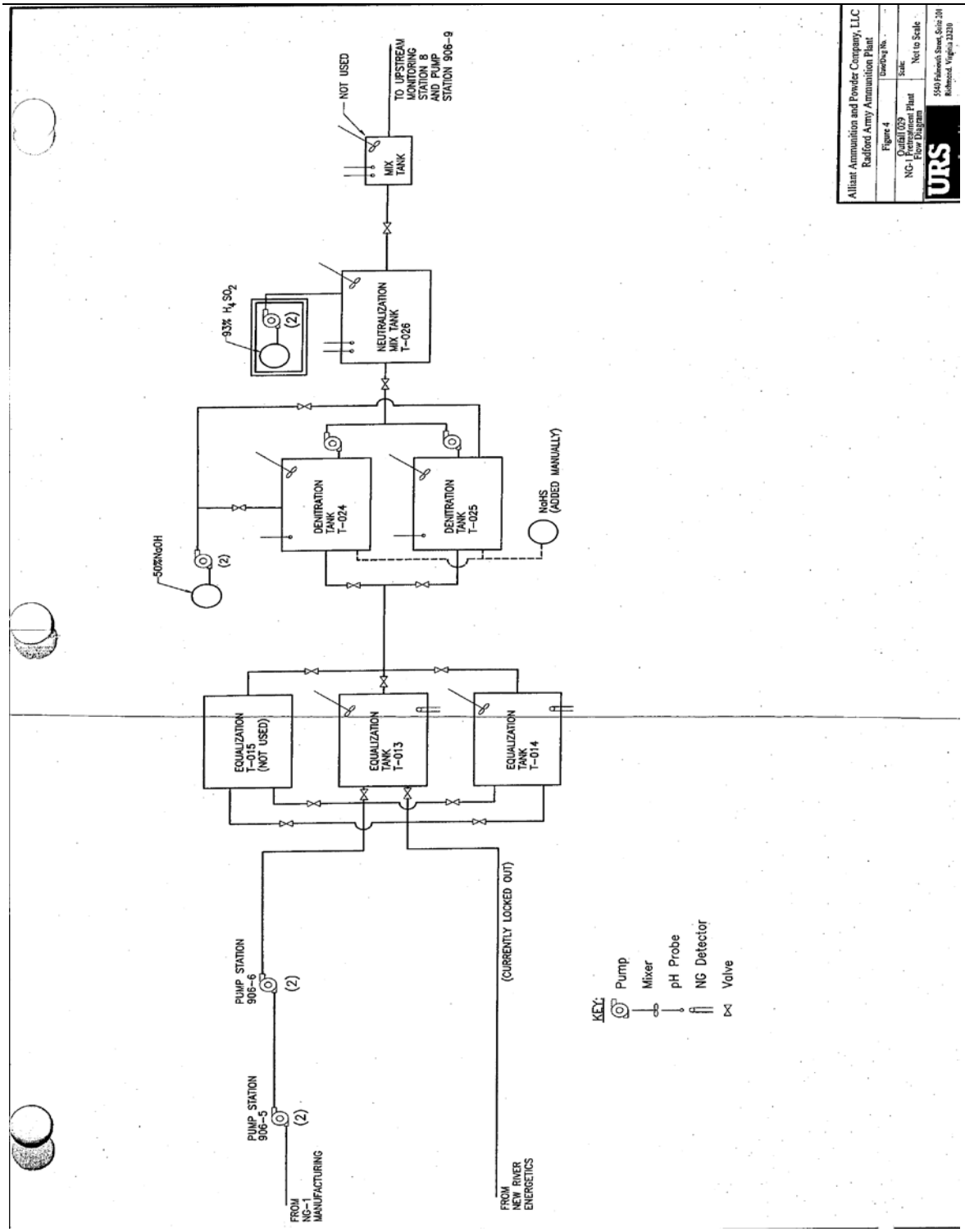


Figure 4: NG-1 Pretreatment Flow Diagram

The tanks allow for monitoring of settled NG and for equilibration of the water streams prior to discharge to the denitration tanks.

4.1.4.1.2 Listing of Major Components and Mechanical Equipment

A list of the major components and mechanical equipment is in Standard Procedure Title: 4-16-014, "NG-1 Waste Water Pretreatment Plant." RFAAP will operate in accordance with the most current revision of the procedure, should the area operate. The procedure is in inactive status; therefore, is not provided in this manual.

4.1.4.1.3 Relationship to Adjacent Units

The equalization tanks collect NG-1 wastewater prior to discharge to the denitration tanks. The wastewater is pumped to the denitration tanks provide for batch treatment of the wastewater.

4.1.4.1.4 Methods of Control of Unit Process

The wastewater is pumped from the equalization tanks to the denitration tanks.

4.1.4.1.5 Discussion of Monitoring

The equalization tanks are continually monitored for NG presence. If NG is detected, alarms will sound at the control room and the outlet pumps will automatically be shut off to prevent the waste from entering the denitration tanks. RFAAP personnel will then drain the NG from the equalization tanks using the sampling valves in each tank.

The water level in each of the tanks is also monitored. No other monitoring of the equalization tanks is required.

4.1.4.1.6 Discussion of Common Operating Problems and Control

No common operating problems are associated with the NG-1 equalization tanks.

4.1.4.2 NG-1 Denitration Tanks 024 and 025

4.1.4.2.1 Physical Description, Function, Flow Routing and Design

The two NG-1 denitration tanks operate independently from each other. The tanks hold the wastewater to allow treatment of the suspended nitroglycerin. Sodium hydroxide and sodium hydrosulfide (if DEGDN, TEGDN, or TMETN waste water is being treated) are added in sequence to raise the pH to 11.8 SU and then allow degradation of nitrate esters prior to discharge to the neutralization mix tank.

4.1.4.2.2 Listing of Major Components and Mechanical Equipment

A list of the major components and mechanical equipment are listed in Standard Procedure Title: 4-16-014, "NG-1 Waste Water Pretreatment Plant." The procedure is in inactive status; therefore, is not provided in this manual.

4.1.4.2.3 Relationship to Adjacent Units

The two denitration tanks receive waste water from the equalization tanks and discharge the treated waste water to the neutralization mix tank.

4.1.4.2.4 Methods of Control of Unit Process

The flow into the NG-1 denitration tanks is controlled by the outlet pumps at the equalization tanks and by the denitration tank inlet valves. The wastewater can be diverted into one or both of the tanks by adjusting the inlet valves.

The addition of 50% sodium hydroxide to the denitration tanks is controlled by the pump on the caustic storage tank, located inside Building 3622. Sodium hydroxide is added until the pH reaches 11.8 SU.

The 45% sodium hydrosulfide is added through a manhole in the tank. The sodium hydrosulfide is stored in 55-gallon drums in Building 3622.

4.1.4.2.5 Discussion of Monitoring

The level of each of the tanks is continuously monitored. The pH is taken manually before and after the addition of sodium hydroxide to the wastewater.

The presence of hydrogen sulfide fumes (produced when sodium hydrosulfide is added) is also monitored. Two detectors are located in the building. Yellow warning lights on the control panel indicate that a hydrogen sulfide level of 10 parts per million (ppm) in the air has been reached. Red warning lights and an audible alarm are triggered when a 15 ppm level is reached. Personnel should exit the building if the hydrogen sulfide level is 10 ppm or greater, in accordance with Standard Procedure Title: 4-16-014, "NG-1 Waste Water Pretreatment Plant." The procedure is in inactive status; therefore, is not provided in this manual.

4.1.4.2.6 Discussion of Common Operating Problems and Control

No common operating problems are associated with the tanks.

4.1.4.3 NG-1 Neutralization Mix Tank 026

4.1.4.3.1 Physical Description, Function, Flow Routing and Design

The neutralization mix tank receives treated waste from denitration tanks 024 and 025 for the addition of 93% sulfuric acid to lower the pH of the wastewater.

4.1.4.3.2 Listing of Major Components and Mechanical Equipment

A list of the major components and mechanical equipment is located in Standard Procedure Title: 4-16-014, "NG-1 Waste Water Pretreatment Plant." The procedure is in inactive status; therefore, is not provided in this manual.

4.1.4.3.3 Relationship to Adjacent Units

The NG-1 neutralization mix tank receives treated waste from denitration tanks 024 and 025 for treatment prior to transfer to the mix tank.

4.1.4.3.4 Methods of Control of Unit Process

The flow into the tank is controlled by the denitration tank outlet pumps and the neutralization mix tank inlet valves. The flow out of the tank is controlled by the neutralization mix tank overflows. The wastewater is not released to the mix tank until its pH is 7.0 SU.

The addition of 93% sulfuric acid is controlled via the outlet pumps at the sulfuric acid storage tank, located in concrete secondary containment adjacent to Building 3622.

4.1.4.3.5 Discussion of Monitoring

The pH of the wastewater is monitored and used to control the addition of the 93% sulfuric acid. The pH is also monitored to ensure the wastewater is not discharged to the mix tank until the pH reaches 7.0 SU.

4.1.4.3.6 Discussion of Common Operating Problems and Control

No common operating problems are associated with the tanks.

4.1.4.4 NG-1 Mix Tank

4.1.4.4.1 Physical Description, Function, Flow Routing and Design

The NG-1 mix tank receives wastewater from the neutralization mix tank. No treatment is conducted at the tank.

4.1.4.4.2 Listing of Major Components and Mechanical Equipment

A list of the major components and mechanical equipment is provided in Standard Procedure Title: 4-16-014, “NG-1 Waste Water Pretreatment Plant.” The procedure is in inactive status; therefore, is not provided in this manual.

4.1.4.4.3 Relationship to Adjacent Units

The NG-1 mix tank receives waste from the neutralization mix tank and discharges to pump station 906-9 and the Bioplant collection system.

4.1.4.4.4 Methods of Control of Unit Process

The flow into the tank is controlled by the neutralization mix tank outlet valves.

4.1.4.4.5 Discussion of Monitoring

The tank is visually inspected to ensure they are operating properly. No other monitoring of the tanks is required.

4.1.4.4.6 Discussion of Common Operating Problems and Control

No operating problems are associated with the NG-1 mix tank.

4.1.5 NG-2 Pretreatment Plant

A flow diagram of the treatment process for the NG-2 Pretreatment Plant is shown in Figure 5.

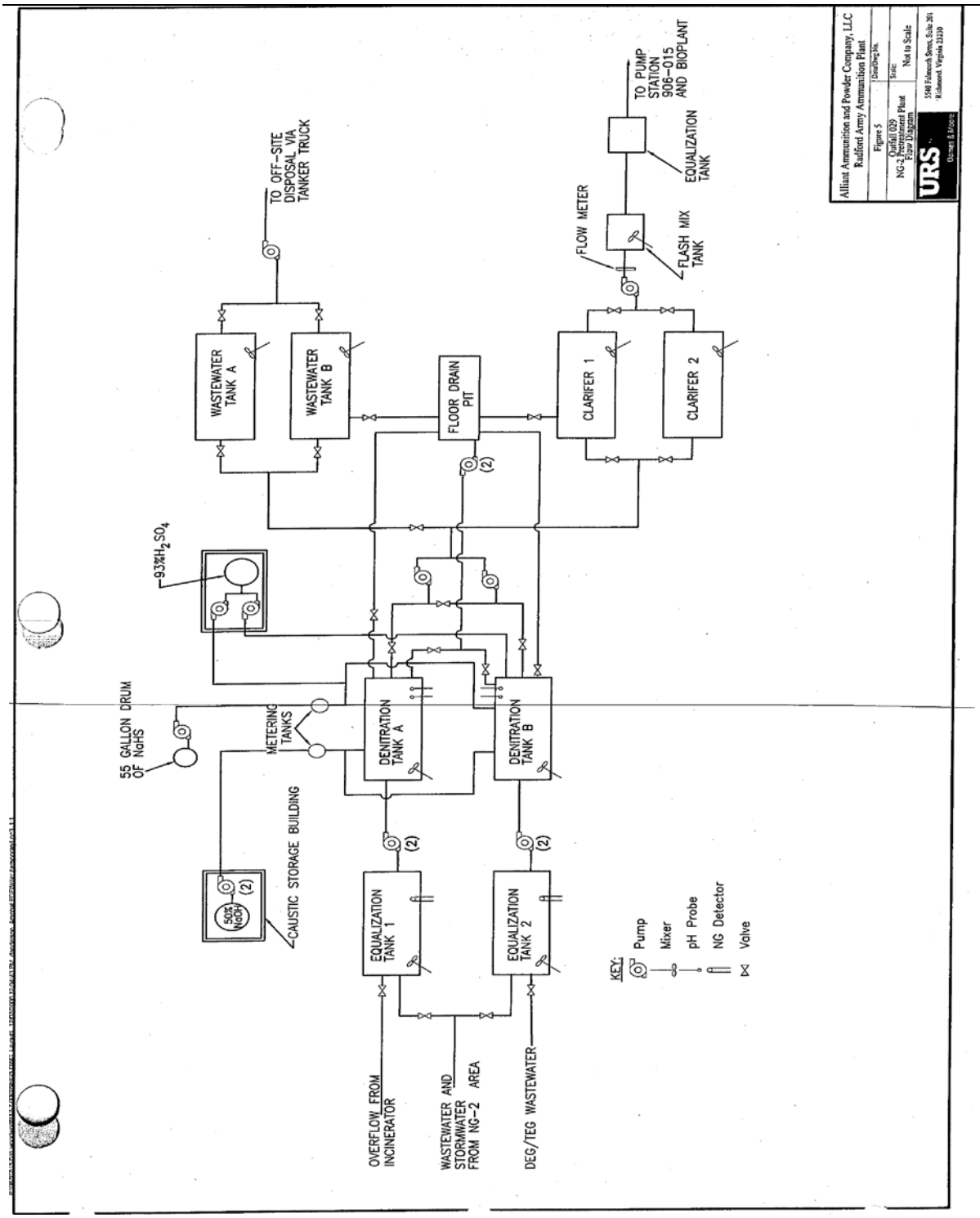


Figure 5: NG-2 Pretreatment Plant Flow Diagram

4.1.5.1 NG-2 Equalization Tanks 1 and 2

4.1.5.1.1 Physical Description, Function, Flow Routing and Design

The equalization tanks operate independently from each other and serve to collect all NG-2 wastewater prior to discharge to the denitration tanks. The tanks allow for monitoring of settled NG and for equilibration of the water streams prior to discharge to the denitration tanks.

4.1.5.1.2 Listing of Major Components and Mechanical Equipment

A list of the major components and mechanical equipment is provided in Standard Procedures Titled: RAD-NG-630, RAD-NG-631, RAD-NG-632, RAD-NG-633, RAD-NG-634, andRAD-NG-635." RFAAP will operate in accordance with the most current revision of the procedure.

4.1.5.1.3 Relationship to Adjacent Units

The equalization tanks collect all NG-2 area wastewater prior to discharge to the denitration tanks. Equalization tank 1 pumps directly to denitration tank A, while equalization tank 2 pumps to denitration tank B.

4.1.5.1.4 Methods of Control of Unit Process

The wastewater is pumped from the equalization tanks to the denitration tanks. Equalization tank 1 pumps wastewater to denitration tank A and equalization tank 2 pumps wastewater to denitration tank B.

4.1.5.1.5 Discussion of Monitoring

The NG-2 equalization tanks are continually monitored for NG presence. If NG is detected, alarms will sound at the control room and the outlet pumps will automatically be shut off to prevent the waste from entering the denitration tanks. RFAAP personnel will then drain the NG from the equalization tanks using the sampling valves in each tank.

The water level in each of the tanks is also monitored.

4.1.5.1.6 Discussion of Common Operating Problems and Control

No common operating problems are associated with the equalization tanks.

4.1.5.2 NG-2 Denitration Tanks A and B

4.1.5.2.1 Physical Description, Function, Flow Routing and Design

The two NG-2 denitration tanks operate independently from each other. The denitration tanks hold the wastewater to allow treatment of the suspended nitrate esters. Sodium hydroxide, sodium hydrosulfide (if treating DEGDN waste water), and sulfuric acid are added in sequence, to allow for the degradation of the nitrate esters prior to discharge to the Bioplant.

4.1.5.2.2 Listing of Major Components and Mechanical Equipment

A list of the major components and mechanical equipment is provided in Standard Procedure Title: "RAD-NG-630, RAD-NG-631, RAD-NG-632, RAD-NG-633, RAD-NG-634, and RAD-NG-635."

4.1.5.2.3 Relationship to Adjacent Units

The denitration tanks receive wastewater from the equalization tanks. Denitration tank A receives waste from equalization tank 1 and discharges the treated wastewater to clarifier 1 or 2. Denitration tank B receives waste from equalization tank 2 and discharges the treated wastewater to tanks 1 and 2 (in the case of DEG and TEG waste water) or to clarifier 1 or 2 (for all other waste water).

4.1.5.2.4 Methods of Control of Unit Process

The flow into the denitration tanks is controlled by the outlet pumps at the equalization tanks and by inlet valves. The flow out of the tanks is controlled by outlet valves.

The addition of 50% sodium hydroxide and 45% sodium hydrosulfide to the tanks is controlled by metering pumps. The sodium hydroxide is pumped to the tanks from the caustic storage tank located in a building adjacent to Building 9410. The sodium hydrosulfide is pumped from 55-gallon drums located in Building 9410.

The addition of 93% sulfuric acid is controlled by the pumps at the acid storage tank, located in concrete secondary containment outside Building 9410.

4.1.5.2.5 Discussion of Monitoring

The pH and level of each of the NG-2 denitration tanks is continuously monitored. The presence of hydrogen sulfide fumes is also monitored.

4.1.5.2.6 Discussion of Common Operating Problems and Control

No common operating problems are associated with the tanks.

4.1.5.3 NG-2 Clarifiers 1 and 2

4.1.5.3.1 Physical Description, Function, Flow Routing and Design

The clarifiers receive treated wastewater from denitration tanks A and B for temporary holding until being drained to the flash mix tank. The clarifiers are now used only as holding tanks.

4.1.5.3.2 Listing of Major Components and Mechanical Equipment

A list of the major components and mechanical equipment is provided in Standard Procedure Title: "RAD-NG-630, RAD-NG-631, RAD-NG-632, RAD-NG-633, RAD-NG-634, and RAD-NG-635."

4.1.5.3.3 Relationship to Adjacent Units

The clarifiers receive treated wastewater from denitration tanks A and B for temporary holding until being pumped to the flash mix tank/equalization tank.

4.1.5.3.4 Methods of Control of Unit Process

The flow into the two tanks is controlled by the denitration tank outlet pumps and the inlet valves. The flow out of the two tanks is controlled by the outlet valves.

4.1.5.3.5 Discussion of Monitoring

The flow rate out of the clarifiers is monitored.

4.1.5.3.6 Discussion of Common Operating Problems and Control

No common operating problems are associated with the tanks.

4.1.5.4 NG-2 Waste Water Tanks 1 and 2

4.1.5.4.1 Physical Description, Function, Flow Routing and Design

The wastewater tanks receive treated DEG and TEG waste from denitration tank B for storage until transfer to tanker truck for offsite disposal.

4.1.5.4.2 Listing of Major Components and Mechanical Equipment

The major components of the waste water tanks include:

- Flow control to divert the flow into one of the two tanks;
- Discharge pumps; and
- Discharge valves.

4.1.5.4.3 Relationship to Adjacent Units

The two NG-2 wastewater tanks receive waste from denitration tank B. Waste from the tanks is pumped to a tanker truck as necessary for off-site disposal.

4.1.5.4.4 Methods of Control of Unit Process

The flow into the two tanks is controlled by the denitration tanks outlet pumps and can be diverted into one or both of the tanks using the inlet valves. The flow out of the tanks is controlled by the outlet valves and outlet pumps.

4.1.5.4.5 Discussion of Monitoring

The two NG-2 wastewater tanks are visually inspected to ensure they are operating properly.

4.1.5.4.6 Discussion of Common Operating Problems and Control

No common operating problems are associated with the tanks.

4.1.5.5 NG-2 Flash Mix Tank/Equalization Tank for Treated Waste Water

4.1.5.5.1 Physical Description, Function, Flow Routing and Design

The flash mix tank consists of an in-ground, open tank located adjacent to Building 9410 at which the wastewater is subject to pH monitoring and continued agitation but no treatment. The equalization tank for treated wastewater consists of an in-ground tank at which the wastewater is not subject to treatment.

4.1.5.5.2 Listing of Major Components and Mechanical Equipment

A list of the major components and mechanical equipment is provided in Standard Procedure Title: "RAD-NG-630, RAD-NG-631, RAD-NG-632, RAD-NG-633, RAD-NG-634, and RAD-NG-635."

4.1.5.5.3 Relationship to Adjacent Units

The flash mix tank/equalization tank receives wastewater from the clarifiers and discharges to pump station 906-15.

4.1.5.5.4 Methods of Control of Unit Process

No methods of control are associated with the tanks.

4.1.5.5.5 Discussion of Monitoring

The pH of the wastewater is continuously monitored in the flash mix tank.

4.1.5.5.6 Discussion of Common Operating Problems and Control

No common operating problems are associated with the tanks.

4.1.5.6 NG-2 Floor Drain Pit

4.1.5.6.1 Physical Description, Function, Flow Routing and Design

The floor drain pit serves to collect wastewater in the event one of the tanks in Building 9410 malfunctions or liquid is spilled in Building 9410. The wastewater is routed to the pit via a floor drainage system.

4.1.5.6.2 Listing of Major Components and Mechanical Equipment

A list of the major components and mechanical equipment is provided in Standard Procedure Title: RAD-NC-300, “TNT Waste Water - Applicable Documents and Use List.”

4.1.5.6.3 Relationship to Adjacent Units

The floor drain pit receives wastewater from the denitration tanks, the clarifiers, the wastewater tanks, and floor spills in Building 9410. Collected wastewater is pumped to the denitration tanks for treatment.

4.1.5.6.4 Methods of Control of Unit Process

The flow into the pit is controlled by outlet valves on the denitration tanks, the clarifiers, and the wastewater tanks. The flow out of the tanks is controlled by the pit outlet pumps.

4.1.5.6.5 Discussion of Monitoring

No monitoring is conducted at the floor drain pit.

4.1.5.6.6 Discussion of Common Operating Problems and Control

No common operating problems are associated with the pit.

4.1.6 TNT Pretreatment Plant

4.1.6.1 Wastewater Tank (T-72)

4.1.6.1.1 Physical Description, Function, Flow Routing and Design

T-72 is a 52,000 gallon tank that receives all process water from the TNT area. The tanks allow for the monitoring for nitrobodies and pH when needed and are contained within a secondary containment dike.

4.1.6.1.2 Listing of Major Components and Mechanical Equipment

A list of the major components and mechanical equipment is provided in Standard Procedure Title: RAD-NC-300, "TNT Waste Water - Applicable Documents and Use List."

4.1.6.1.3 Relationship to Adjacent Units

T-72 receives wastewater from the TNT area and discharges it to the Equalization basins 9546-3.

4.1.6.1.4 Methods of Control of Unit Process

Wastewater is pumped from T-72 into the Equalization basins 9546-3.

4.1.6.1.5 Discussion of Monitoring

When TNT is operating sampling is done in accordance with Standard Procedure Title: RAD-NC-302, "TNT Waste Water - Normal Operations 9546-3 North and South Basins."

4.1.6.1.6 Discussion of Common Operating Problems and Control

There are no common problems with this feature.

4.1.6.2 Equalization Tanks (9546-3)

4.1.6.2.1 Physical Description, Function, Flow Routing and Design

The equalization tanks are divided up into a North and South basin. These two basins can be selected to receive water from T-72.

4.1.6.2.2 Listing of Major Components and Mechanical Equipment

A list of the major components and mechanical equipment is provided in Standard Procedure Title: RAD-NC-302, "TNT Waste Water - Normal Operations 9546-3 North and South Basins."

4.1.6.2.3 Relationship to Adjacent Units

The Equalization tank receives wastewater from T-72 and discharges it to the GAC units or to basin 9546-2 and into 9546-4.

4.1.6.2.4 Methods of Control of Unit Process

Wastewater is pumped from Equalization basins 9546-3 to the granular activated carbon units. Details on the process are found in Standard Procedure Title: RAD-NC-302, "TNT Waste Water - Normal Operations 9546-3 North and South Basins."

4.1.6.2.5 Discussion of Monitoring

When TNT is operating sampling is done in accordance with Standard Procedure Title: RAD-NC-302, "TNT Waste Water - Normal Operations 9546-3 North and South Basins."

4.1.6.2.6 Discussion of Common Operating Problems and Control

There are no common problems with this feature.

4.1.6.3 Granular Activated Carbon Treatment and EQ basin 9546-2

4.1.6.3.1 Physical Description, Function, Flow Routing and Design

Material from basin 9546-3 is routed through four granular activated carbon units to remove DNT at approximately 130 gpm. If DNT levels are below those prescribed in Standard Procedure Title: 4-23-029, "Waste Water Operations for 9546-1, 9546-2, 9546-3 and 9546-4" the GAC units may be bypassed and wastewater can be pumped directly into 9546-2.

4.1.6.3.2 Listing of Major Components and Mechanical Equipment

A list of the major components and mechanical equipment is provided in Standard Procedure Title: RAD-NC-303, "TNT Waste Water - Processing Water Through The GAC's and Changing GAC Units.”."

4.1.6.3.3 Relationship to Adjacent Units

This unit receives water from basin 9546-3 and discharges into basin 9546-4.

4.1.6.3.4 Methods of Control of Unit Process

Wastewater is pumped through the granular activated carbon units or bypasses the carbon units and goes directly into the 9546-2 eq basin. Details on the process are found in Standard Procedure Title: RAD-NC-303, "TNT Waste Water - Processing Water Through The GAC's and Changing GAC Units."

4.1.6.3.5 Discussion of Monitoring

When TNT is operating sampling is done in accordance with Standard Procedure Title: 4-23-029, "Waste Water Operations for 9546-1, 9546-2, 9546-3 and 9546-4."

4.1.6.3.6 Discussion of Common Operating Problems and Control

One common operating problem is the saturation of the carbon units with DNT. This is controlled by having a sampling plan in place to identify when the two primary carbon units are becoming saturated as detailed in Standard Procedure Title: RAD-NC-303, "TNT Waste Water - Processing Water Through The GAC's and Changing GAC Units."."

4.1.6.4 Discharge Tank (9546-4) and Internal Outfall 291

4.1.6.4.1 Physical Description, Function, Flow Routing and Design

After wastewater passes through EQ basin 9546-2 it is retained in discharge tank 9546-4. Sampling is done per Standard Procedure Title: 4-23-028, "Management of TNT Area Wastewater" and then pumped through internal Outfall 291 to the industrial wastewater treatment plant collection system.

4.1.6.4.2 Listing of Major Components and Mechanical Equipment

A list of the major components and mechanical equipment is provided in Standard Procedure Title: 4-23-029, "Waste Water Operations for 9546-1, 9546-2, 9546-3 and 9546-4."

4.1.6.4.3 Relationship to Adjacent Units

Discharge Tank 9546-4 receives water from 9546-2 and discharges into the industrial wastewater sewer through Outfall 291.

4.1.6.4.4 Methods of Control of Unit Process

Wastewater is pumped out of 9546-4 in accordance to the Standard Procedure Title RAD-NC-300, "TNT Waste Water - Applicable Documents and Use List" and Standard Procedure Title: RAD-NC-302, "TNT Waste Water - Normal Operations 9546-3 North and South Basins."

4.1.6.4.5 Discussion of Monitoring

Sampling occurs according to Standard Procedure Title: 4-23-029, "Waste Water Operations for 9546-1, 9546-2, 9546-3 and 9546-4" and Standard Procedure Title: 4-23-028, "Management of TNT Area Wastewater."

4.1.6.4.6 Discussion of Common Operating Problems and Control

There are no common problems with this feature.

4.1.7 NC hydrolysis

4.1.7.1 Treatment Tank

4.1.7.1.1 Physical Description, Function, Flow Routing and Design

Alkaline hydrolysis of nitrocellulose routinely occurs in tank B472 but may occur in other wastewater tanks when excess capacity is needed. B472 is a 72,000 gallon tank with two agitators to allow nitrocellulose to contact sodium hydroxide. This sodium hydroxide is either spent sodium hydroxide from

our screen cleaning operation or is new material. The solid nitrocellulose is broken down into soluble components which are pumped to the industrial waste treatment plant sewer system or trucked directly to the industrial waste treatment plant.

4.1.7.1.2 Listing of Major Components and Mechanical Equipment

A list of the major components and mechanical equipment is provided in Standard Procedure 4-27-391 Operation of Nitrocellulose Pretreatment Reactor (B472).

4.1.7.1.3 Relationship to Adjacent Units

The nitrocellulose hydrolysis units receive waste nitrocellulose from various locations throughout the plant. Supernatant from the hydrolysis units goes into the Bioplant Sewer collection system or is delivered directly to the Bioplant in tankers.

4.1.7.1.4 Methods of Control of Unit Process

Details of the control methods can be found in 4-27-391 Operation of Nitrocellulose Pretreatment Reactor (B472).

4.1.7.1.5 Discussion of Monitoring

Tank levels are checked as needed to ensure their capacity is not exceeded.

4.1.7.1.6 Discussion of Common Operating Problems and Control

There are no common problems with this feature.

4.2 SPECIFIC INFORMATION FOR EACH UNIT PROCESS

4.2.1 Pump Stations

4.2.1.1 Normal Operation

Pump stations are necessary in the RFAAP collection system to move wastewater from the areas lower in elevation than the Bioplant. The pump stations are operated by float type level controls. Pumps cycle alternatively during normal flows or run simultaneously at peak flows. The arrangement of the electrical apparatus also allows for manual operation of the pumps.

Alternate Operational Modes

Each pump station has a diesel generator for backup emergency power. Alternate operation modes are provided in current procedures.

4.2.1.2 Emergency Operational Modes and Fail-Safe Features

Each pump station has a diesel generator for backup emergency power. Emergency operational modes and fail-safe features are provided in Standard Procedure Title 4-42-096 “Entering Waste Lift Station”.

4.2.2 Monitoring Station

4.2.2.1 Normal Operation

Each monitoring station maintains monitoring equipment for the continuous measurement of pH, flow and total organic carbon of the discharge. Information collected from the monitoring station is transformed to the REDMAP Program for optimization of treatment at the Bioplant.

4.2.2.2 Alternate Operational Modes

Alternate operation modes are not required for the monitoring stations.

4.2.2.3 Emergency Operational Modes and Fail-Safe Features

Emergency operational modes and fail-safe features are not required for the monitoring station.

4.2.3 Mobile GAC Unit

4.2.3.1 Mobile GAC Unit Normal Operation

The mobile granular activated carbon (GAC) unit operates as discussed above, and in accordance with Standard Procedure 4-08-029 “Waste Water Adsorption,”.

4.2.3.2 Mobile GAC Unit Alternate Operational Modes

Alternate operational modes are provided in Standard Procedure Title: 4-08-029, “Waste Water Adsorption.”

4.2.3.3 Emergency Operational Modes and Fail-Safe Features

Emergency operational modes and fail-safe features are provided in Standard Procedure Title 4-08-029 “Waste Water Adsorption”.

4.2.4 NG-1 Pretreatment Plant

4.2.4.1 NG-1 Equalization Tanks

4.2.4.1.1 Normal Operation

Inactive

4.2.4.1.2 Alternate Operational Modes

Inactive

4.2.4.1.3 Emergency Operational Modes and Fail-Safe Features

Inactive

4.2.4.2 NG-1 Denitration Tanks 024 and 025

4.2.4.2.1 Normal Operation

Inactive

4.2.4.2.2 Alternate Operational Modes

Inactive

4.2.4.2.3 Emergency Operational Modes and Fail-Safe Features

Inactive

4.2.4.3 NG-1 Neutralization Mix Tank

4.2.4.3.1 Normal Operation

Inactive

4.2.4.3.2 Alternate Operational Modes

Inactive

4.2.4.3.3 Emergency Operational Modes and Fail-Safe Features

Inactive

4.2.4.4 NG-1 Mix Tank

4.2.4.4.1 Normal Operation

Inactive

4.2.4.4.2 Alternate Operational Modes

Inactive

4.2.4.4.3 Emergency Operational Modes and Fail-Safe Features

Inactive

4.2.5 NG-2 Pretreatment Plant

4.2.5.1 NG-2 Equalization Tanks 1 and 2

4.2.5.1.1 Normal Operation

Normal operation in accordance with Standard Procedure Standard Procedures Titled: "RAD-NG-630, RAD-NG-631, RAD-NG-632, RAD-NG-633, RAD-NG-634, and RAD-NG-635."

4.2.5.1.2 Alternate Operational Modes

Alternate operation in accordance with Standard Procedure Standard Procedures Titled: "RAD-NG-630, RAD-NG-631, RAD-NG-632, RAD-NG-633, RAD-NG-634, and RAD-NG-635."

4.2.5.1.3 Emergency Operational Modes and Fail-Safe Features

Emergency operation in accordance with Standard Procedure Standard Procedures Titled: "RAD-NG-630, RAD-NG-631, RAD-NG-632, RAD-NG-633, RAD-NG-634, and RAD-NG-635."

4.2.5.2 NG-2 Denitration Tanks A and B

4.2.5.2.1 Normal Operation

Normal operation in accordance with Standard Procedure Standard Procedures Titled: "RAD-NG-630, RAD-NG-631, RAD-NG-632, RAD-NG-633, RAD-NG-634, and RAD-NG-635."

4.2.5.2.2 Alternate Operational Modes

Alternate operation in accordance with Standard Procedure Standard Procedures Titled: "RAD-NG-630, RAD-NG-631, RAD-NG-632, RAD-NG-633, RAD-NG-634, and RAD-NG-635."

4.2.5.2.3 Emergency Operational Modes and Fail-Safe Features

Emergency operation in accordance with Standard Procedure Standard Procedures Titled: "RAD-NG-630, RAD-NG-631, RAD-NG-632, RAD-NG-633, RAD-NG-634, and RAD-NG-635."

4.2.5.3 NG-2 Clarifiers 1 and 2

4.2.5.3.1 Normal Operation

Normal operation in accordance with Standard Procedure Standard Procedures Titled: "RAD-NG-630, RAD-NG-631, RAD-NG-632, RAD-NG-633, RAD-NG-634, and RAD-NG-635."

4.2.5.3.2 Alternate Operational Modes

Alternate operation in accordance with Standard Procedure Standard Procedures Titled: "RAD-NG-630, RAD-NG-631, RAD-NG-632, RAD-NG-633, RAD-NG-634, and RAD-NG-635."

4.2.5.3.3 Emergency Operational Modes and Fail-Safe Features

Emergency operation in accordance with Standard Procedure Standard Procedures Titled: "RAD-NG-630, RAD-NG-631, RAD-NG-632, RAD-NG-633, RAD-NG-634, and RAD-NG-635."

4.2.5.4 NG-2 Waste Water Tanks 1 and 2

4.2.5.4.1 Normal Operation

Normal operation in accordance with Standard Procedure Standard Procedures Titled: "RAD-NG-630, RAD-NG-631, RAD-NG-632, RAD-NG-633, RAD-NG-634, and RAD-NG-635."

4.2.5.4.2 Alternate Operational Modes

Alternate operation in accordance with Standard Procedure Standard Procedures Titled: "RAD-NG-630, RAD-NG-631, RAD-NG-632, RAD-NG-633, RAD-NG-634, and RAD-NG-635."

4.2.5.4.3 Emergency Operational Modes and Fail-Safe Features

Emergency operation in accordance with Standard Procedure Standard Procedures Titled: "RAD-NG-630, RAD-NG-631, RAD-NG-632, RAD-NG-633, RAD-NG-634, and RAD-NG-635."

4.2.5.5 NG-2 Flash Mix Tank/Equalization Tank

4.2.5.5.1 Normal Operation

Normal operation in accordance with Standard Procedure Standard Procedures Titled: "RAD-NG-630, RAD-NG-631, RAD-NG-632, RAD-NG-633, RAD-NG-634, and RAD-NG-635."

4.2.5.5.2 Alternate Operational Modes

Alternate operation in accordance with Standard Procedure Standard Procedure Title: "RAD-NG-630, RAD-NG-631,

RAD-NG-632, RAD-NG-633, RAD-NG-634, and RAD-NG-635."

4.2.5.5.3 Emergency Operational Modes and Fail-Safe Features

Emergency operation in accordance with Standard Procedure Standard Procedures Titled: "RAD-NG-630, RAD-NG-631, RAD-NG-632, RAD-NG-633, RAD-NG-634, and RAD-NG-635."

4.2.5.6 Floor Drain Pit

4.2.5.6.1 Normal Operation

Normal operation in accordance with Standard Procedure Standard Procedures Titled: "RAD-NG-630, RAD-NG-631, RAD-NG-632, RAD-NG-633, RAD-NG-634, and RAD-NG-635."

4.2.5.6.2 Alternate Operational Modes

Alternate operation in accordance with Standard Procedure Standard Procedures Titled: "RAD-NG-630, RAD-NG-631, RAD-NG-632, RAD-NG-633, RAD-NG-634, and RAD-NG-635."

4.2.5.6.3 Emergency Operational Modes and Fail-Safe Features

Emergency operation in accordance with Standard Procedure Standard Procedures Titled: "RAD-NG-630, RAD-NG-631, RAD-NG-632, RAD-NG-633, RAD-NG-634, and RAD-NG-635."

4.2.6 TNT Pretreatment Plant

4.2.6.1 Wastewater Tank (T-72)

4.2.6.1.1 Normal Operation

The wastewater Tank (T-72) operates as discussed above, and in accordance with Standard Procedure Title: RAD-NC-300, "TNT Waste Water - Applicable Documents and Use List" and Standard Procedure Title: RAD-NC-302, "TNT Waste Water - Normal Operations 9546-3 North and South Basins."

4.2.6.1.2 Alternate Operational Modes

Alternate operational modes are provided in Standard Procedure Title: RAD-NC-300, "TNT Waste Water - Applicable Documents and Use List" and Standard Procedure Title: RAD-NC-302, "TNT Waste Water - Normal Operations 9546-3 North and South Basins."

4.2.6.1.3 Emergency Operational Modes and Fail-Safe Features

Emergency operational modes are provided in Standard Procedure Title: RAD-NC-300, "TNT Waste Water - Applicable Documents and Use List" and Standard Procedure Title: RAD-NC-302, "TNT Waste Water - Normal Operations 9546-3 North and South Basins."

4.2.6.2 Equalization Tanks (9546-3)

4.2.6.2.1 Normal Operation

The Equalization Tank (9546-3) operates as discussed above, and in accordance with Standard Procedure Title: RAD-NC-300, "TNT Waste Water - Applicable Documents and Use List" and Standard Procedure Title: RAD-NC-302, "TNT Waste Water - Normal Operations 9546-3 North and South Basins."

4.2.6.2.2 Alternate Operational Modes

Alternate operational modes are provided in Standard Procedure Title: RAD-NC-300, "TNT Waste Water - Applicable Documents and Use List" and Standard Procedure Title: RAD-NC-302, "TNT Waste Water - Normal Operations 9546-3 North and South Basins."

4.2.6.2.3 Emergency Operational Modes and Fail-Safe Features

Emergency operational modes are provided in Standard Procedure Title: RAD-NC-300, "TNT Waste Water - Applicable Documents and Use List" and Standard Procedure Title: RAD-NC-302, "TNT Waste Water - Normal Operations 9546-3 North and South Basins."

4.2.6.3 Granular Activated Carbon Treatment and EQ basin 9546-2

4.2.6.3.1 Normal Operation

The ..... Granular Activated Carbon Treatment and EQ basin 9546-2 operates as discussed above, and in accordance with Standard Procedure Title: RAD-NC-303, "TNT Waste Water - Processing Water Through The GAC's and Changing GAC Units" and Standard Procedure Title: RAD-NC-302, "TNT Waste Water - Normal Operations 9546-3 North and South Basins"

4.2.6.3.2 Alternate Operational Modes

Alternate operational modes are provided in Standard Procedure Title: RAD-NC-303, "TNT Waste Water - Processing Water Through The GAC's and Changing GAC Units" and Standard Procedure Title: RAD-NC-302, "TNT Waste Water - Normal Operations 9546-3 North and South Basins"

4.2.6.3.3 Emergency Operational Modes and Fail-Safe Features

Emergency operational modes are provided in Standard Procedure Title: RAD-NC-303, "TNT Waste Water - Processing Water Through The GAC's and Changing GAC Units" and Standard Procedure Title: RAD-NC-302, "TNT Waste Water - Normal Operations 9546-3 North and South Basins"

4.2.6.4 Discharge Tank (9546-4) and Internal Outfall 291

4.2.6.4.1 Normal Operation

The Discharge Tank (9546-4) and Internal Outfall 291 operates as discussed above, and in accordance with Standard Procedure Title: RAD-NC-303, "TNT Waste Water - Processing Water Through The GAC's and Changing GAC Units" and Standard Procedure Title: RAD-NC-302, "TNT Waste Water - Normal Operations 9546-3 North and South Basins"

4.2.6.4.2 Alternate Operational Modes

Alternate operational modes are provided in Standard Procedure Title: RAD-NC-303, "TNT Waste Water - Processing Water Through The GAC's and Changing GAC Units" and Standard Procedure Title: RAD-NC-302, "TNT Waste Water - Normal Operations 9546-3 North and South Basins"

4.2.6.4.3 Emergency Operational Modes and Fail-Safe Features

Emergency operational modes are provided in Standard Procedure Title: RAD-NC-303, "TNT Waste Water - Processing Water Through The GAC's and Changing GAC Units" and Standard Procedure Title: RAD-NC-302, "TNT Waste Water - Normal Operations 9546-3 North and South Basins".

5.0 FACILITY MAINTENANCE

5.1 CONCEPTUAL DESCRIPTION OF MAINTENACE PROGRAM

..The RFAAP Procedure Title: 4-27-091 "Preventative Maintenance Program" defines the purposes and objectives, responsibilities, and procedures for preparing and performing preventive maintenance.

The objective of each preventive maintenance procedure (PM) consists of one or a combination of the following:

- Provide for a safe operation and reduce maintenance cost by detection and correction of defects before they develop into major problems;
- Reduce the frequency of service calls;
- Avoid excessive unexpected shutdowns and delays; and
- Assure the reliability level necessary for production schedules.

If at any time the operator feels that any safety/quality requirements are not being met, they have authority to stop operations and notify supervision immediately.

The facility maintenance program is performed through a task reporting system. Task reports define the maintenance requirements, maintenance frequency, and serve as a record of maintenance activities as defined in the task reporting system. The following schedule and work order system is utilized for system maintenance.

5.2 PLANNING AND SCHEDULING

5.2.1 Preventive Maintenance Schedules

The following preventative maintenance schedule is incorporated by the task report system. RFAAP will operate in accordance with the most current revision of these records and reports; the revisions that are current (as of the submittal of this O&M manual) are included here as examples.

Table 5-1 Pump Stations/Upstream Monitoring Stations

System	Task Number	Equipment	Frequency
Pump Station 906-15	940126-1M	• Pump Station	1.00 Month(s)
Pump Station 906-17	940079-1M	• Bar Screen	1.00 Month(s)
Bldg 403-21	751515-2W	• TC Analyzer	2.00 Week(s)
Bldg 403-18	751516-2W	• TC Analyzer	2.00 Week(s)
Bldg 403-19	751517-2W	• TC Analyzer	2.00 Week(s)
Bldg 403-12	750117-2W	• TC Analyzer	2.00 Week(s)
Bldg 403-13	750118-2W	• TC Analyzer	2.00 Week(s)
Bldg 403-14	750119-2W	• TC Analyzer	2.00 Week(s)
Bldg 403-15	750120-2W	• TC Analyzer	2.00 Week(s)
Bldg 403-20	751520-2W	• TC Analyzer	2.00 Week(s)
Bldg 403-21	751508-1M	• pH Meter • Magnetic Flowmeter	1.00 Month(s)
Bldg 403-15	751509-1M	• pH Meter • Magnetic Flowmeter	1.00 Month(s)
Bldg 403-19	751510-1M	• pH Meter • Magnetic Flowmeter	1.00 Month(s)
Bldg 403-13	751511-1M	• pH Meter • Flowmeter	1.00 Month(s)
Bldg 403-12	751512-1M	• pH Meter • Flowmeter	1.00 Month(s)
Bldg 403-18	751513-1M	• pH Meter • Flowmeter	1.00 Month(s)
Bldg 403-14	751514-1M	• pH Meter • Flowmeter	1.00 Month(s)
Bldg 403-20	751522-1M	• pH Meter • Flowmeter	1.00 Month(s)
Bldg 403-13	670006-1Y	• Backflow prevention valve	1.00 Year(s)
Bldg 403-12	670005-1Y	• Backflow prevention valve	1.00 Year(s)
Bldg 403-14	670007-1Y	• Backflow prevention valve	1.00 Year(s)
Bldg 403-15	670008-1Y	• Backflow prevention valve	1.00 Year(s)
Bldg 403-21	670192-1Y	• Backflow prevention valve	1.00 Year(s)
Pump Station 906-12	710466-6M	• Critical Defects	6.00 Month(s)
Pump Station 906-13	710468-6M	• Critical Defects	6.00 Month(s)
Pump Station 906-15	710472-6M	• Stationary Generators	6.00 Month(s)
Pump Station 906-12	750268-6M	• Pump Control System	6.00 Month(s)

Pump Station 906-13	750269-6M	• Pump Control System	6.00 Month(s)
Pump Station 906-14	750270-6M	• Pump Control System	6.00 Month(s)
Pump Station 906-15	750271-6M	• Pump Control System	6.00 Month(s)
Pump Station 906-08	751565-6M	• Pump Station	6.00 Month(s)
Pump Station 906-07	710459-1Y	• Stationary Generators	1.00 Year(s)
Pump Station 906-11 Annual Inspection	710465-1Y	• Lights • Grounds • Limit Switches • Switches • Motor Starters • Conduit and Fittings • Motors • Float Switches • Receptacles	1.00 Year(s)
Pump Station 906-12	710467-1Y	• Stationary Generators	1.00 Year(s)
Pump Station 906-13	710469-1Y	• Stationary Generators	1.00 Years(s)
Pump Station 906-11 Lubrication	420013-1Y	• Agitators • Pumps	1.00 Years(s)
Equalization Tanks 906-11	420014-1Y	• Mixer Pump	1.00 Years(s)
Biological Sewer Air Release Valve 906-14	670226-1Y	• General Condition	1.00 Years(s)
Biological Sewer Air Release Valve 906-09	670225-1Y	• General Condition	1.00 Years(s)
Biological Sewer Air Release Valve 906-12	670227-1Y	• General Condition	1.00 Years(s)
Pump Station 906-01 Annual Inspection	710453-1Y	• Motor Starters • Conduit and Fittings • Transformer • Wiring • Breakers • Circuit Breakers	1.00 Years(s)

Pump Station 906-02 Annual Inspection	710454-1Y	• Motor Starters • Conduit and Fittings • Transformer • Wiring • Breakers • Circuit Breakers	1.00 Years(s)
Pump Station 906-07 Annual Inspection	710458-1Y	• Motor Starters • Conduit and Fittings • Transformer • Wiring • Breakers • Circuit Breakers	1.00 Years(s)
Pump Station 906-08 Annual Inspection	710460-1Y	• Motor Starters • Conduit and Fittings • Transformer • Wiring • Breakers • Circuit Breakers	1.00 Years(s)
Pump Station 906-08	710461-1Y	• Stationary generators	1.00 Years(s)
Pump Station 906-09 Annual Inspection	710462-1Y	• Motor Starters • Conduit and Fittings • Transformer • Wiring • Breakers • Circuit Breakers	1.00 Years(s)
Pump Station 906-01 Visual Inspection	530052-2Y-V	• Metal • Rope and Slings • Hoists	2.00 Year(s)
Pump Station 906-13 Visual Inspection	530271-2Y-V	• Metal • Rope and Slings • Hoists	2.00 Year(s)
Pump Station 906-01	030112-5Y	• Building structure	5.00 Year(s)
Pump Station 906-02	030113-5Y	• Building structure	5.00 Year(s)

Table 5-2 NG-1 Pretreatment Plant			
System	**Task Number**	**Equipment**	**Frequency**
NO PM'S LISTED – NG-1 AREA INACTIVE			

Table 5-3 NG-2 Pretreatment Plant			
System	**Task Number**	**Equipment**	**Frequency**
NG-2 Pretreatment Building	420238-1Y	• Denitration tanks valves • Waste water transfer pump	1.00 Year(s)
NG-2 Pretreatment Building	420238-6M	• Denitration tank pumps	6.00 Month(s)
NG-2 Pretreatment Building	751401-1Y	• Thermometers • Pressure gauges • Steam station • Air supply station • Outside air station • Caustic tank • Steam station gauge • Equalization tank valves • Waste water tanks gauge • East wall gauges • Sulfuric acid gauges • Temperature transmitter • Equalization Tank 1 Level Transmitter • Equalization Tank 1 NG Detector • Pressure gauges inside building • Control room • Alarms • Denitration Tanks • Denitration Tanks Level Transmitters • Clarifier Tank Level Transmitter • Clarifier output flow meter • Clarifier output valve • NaOH Level transmitters • Flash Mix Tank Equalization Tank Discharge	1.00 Year(s)
NG-2 Pretreatment Building	420240-6M	• Lubrication of pumps, mixers • Alarm	6.00 Month(s)

Table 5-3 NG-2 Pretreatment Plant			
System	**Task Number**	**Equipment**	**Frequency**
		• Denitration pumps • Wash water transfer pump • Equalization Tank sump pump • Denitration Tanks agitator	
NG-2 Pretreatment Building	670186-1Y	• Backflow Prevention valve	1.00 Year(s)
NG-2 Pretreatment Building	712188-1Y	• Emergency Lighting	1.00 Year(s)
NG-2 Pretreatment Building	712189-1Y	• Lights • Grounds • Switches • Push button and selector switches • Relays • Motor Starters • Conduit and fittings • Motors • Transformers • Horns • Breakers • Thermostats • Receptacles • Hot Water Heater	1.00 Year(s)

Table 5-3 TNT Pretreatment Plant			
System	**Task Number**	**Equipment**	**Frequency**
TNT Pretreatment Building	030906-5Y	• Building Structure	5.00 Year(s)
TNT Pretreatment Building	670204-1Y	• Backflow Prevention Device	1.00 Year(s)
TNT Pretreatment Building	670205-1Y	• Backflow Prevention Device	1.00 Year(s)
TNT Pretreatment Building	670208-1Y	• Backflow Prevention Device	1.00 Year(s)
TNT Pretreatment Building	670218-1Y	• Backflow Prevention Device	1.00 Year(s)
TNT Pretreatment Building	460020-1M	• Lime Conveyor • Pumps • Mixers	1.00 Month(s)

Table 5-3 TNT Pretreatment Plant

System	Task Number	Equipment	Frequency
TNT Pretreatment Building	460020-6M	• Lime Conveyor • Mixers	6.00 Month(s)
TNT Pretreatment Building	712352-6M	• Critical Defects	6.00 Month(s)
TNT Pretreatment Building	712353-1Y	• Critical Defects	1.00 Year(s)
TNT Pretreatment Building	751491-1Y	• Flow Recorder • pH probe	1.00 Year(s)
TNT Pretreatment Building	751490-1Y	• Flow Meter • Pressure Gauge • Controllers • Transducers • Mix Tank Converter • Chart Recorders	1.00 Year(s)
TNT Pretreatment Building	113877-1Y	• Mixers • Tanks • Conveyors • Reducers • Pumps • Blowers • Dust Collectors • Motors	1.00 Year(s)
TNT Pretreatment Building	113875-1Y	• Mixers • Tanks • Conveyors • Reducers • Pumps • Blowers • Dust Collectors • Motors	1.00 Year(s)
TNT Pretreatment Building	113874-3M	• General Condition	3.00 Month(s)
TNT Pretreatment Building	113873-3M	• General Condition	3.00 Month(s)
TNT Pretreatment Building	113872-1Y	• Building Structure	1.00 Year(s)
TNT Pretreatment Building	030907-5Y	• Building Structure	5.00 Year(s)
TNT Pretreatment Building	113881-1Y	• General Condition	1.00 Year(s)

Table 5-3 TNT Pretreatment Plant

System	Task Number	Equipment	Frequency
TNT Pretreatment Building	113880-3M	• General Condition	3.00 Month(s)
TNT Pretreatment Building	460021-1M	• Mixers • Pumps	1.00 Month(s)
TNT Pretreatment Building	113878-1Y	• Building Structure	1.00 Year(s)
TNT Pretreatment Building	460021-6M	• Mixers	6.00 Month(s)
TNT Pretreatment Building	030908-5Y	• Building Structure	5.00 Year(s)
TNT Pretreatment Building	751492-1Y	• pH Meter • Pressure Control Valve • Pressure Gauge • High Level Probe • Alarm Panel	1.00 Year(s)
TNT Pretreatment Building	460047-1Y	• Waste Water Basins	1.00 Year(s)
TNT Pretreatment Building	113883-1Y	• Building Structure	1.00 Year(s)
TNT Pretreatment Building	113886-1Y	• General Condition	1.00 Year(s)
TNT Pretreatment Building	113885-3M	• General Condition	3.00 Month(s)
TNT Pretreatment Building	712354-1Y	• Critical Defects	1.00 Year(s)
TNT Pretreatment Building	460048-1Y	• Critical Defects	1.00 Year(s)
TNT Pretreatment Building	113888-1Y	• Building Structure	1.00 Year(s)
TNT Pretreatment Building	113890-3M	• General Condition	3.00 Month(s)
TNT Pretreatment Building	113891-1Y	• General Condition	1.00 Year(s)

Table 5-3 B472 Nitrocellulose Pretreatment Plant

System	Task Number	Equipment	Frequency
Nitrocellulose Pretreatment Building	430486-3M	• Lightning Mixer	3.00 Month(s)
Nitrocellulose Pretreatment Building	430486-1Y	• Lightning Mixer	1.00 Year(s)

5.2.2 Work Order System

The task reports serve as the work order and record of maintenance. Staff perform the inspections and complete the PM worksheets by indicating the appropriate blank spaces that the items inspected were "ok" as defined in the task report by the use of check mark, or that the item had a defect found by the use of an X mark.

5.3 EQUIPMENT RECORD SYSTEM

5.3.1 Discussion and Example of Equipment Numbering System

The equipment in the NG-1 Pretreatment System is numbered as follows:

- Equalization Tanks: 013, 014, and 015
- Denitration Tanks: 024 and 025
- Neutralization Mix Tank: 026

The equipment in the NG-2 Pretreatment System is numbered as follows:

- Equalization Tanks: 1 and 2
- Denitration Tanks: A and B
- Clarifiers: 1 and 2
- Wastewater Tanks: 1 and 2

5.3.2 Discussion of Nameplate Data Cards for All Major Equipment

Not applicable.

5.3.3 Discussion of Maintenance Records for Major Equipment

Maintenance records are discussed in Section 5.2.2.

5.4 STOREROOM AND INVENTORY SYSTEM

5.4.1 List of Spare Parts

Spare parts are available throughout the RFAAP facility. Readily available spare parts include:

- Samplers;
- pH meters;
- Temperature meters; and
- Flow meters

5.4.2 Procedures for Stockroom Inventory including Example Forms and Records

Procedures for stockroom inventory are defined in the operational Standard Procedures provided in Appendices C, D, and E.

5.4.3 List of Tools

As defined in Procedure Title 4-08-029, “Wastewater Adsorption,” the following tools are maintained onsite:

- Waste powder cans;
- Hoses;
- Hose connections;
- Portable platform ladder; and
- Rubber gloves.

As defined in Procedure Title 4-42-096, “Entering Waste Lift Station,” the following tools are maintained on-plant:

- Safety harness;
- Oxygen analyzer;

- 5-minute air pack; and
- 2-way radio.

5.4.4 Procedures for Tool Use Control

All tools and equipment shall be returned to designated place of storage when not being used.

6.0 LABORATORY TESTING

6.1 DISCUSSION OF PURPOSE OF SAMPLING AND TESTING PROGRAM

RFAAP continually monitors the critical indicators at each of the monitoring stations as defined previously. The purpose of the monitoring is to optimize the performance of the Bioplant. Monitoring of the TNT wastewater pretreatment discharge to the Bioplant is required by the Permit. The TNT wastewater pretreatment monitoring is provided at internal outfall 291. Monitoring at this outfall is only required when the manufacturing area is active. No monitoring at the other pretreatment facilities is required by the permit. The sampling and testing for the Outfall 029 – Bioplant is provided in a separate O&M manual.

6.2 OUTLINE OF SAMPLING AND TESTING PROGRAM

The sampling and testing for the Outfall 029 – Bioplant is provided in a separate O&M manual. Collection and testing of samples at internal Outfall 291 is outlined below.

6.2.1 Collection of Samples

The purpose of sampling is the collection of a representative portion of the wastewater stream for accurate analysis. There are three primary types of samples: continuous, grab, and composite. Only grab sampling is required at internal Outfall 291.

Grab samples are collected at a specific time and represent the condition of the wastewater only at that time.

The weekly sampling requirements at internal Outfall 291 involve both grab sampling. Tables 6-1 outlines the sampling parameters and their respective limits, monitoring requirements, and sampling techniques.

Table 6-1. Internal Outfall 291 Weekly Sampling							
Parameter	**Monthly Average**		**Minimum**	**Maximum**		**Monitoring Requirements**	
						Frequency	**Sample Type**
Flow (MGD)	NL	NL	NA	NL	NL	1/D-Week	Measure
TNT Nitrobodies	NL	0.9 kg/d	NA	NL	1.3 kg/d	1/D-Week	Grab

kg/d = kilograms per day

NL = No limitation, monitoring only

NA = not applicable

1/D-Week = Once per discharge week

It is crucial to the accuracy of the results that the following guidelines are observed when grab samples are collected:

- The sample should be taken at or near the same time for each sampling event;
- The waste water at the sampling point should be well mixed and homogeneous;
- Nonrepresentative material, including particles greater than 0.25 inches in diameter, should be excluded from the sample; and
- Preservation guidelines for each test should be followed. Records of monitoring information should include:
- The date, exact place, and time of sampling or measurements;
- The individual(s) who performed the sampling or measurements;
- The date(s) and time(s) analyses were performed;
- The individual(s) who performed the analyses;
- The analytical techniques or methods used; and
- The results of such analyses.

The U.S. Environmental Protection Agency (EPA) Method Number and bottle, preservation method and holding time requirements for each parameter are outlined for the weekly, monthly, quarterly, annual and one-time sampling requirements in Tables 6-7, 6-8, 6-9, 6-10 and 6-11 respectively.

Sampling should be conducted in accordance with the guidelines in the respective tables. Discussion of Testing

Laboratory testing is completed in accordance with the U.S. EPA Test Method for each parameter as outlined in Tables 6-7, 6-8, 6-9, and 6-10.

6.3 DISCUSSION OF LABORATORY RECORDS

The sampling and testing for the Outfall 029 – Bioplant is provided in

a separate O&M manual.

The maintenance of laboratory records allows both for quality assurance reviews of procedures and the review of historical data to ensure compliance with VPDES permit requirements. RFAAP maintains the following information:

- Summaries of all tests;
- Record of chain of custody of samples, including the staff who obtained the sample, the date and time of the sampling, the staff involved with the laboratory testing, and the date and time of the testing;
- Reagents, procedures, and equipment used to perform testing; and
- Equipment calibration.

7.0 RECORDS AND REPORTING

7.1 DISCUSSION OF RECORD KEEPING AND REPORTING REQUIREMENTS

The maintenance of accurate operational records assists in the efficient operation of a wastewater treatment system. The review and compilation of historical data allows the identification of trends, problem areas, and successes. Specifically, preventive maintenance schedules and records encourage inspection and maintenance, optimizing performance and extending the life of equipment.

The VPDES permit requires that the Discharge Monitoring Report (DMR) from Outfall 029, outlining the results of the wastewater sampling, be submitted to DEQ-Water Division's Regional Office in the month following performance of sampling. The DMR will be submitted to:

Commonwealth of Virginia
Department of Environmental Quality
Blue Ridge Regional Office
901 Russell Drive
Salem, VA 24153
Telephone (540) 562-6700, Fax (540) 562-6752
Electronic Submittal via the eDMR System

7.2 REFERENCE EXAMPLES OF RECORDS

7.2.1 Daily Checker's Sheet

Operators are required to inspect the pump stations on a daily basis as defined by DUP-8620.

7.2.2 Weekly Checker's Sheet

Operators are required to inspect the pump stations on a weekly basis as defined by DUP-7698.

7.2.3 Pretreatment Building Batch Make-up Record

Operators are required to record the specific information on the treatment of each batch at NG-1 and NG-2 Pretreatment Plants on DUP Form 6061. This form is obsolete since neither plant is currently operating.

7.3 DISCUSSION OF MAINTENANCE AND AVAILABILITY OF RECORDS

Records related to the maintenance of the treatment system for Outfall 029 are maintained at the locations as described below.

7.3.1 DMRs

DMRs are maintained in the Environmental Department in Building 220.

7.3.2 Checker's Sheets

Checker's Sheets are maintained by the Utilities Area Supervisor in Building 409.

8.0 EMERGENCY OPERATION PLAN

8.1 DESCRIPTION OF EMERGENCY OPERATING PLAN

RFAAP maintains and implements a Hazardous Materials Emergency Response Plan in accordance with 29 CFR 1910.120 and a Disaster Control Plan for responding to hazardous substance releases. The plans include drills for responding to discharges.

Each operating area at this facility has trained personnel in spill control and/or HAZMAT, and have had area training with regards to the specific equipment and processes applicable to the ODC and SPCC plans. The Roads and Grounds Department has trained personnel capable of responding to releases. Plant personnel are trained to handle various chemical spills under General Operating Procedure 4-27-269; "Chemical and Solvent Spills."

8.2 ANALYSIS OF VULNERABILITY

Most of the southern half of the main Radford plant area drains into Stroubles Creek and ultimately into the New River. The northern half of the main plant area and the horseshoe area, drain directly to the New River through a flood drainage system. Both Stroubles Creek and the New River are considered state waters. It is not anticipated that accidental discharge would result in impact to these waters due to the implementation of rapid emergency response.

Although a discharge from treatment operations would not normally result in a direct discharge to state waters, there is a minimal, although unlikely, potential that an accident could occur, resulting in discharge to the New River. A direct discharge from Outfall 029 may result in a direct discharge to state waters, constituting a violation of water quality standards.

Outside of the RFAAP facility, there are no other downstream facilities or services that have drinking water intakes from the New River within five miles of the plant.

8.3 LISTING OF EMERGENCY EQUIPMENT AND LOCATION

8.3.1 Materials

The Roads and Grounds Department of RFAAP maintains the following inventories of materials and equipment for containment and cleanup of spills at buildings 1908 and 1999. Spill material inventories are set up by RFAAP's Materials Management Department to assure that minimum quantities of all materials are maintained on plant at all times:

- Oil booms;
- Bags of absorbent materials located at Building 1908; and
- Absorbent pads and absorbent pillows.

The following emergency materials are available onsite:

- Soda Ash/Alum Chemicals;
- Solvents;
- Sand;
- Sawdust; and
- Absorb-all.

8.3.2 Equipment

Backhoes, grade-alls, front-end loaders, and several 275-gallon or 550-gallon oil tank trailers are kept at Building 7217 and are accessible within 15 minutes during normal work hours and within one hour during off shift hours. Additional, large oil tankers, which are leased and maintained on plant, are available for bulk storage of used oil if necessary.

The following emergency equipment is available onsite.

- Shovels, non-sparking;
- Waste containers;
- Broom;
- Dustpan;

- Respirators;
- Rubber gloves or impervious gloves;
- Leather gloves;
- Rubber apron;
- Safety goggles or glasses;
- Rubber boots; and

8.4 DESCRIPTION OF MUTUAL AID PROGRAM WITH PARTICIPANT IDENTIFICATION, TYPE OF AID AND PHONE NUMBER

Mutual assistance agreements are established with the Cities and Towns of Blacksburg, Christiansburg, Dublin, Pulaski Radford, the Communities of Fairlawn, Long Shop/McCoy, Riner, and the Regional Emergency Medical Service (**REMSI)** in Pulaski County. The agreements state that mutual emergency medical team and/or firefighting assistance will be provided by and for RFAPP and the respective communities as conditions permit. Mutual assistance is authorized by the Fire Chief or Commanding Officer at RFAAP and the Fire Chief or Mayor of the respective community. The Fire Chief at RFAAP can be reached at phone number 7233.

8.5 DESCRIPTION OF POLICE AND FIRE COORDINATION WITH PHONE NUMBERS

RFAAP maintains a contract with Centerra security and emergency response services. Centerra can be reached on the facility at phone number 7323. In the event backup police response is required, the Montgomery County Sheriff's office can be reached at (540) 382-2951 or 911.

RFAAP maintains fire response personnel on the facility. Fire response can be reached at phone number 7323.

9.0 PERSONNEL

9.1 ORGANIZATIONAL STAFFING CHART

An organizational chart is provided as Table 9-1.

9.2 OUTLINE OF RESPONSIBILITIES OF ALL OPERATIONAL AND SUPERVISORY PERSONNEL

9.2.1 Waste Water Chief Operator

The Waste Water Chief Operator (WWCO) reports to supervision and oversees the operation of plant-wide industrial wastewater treatment facilities. The WWCO will also:

- Collect waste water samples for analysis in accordance with the guidelines outlined in Section 6.0 of this Manual;
- Provide operational support to assist maintenance personnel in repairing equipment and data collection and control systems; and
- Monitor plant-wide wastewater flows via the RFAAP computer-based monitoring system to ensure discharges are within permitted limits.

9.2.2 Waste Water Operator

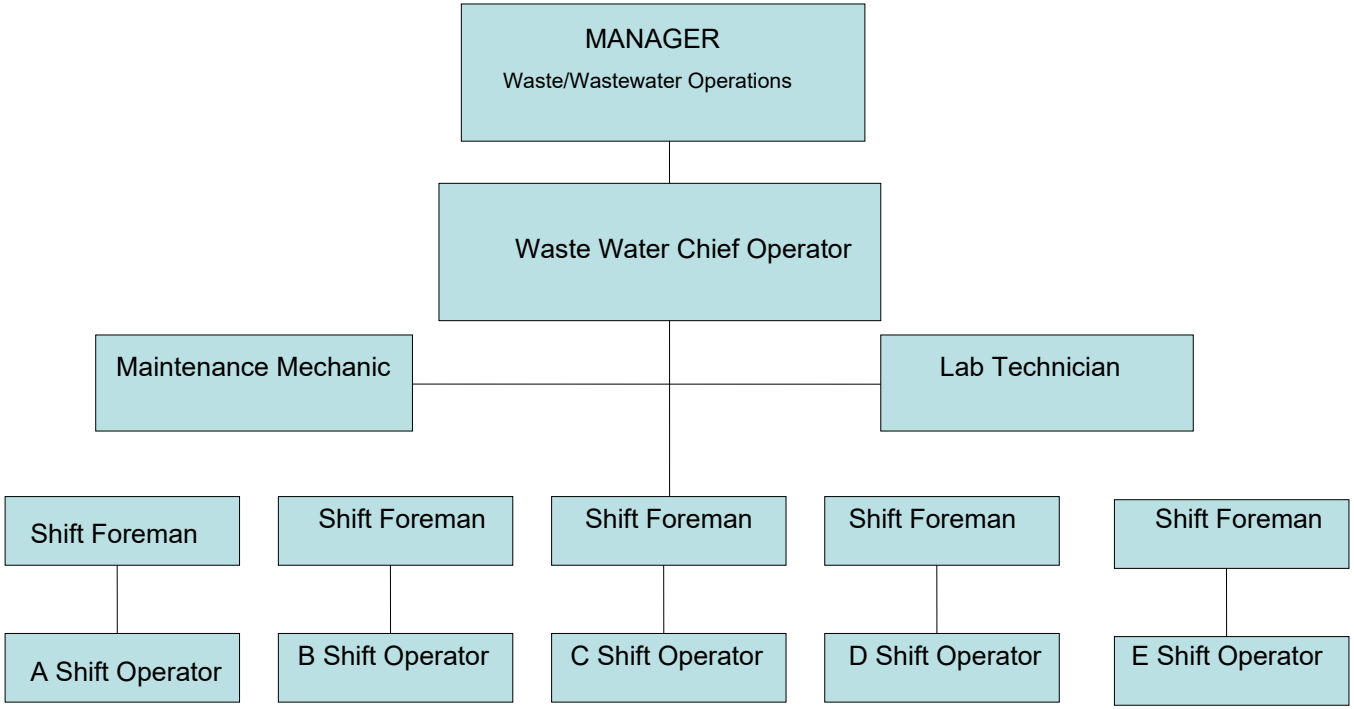
The Wastewater Operator (WWOP) reports to supervision and generally supports the operation of the wastewater treatment systems. The WWOP will also:

- Treat and control industrial waste disposal requirements;
- Determine chemical feed rate and introduce chemicals into the waste;
- Direct Utilities Operators to assist in system operation;
- Detect control problems, flow blockage, and sludge ratio and determine correct action if needed; and
- Perform laboratory analysis for various chemical and physical properties of waste at raw, internal, and discharge points.
- Perform duties required of the operation to comply with discharge permits;

- Perform control tests and other operations in accordance with established operating procedures, safety regulations, and housekeeping rules; and

Table 9-1

Organizational Chart



9.2.3 Utilities Operator B

Reporting to supervision, the responsibilities of Utilities Operator B (UTOB) include:

- Performing checker duties in the Utilities Area;
- Maintenance of chemical inventory in silos and tanks
- Performing routine preventive maintenance checks on pump stations and storage tanks;
- Taking samples at outfalls and performing analyses; and
- Performing control tests and other operations in accordance with established operating procedures, safety regulations, and housekeeping rules.

9.2.4 Utilities Operator Trainee

Reporting to the supervision, the responsibilities of Utilities Operator Trainee (UTOT) include:

- Working with the higher level waste water operators for training purposes;
- Learning the duties and responsibilities of Utilities Operator classifications;
- Learning established operating procedures, safety regulations, and housekeeping rules; and
- Other responsibilities as assigned by the WWCO, WWOP, and UTOB.

9.3 REQUIRED QUALIFICATIONS OF PERSONNEL

9.3.1 Waste Water Chief Operator

The WWCO must have a high school diploma or equivalent and have a minimum of a Waste Water Class II license. The WWCO must also qualify in lower wastewater operator classifications.

9.3.1 Waste Water Operator

The WWOP must have a high school diploma or equivalent and a minimum of one year of experience.

9.3.2 Utilities Operator B

The UTOB must have a high school diploma or equivalent.

9.3.3 Utilities Operator Trainee

The UTOT must have a high school diploma or equivalent.

9.4 ATTENDANCE REQUIREMENTS CHART

Each shift will be staffed with a sufficient number of qualified operators to ensure necessary controls are maintained.

9.5 ROUTINE WORK SCHEDULES

The Outfall 029 facility is staffed 24 hours per day and 365 days per year. The facility is staffed by the personnel defined in Table 9-1.

9.6 DESCRIPTION OF TRAINING NEEDS AND PROGRAMS

RFAAP recognizes that effective employee training is essential to improving the quality and efficiency of operations, as well as to reducing environmental, health, and safety hazards. The Training Department maintains the master Training Plan for RFAAP, which includes a list of all jobs and the requirements for each job classification and is available for all employees to review. The Training Department automatically schedules training classes for staff based on their job assignments and notifies the individual of the class. Supervisors are notified when individuals under their direction are nearing expiration of their training certifications.

10.0 SAFETY

10.1 BRIEF DESCRIPTION OF SAFETY PROGRAM

According to the Alliant Techsystems Management Manual, the RFAAP safety program provides:

- Effective and practical safety control of all operations;
- Delineation of individual and organizational responsibilities for safety matters; and
- Centralized control of all safety program activities.

All managers and supervisors are expected to implement the safety program within their areas. Training and guidance are provided by the Safety Department.

10.2 DESCRIPTION OF SAFETY HAZARDS INVOLVED WITH THE OPERATION OF EACH COMPONENT

10.2.1 Electrical Hazards

All equipment that is known to or may potentially pose an electrical hazard should be treated with caution. Standard 110-volt current can easily kill or maim, but lower voltage and higher amperage current can also cause severe damage to the nervous system.

Individuals injured by an electricity-related accident should be freed from live conductors using insulated or non-conductive material (i.e., wood). It is critical that bare hands are not used to remove a live wire. CPR or other artificial respiration should be applied until breathing is restored.

Guidelines for safe conduct near live electric equipment include:

- Take caution to not ground yourself;
- Only authorized and experienced staff should perform work or maintenance on electrical equipment;

- Maintain electrical controls;
- Do not use metal ladders or non-insulated tools around electrical equipment;
- Always assume a circuit is live unless it has been confirmed dead;
- Do not remove guards or bypass protective devices;
- Follow lock-out procedures when working with electric equipment; and
- Ensure portable electrical tools are either double-insulated or equipped with a separate electrical conductor.

10.2.2 Mechanical Equipment Hazards

Maintenance of mechanical equipment should be conducted by qualified personnel and should be completed with the necessary materials at the site the work is to be completed. Lock-out procedures should be followed to ensure personnel safety.

Lifting equipment should be equipped with safety latches and should be used only for its intended purpose. Only qualified operators should be permitted to use lifting equipment.

10.2.3 Explosion and Fire Hazards

Explosions are possible when oxygen and an oxidizing reagent (including flammable gas, chlorine, or fertilizer) are present in the proper proportions and exposed to a source of ignition (open lights, sparks, hot filaments). All personnel should be aware of these criteria and should make an effort to reduce or eliminate potential for explosion.

Flammable gases in the waste water present one of the greatest explosion and fire hazards at the treatment system facilities, necessitating the storage of flammable material in hazardous material cabinets outside the facilities. Further, a combustible gas indicator should be used if there is concern of too great a concentration of those gases. Smoking and open flames

are prohibited in the Limited Area of RFAAP, and are therefore also prohibited at the wastewater treatment facilities.

10.2.4 Bacterial Infection

Contact with waste water may expose workers to waterborne disease, including typhoid fever, amoebic dysentery, infection jaundice, and other intestinal infections, as well as risk of tetanus and skin infections. Workers who are regularly exposed to waste water should ensure their vaccinations are current. Workers should also wear protective clothing and should regularly wash their face, hands, and arms. The system operators should also ensure than potable water is not contaminated by waste water through cross-connections or other means.

10.2.5 Oxygen Deficiency and Noxious Gases

Certain areas within the treatment system facilities contain noxious or toxic gases and vapors, and associated oxygen deficiencies, including sewers, sewer manholes, covered tanks, enclosed rooms, and underground structures. Techniques available for detecting the presence of the more dangerous atmospheric conditions include:

- Combustible gas indicator – a device that detects the concentration of combustibles present as a percentage of the lower explosive limit;
- Acetate ampule – changes color when broken in cotton to indicate the presence of hydrogen sulfide;
- Palladium chloride ampule – changes color when broken in cotton to indicate the presence of carbon monoxide; and
- Oxygen detector – notification when the atmosphere contains less than 19.5% oxygen.

10.3 DESCRIPTION AND REQUIREMENTS FOR AN ONGOING PREVENTIVE SAFETY PROGRAM INCLUDING

EDUCATION IN SAFETY PROCEDURES AND TRAINING IN FIRST AID AND EMERGENCY PRODURES

The preventive safety program begins with the training of new employees, when the specific safety and health hazards of each process, emergency operations (including shutdown procedures), and other safe work practices are stressed during the initial training sessions. The preventive safety program continues with the inclusion of maintenance of sound health and safety practices in the job description for each level of wastewater operator. Relevant refresher training is provided to each operator at least every three years to ensure maintenance of health and safety practices throughout the plant.

10.4 LISTING OF ALL EMERGENCY PHONE NUMBERS

In the event of an emergency onsite, the following emergency phone numbers shall be utilized:

Facility:

- Hospital 7123
- Fire 911
- Ambulance 7163
- Guard HQ 7526
- Safety Department 7374

Local:

- Montgomery County Local Emergency Planning Committee 540-808-6329
- Pulaski County Local Emergency Planning Committee 540-980-7801

State:

- Virginia Department of Emergency Management 800-468-8892

10.5 LISTING OF ALL AVAILABLE SAFETY EQUIPMENT AND LOCATION

The following safety equipment is available onsite:

- ..... Safety showers;
- ..... Eye wash stations;
- ..... Respirators;
- ..... Rubber gloves or impervious gloves;
- ..... Leather gloves;
- ..... Rubber apron;
- ..... Safety goggles or glasses;
- ..... Rubber boots;
- ..... First aid kits;
- ..... Fire extinguishers; and
- ..... Personal flotation devices.

10.6 LISITING OF NUMBER AND LOCATION OF FIRST AID KITS AND MANUAL

RFAAP does not maintain first aid kits at site-specific locations. In the event of a minor accident or injury, RFAAP maintains a hospital onsite during normal working hours. In the event of a major accident or injury, RFAAP maintains an ambulance service with EMTs 24-hours per day, seven days per week. The ambulance service can be reached by telephone at 7163. EMT personnel will administer first aid onsite.

10.7 LISTING OF SAFETY RULES

As defined in Standard Procedure 4-42-096 “Entering Waste Lift Station”, the following safety rules apply:

- Entry into any wastewater lift station requires a completed DUP-5028. The Safety Representative section may be completed by the entrant

Supervisor ONLY for routine entry for operational inspections of waste water lift stations;

- If the automatic exhaust fan does not start upon opening the lift station lid, notify supervision. DO NOT enter the lift station if fan is inoperable;

  WARNING: DO NOT ENTER THE WASTE WATER LIFT STATION IF THE EXHAUST FAN IS NOT OPERATING. NOTIFY SUPERVISION SO THAT A CONFINED SPACE PERMIT CAN BE OBTAINED IN COMPLIANCE WITH PLANT WIDE PROCEDURE 4-A-003.

- If any unusual sounds are heard from the lower level of the waste water lift station, call supervision. DO NOT enter the waste water lift station;

  NOTE: This could be excessive pump noise, fan noise, pipes ringing, etc.

- In case of an emergency of if help is required, due to injury or accident, call the Fire Department, at Extension 16 or by 2-way radio on Guard Department frequency;
- Safety glasses, hard hat, safety harness and safety shoes are required to be worn during entry into waste water lift station; and
- A five-minute air pack is to be carried by operator entering the pit.

As defined in Standard Procedure 4-08-029 “Waste Water Adsorption”, the following safety rules apply:

- Operator towing the activated carbon adsorption unit shall use extreme caution while transporting the unit to each designated location;
- Adsorption towers must be emptied of liquid prior to moving the unit to the next location;
- Ground the fuel container to the engine of the prior to refueling;
- A fully charged fire extinguisher will be available during the refueling of the pump, which may be found on the jeep;
- The pump unit should be cut off as soon as the tank has finished draining to prevent the pump from running dry;
- The pump and seals shall be cleaned monthly be area maintenance;

- If necessary to use the secondary AC unit, assure the trailer is parked on level ground and chocked in both directions; and
- DUP-8142, "Activated Carbon (AC) Treatment and Sampling Record," must be completed during the draining of solvent recovery and water dry tanks.

10.8 DISCUSSION OF IMPORTANCE OF GOOD HOUSEKEEPING

As defined in Standard Procedures 4-42-096, 4-08-029, and RAD-NG-630, RAD-NG-631, RAD-NG-632, RAD-NG-633, RAD-NG-634, andRAD-NG-635, good housekeeping inside and outside of all buildings shall be maintained at all times by the operator on duty.

10.9 DISCUSSION OF ACCIDENT REPORTING

Employees are required to report all injuries to their direct supervisor, who will subsequently complete Forms DUP 8408A, 8408B and 8408C for submission to the Safety Department.

11.0 PLANT UTILITIES

11.1 LISTING OF UTILITIES SERVICING FACILITY WITH CONTACT NAME, ADDRESS AND PHONE NUMBER

The primary electrical service is provided by RFAAP:

Address: Building 400, RFAAP
Contacts: Area Engineer, 540-639-7162
Shift Foreman, 540-639-7133

Backup power is provided by American Electric Power:

Address: P.O. Box 2021
Roanoke, VA
Phone: 540-985-2761
Contact: Shift Supervisor

11.2 EMERGENCY CUT-OFF PROCEDURES

In the event of an emergency, each pump station can be shut down by the “motor stop” located on the control panel adjacent to the station.

Emergency shutdown procedures for NG-2 Pretreatment Plant are outlined in Standard Procedures Titled: RAD-NG-630, RAD-NG-631, RAD-NG-632, RAD-NG-633, RAD-NG-634, andRAD-NG-635.

11.3 RELIABILITY OF ELECTRICAL SERVICE AND EFFECT ON CONTINUOUS OPERATION

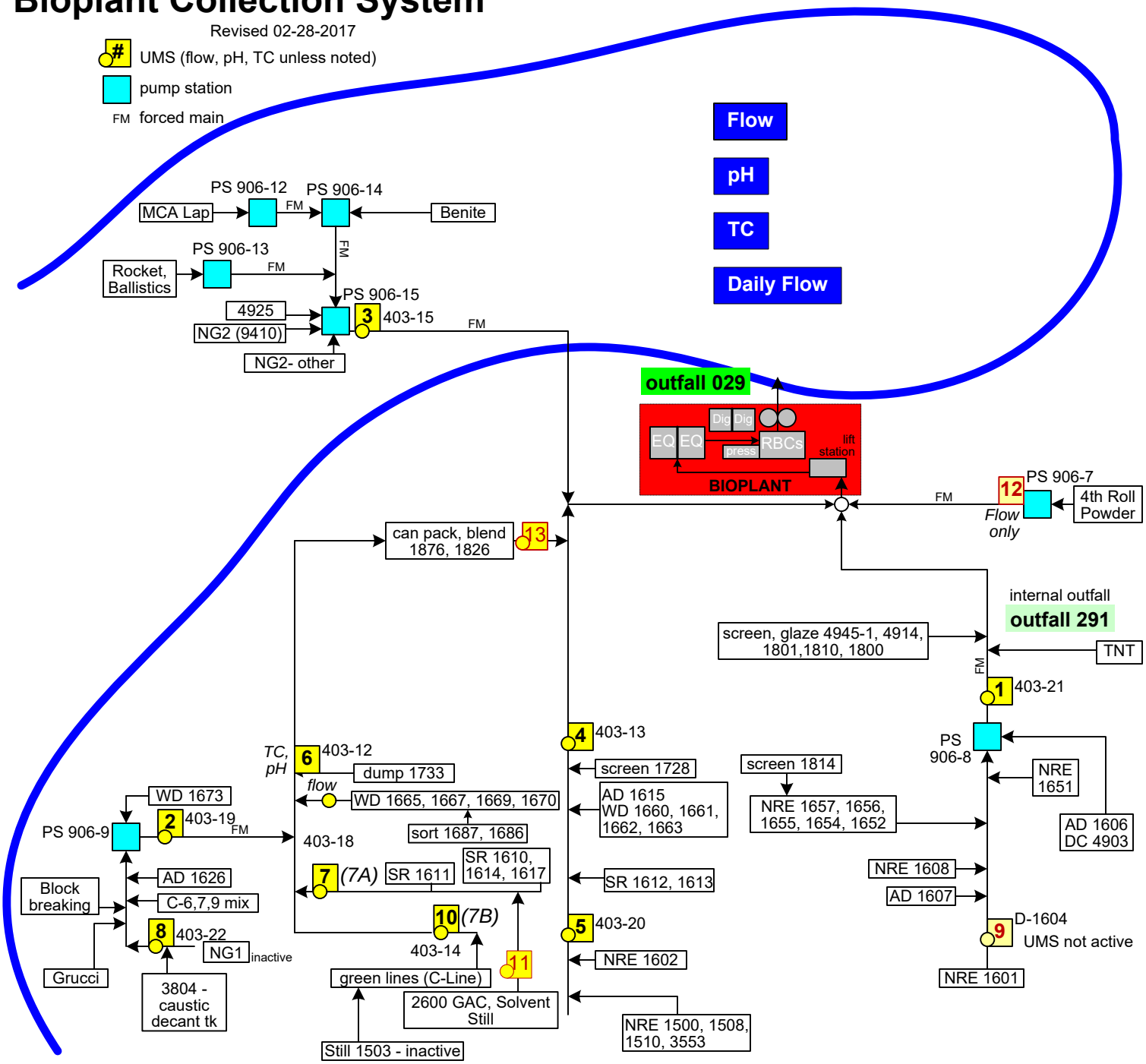
The RFAAP electrical service is typically reliable. Backup power generation (diesel generator) is available onsite at each pump station in the event of power failure.

In the event of an unscheduled power outage, the emergency generator at each pump station will start automatically and supply power its associated

pump station. The wet well pumps will start automatically. Breakers on other equipment must be reset and the equipment restarted manually.

Bioplant Collection System

Revised 02-28-2017



NOTE: UMS 11, and 13 are proposed – not currently present

Appendix G. Process evaluation - Fall 2021

Sample Site	Date Sampled	COD mg/L	Dissolved COD	Total Phosphorus mg/L	Dissolved TP	Orthophosphate mg/L	Dissolved Orthophos	TKN mg/L	Dissolved TKN
Raw Influent	10/26/2021	3270	*2290	5.51	*5.95			31.4	*86.2
EQ Basin	10/26/2021	2240	*228	4.11	*0.59			56.2	*1.65
RBC	10/26/2021	1060	*449	5.64	*0.60			73.6	*6.15
CLE	10/26/2021	33	*31.3	0.55	*0.096			1.9	*2.13
Raw Influent	10/28/2021	5180	*3970	20.4	*1.34	<0.02	-	100	*11.9
EQ Basin	10/28/2021	653	*118	3.61	*0.42	<0.02	-	82.3	*3.06
RBC	10/28/2021	5250	*143	6.79	*0.055	<0.02	-	91.2	*2.18
CLE	10/28/2021	53.3	*48.2	0.42	*<0.02	<0.02	-	1.46	*1.4
Raw Influent	11/2/2021	2410		2.4		<0.02		124	
EQ Basin	11/2/2021	2210		6.2		<0.02		103	
RBC	11/2/2021	2550		4.34		<0.02		107	
CLE	11/2/2021	36.4		0.048		<0.02		0.68	
Raw Influent	11/4/2021	2280		18.6		0.02		82.8	
EQ Basin	11/4/2021	3490		6				81.8	
RBC	11/4/2021	2550		3.91				106	
CLE	11/4/2021	44.8		0.041				1.94	
Raw Influent	11/9/2021	3000	1170	1.85	1.15			46.8	20.1
EQ Basin	11/9/2021	1760	88.8	4.48	0.32	<0.02		74.8	14.9
RBC	11/9/2021	1890	116	0.26	0.32			79.3	0.91
CLE	11/9/2021	15.4	<10	0.059	0.026	<0.02		0.98	<0.50
Raw Influent	11/16/2021	2050		1.68		0.02		70.9	
EQ Basin	11/16/2021	1580		2.68		0.02		56.9	
RBC	11/16/2021	34.4		0.069		<0.02		5.04	
CLE	11/16/2021	1490		2.2		<0.02		35.4	
Raw Influent	11/18/2021	1420	721	10.9	0.61	0.05		60	13.5
EQ Basin	11/18/2021	1300	138	9.35	0.172	0.02		80.3	6.12
RBC	11/18/2021	1240	95.8	2.38	0.178	<0.02		66.5	5.34
CLE	11/18/2021	59	72.9	0.082	0.052	<0.02		2.48	2.96

*Sample with an asterick were analzyed as Dissolved/Soluble by Enthlapy lab, the lab filtered again, miscommunicaton.

WE suspect a sample switch, we do not think11/16 CLE data is accurate

Conclusions

Bioplant lacking available orthophosphate, Larry Reynolds suggested adding phosphoric acid

Appendix H. Nutrient Evaluations of Bioplant - Fall 2021

Sample Site	Date Sampled	Calcium mg/L	Cobalt mgL	Copper mg/L	Iron mg/L	Potassium mg/L	Magnesium mg/L	Mangenese mg/L	Molybdenum mg/L	Sodium mg/L	Zinc mg/L
Raw Influent	10/26/2021	62.8	<0.04	0.968	1.74	62.6	14.1	0.355	<0.5	190	0.227
Raw Before Additions	10/26/2021	62.4	<0.04	1.08	3.59	61.1	13.9	0.368	<0.5	191	0.241
CLE	10/26/2021	22.8	<0.04	<0.1	<0.1	56.4	8.13	<0.1	<0.5	103	<0.1
CLE	11/2/2021	24.7	<0.04	<0.1	<0.1	18.1	9.37	<0.1	<0.5	151	<0.1

Conclusions

Iron, Zinc, (Copper third because it can also act synergistically) deficient, need to be explored but prioritized after phosphoric acid switch if issues persist.

Appendix I. Nitroglycerin adsorption testing - Fall 2021

Sample Site	Date Sampled	TSS mg/L	TVSS mg/L	NG mg/L	Dissolved NG (after filtering)
Raw Influent	11/8/2021	6880	1030	10.7	16.9
EQ Effluent	11/8/2021			12.6	12.7
RBC In	11/8/2021	2090	480		
RBC Effluent	11/8/2021	1420	250	8.2	8.2
Clarifier In	11/8/2021	7	2		
CLE	11/8/2021	12	4	7.9	7.9
906-15	11/8/2021			413.9	412.7
906-8	11/8/2021			184.5	184.3
906-7	11/8/2021			15.9	15.7
Station 7b	11/8/2021			<0.2	<0.2
East Basin	11/8/2021	15	6		
West Basin	11/8/2021	28	10		
Thickner	11/8/2021	31	8		

Conclusions

Nitroglycerin (NG) is not immediately being adsorbed by solids within the system

Appendix J. Graphite Sampling 2021 and 2022

Sample Site	Date Sampled	content, % weight
Station 9	12/15/2021	0.013
Station 5	12/15/2021	0.0004
906-8	12/15/2021	0.008
Coating House	12/15/2021	0.004
Air Dry	12/15/2021	0.003

	Station 1			Station 5			Station 9		Raw Influent			Station 2	
Date	Graphite, mg/L	TSS, mg/L	TC , mg/L	Graphite, mg/L	TSS, mg/L	TC , mg/L	Graphite, mg/L	TSS, mg/L	Graphite, mg/L	TSS, mg/L	TC , mg/L	Graphite, mg/L	TSS, mg/L
2/14/2022	5.7	310	91	0.1	52	915	5.6	70	118	432	650		
2/15/2022	5.9	34	423	0.1	16	682	5.4	64	194	524	193		
2/16/2022	23	100	247	0.1	8	856	7	142	203	894	300		
2/17/2022	7.2	60	28	0.01	8	532	14	188	288	870	618	12	
2/18/2022	65.9	244	142	0.1	42	182	71.7	642	129.8	682	535		
2/21/2022	45.7	412	30	0.01	124	438	29.9	1014	226	960	570		
2/22/2022	62	834	60	0.3	50	330	49.8	1014	136.5	556	416		
2/23/2022	38.4	412	234	0.01	94	276	171.7	2358	237	954	268	9.44	3074
2/24/2022	4	84	72	0.1	76	396	4.4	174	172	1140	504		
2/25/2022	7	552		0.2	78	264	50.3	874	220.1	1600	123		
2/28/2022	38.8	418	492	0.476	56	823	11.9	524	190.18	806	282		
3/1/2022	114.85	918	581	0.1	96	642	35.7	1432	171	924	458		
3/2/2022	46	542	181	0.476	162	923	49.4	570	188.2	1124	549		
3/3/2022	12.4	460	14	0.01	62	0	11.4	1380	139.4	504	446		
3/4/2022	9.52	300	67	0.286	82	608	14.95	1422	257.9	1148	258		

Conclusions

Samples were taken at different production times. While NGDS was in producton on 2/23/22, graphite comprised >67% of total solids discharge.

TSS has a strongly correlation to graphite than TC.

Station 9 (and downstream Station 1) had r-values of approximately 0.5 between graphite and TSS, which is a moderate relationship.

Appendix K. Toxicity Identification Evaluations (TIE) Manipulation Results

Sample Date	Sample Location	Date Sample Run	Test	LC50 (% Sample)	95% Confidence Interval	Test Organism
1/26/2021	Outfall 029	1/28/21	Baseline	All organisms died within 48 hr. test period	NA	*C. dubia*
			Post C-18 SPE		NA	
			EDTA (0.6 mL)		NA	
			EDTA (1.6 mL)		NA	
			Sodium Thiosulfate (2.0 mL)		NA	
			Sodium Thiosulfate (5.0 mL)		NA	
4/29/2021	Outfall 029	5/1/21	Initial	21.5	17.0-25.8	*C. dubia*
		5/7/21	Baseline	9.38	2.23-13.9	
			Filtration	10.9	4.43-14.5	
			SPE	7.47	0.46-12.4	
			pH 7	16	11.7-19.8	
		5/10/21	HDPE Cubitainer	13.3	9.01-16.4	
			Glass	14	11.4-17.3	
			PVC	13.9	9.32-20.6	
4/29/2021	Outfall 029	5/1/2021	Initial	21.5	17.0-25.8	
		5/27/21	Baseline	61.6	54.4-69.7	
			SPE HLB	60.6	51.7-71.0	
			UV	47.4	39.6-56.0	
			Mock Sample	>100	<1.00	
8/24/2021	Outfall 029	8/25/21	Initial	31.9	28.5-35.6	*P. promelas*
		8/27/21	Baseline	38.5	27.1-55.5	
			Aeration	30	21.7-38.6	
			Filtration	37.9	33.2-43.2	
			EDTA	NA	NA	
			pH 7	22.6	16.5-30.3	
			pH 9	27.2	20.3-36.4	
			SPE HLB	>100	NA	
			Thiosulfate	NA	NA	
			pH 3 Adjusted	55.1	38.2-92.0	
			pH 3 Aeration	51.3	36.4-77.0	
			pH 3 Filtration	38	24.7-59.8	
			pH 3 HLB SPE	>100	NA	
			pH 11 Adjusted	37.7	27.4-52.0	
			pH 11 Aeration	30.9	23.3-40.9	
			pH 11 Filtration	37.9	33.2-43.2	
			pH 11 HLB SPE	>100	NA	
11/16/2021	Outfall 029	12/2/21	Initial	4.17	NA	*C. dubia*
			Storage 16 days, 11 dilutions	1.43	NA	
			Storage 16 days, 11 dilutions	30.3	NA	*P. promelas*

Pace Analytical Services
225 Industrial Park Road
P O Box 286
Beaver WV 25813
TEL: (304) 255-2500
Website: www.pacelabs.com

Executive Summary

BAE Systems submitted a sample for a 48-Hour Acute Toxicity Identification Evaluation (TIE). The TIE utilized *Ceriodaphnia dubia* as the test species. Based upon information from the client, a series of tests was selected from the EPA TIE manuals which were selected to target the reduction of toxicity by reducing total metals and/or nitroglycerin. At somewhat random sampling events, baseline toxicity for Outfall 029 was elevated; other times there was no toxicity with the effluent. The objective of this TIE was to render the 100% effluent from Outfall 029 non-toxic. Therefore, all tests performed for this TIE consisted of only a control and a full-strength, 100% effluent which was manipulated by one of a few methods.

An initial Baseline test was initiated on 01-27-21 in order to confirm that the effluent contained toxicity. Toxicity in the effluent was confirmed within the first 24-hour period; therefore, a second Baseline test along with a round of sample manipulations were initiated.

The results of these test manipulations are as follows.

Baseline Test: The Baseline test did have substantial toxicity. Only 3 of 20 test organisms were alive at 24 hours into the test. By the time that the test was concluded at 48 hours, all of the test organisms had died in the 100% effluent. All test organisms survived in the control.

Post C-18 SPE Column Test: The effluent was prepared by filtering 1 liter of the effluent through a 0.45µm glass-fiber filter. The filtered effluent was then passed through a C-18 column and the post-column effluent was then tested for toxicity. Only 4 of 20 test organisms were alive at 24 hours into the test. At 48 hours, all of the test organisms had died in the 100% effluent. All test organisms survived in the control.

EDTA tests: Ethylenediaminetetraacetic Acid (EDTA) was introduced to the effluent at two different concentrations. 500 mls of the 100% effluent was prepared for each concentration level. 0.6 mls of a 2500 mg/L stock solution of EDTA was added to the first aliquot, and 1.6 mls of the EDTA was added to the second aliquot. The EDTA-spiked effluent was allowed to rest for 2 hours in order to allow the EDTA time to complex the metals prior to the distribution of the test organisms to the test chambers. For the 0.6 ml EDTA test, only 3 of 20 test organisms were alive at 24 hours into the test. For the 1.6 ml EDTA test, only 2 of 20 test organisms were alive at 24 hours into the test. By the time that the tests were concluded at 48 hours, all of the test organisms had died in both the 0.6 ml and 1.6 ml EDTA tests. All test organisms survived in the controls in both tests.

Sodium Thiosulfate Tests: Sodium Thiosulfate was also introduced to the effluent at two different concentrations. 500 mls of the 100% effluent was prepared for each concentration level. 2.0 mls of a 2500 mg/L stock solution of Sodium Thiosulfate was added to the first aliquot, and 5.0 mls of the Sodium Thiosulfate solution was added to the second aliquot. The spiked solutions were allowed to rest for 2 hours in order to allow the Sodium Thiosulfate time to complex the metals

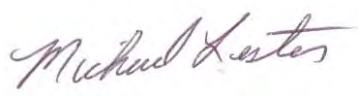
prior to the distribution of the test organisms to the test chambers. For the 2.0 ml Sodium Thiosulfate test, 7 of 20 test organisms were alive at 24 hours into the test. For the 5.0 ml Sodium Thiosulfate test, again, 7 of 20 test organisms were alive at 24 hours into the test. By the time the tests were concluded at 48 hours, all of the test organisms had died in both the 2.0 ml and 5.0 ml Sodium Thiosulfate tests. All test organisms survived in the controls in both tests.

Based upon the analytical chemistry which was performed on the effluent, and as reported under Pace Job #7358269 (attached), I do not see any constituent which was at a level which I would consider to be at a toxic level. Total aluminum, which was measured to be at 0.755 mg/L was the only constituent that I thought may be approaching a level which would be limiting to the *Ceriodaphnia*. However, the Sodium Thiosulfate and EDTA test manipulations should have lowered this metal, and reduced toxicity if it had been at a limiting level.

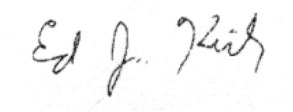
Please feel free to contact myself, or Ed Kirk, Director-Biological Division, should you have any comments or questions, or if we can be of any further assistance.

We truly appreciate your business!

Sincerely,



Michael Lester
Bioassay Lab Manager
Pace Analytical



Ed J. Kirk
Biological Services Manager
Pace Analytical

PACE ANALYTICAL
SAMPLE INFORMATION

Client: BAE Systems
Radford Army Ammunition Plant

Address: P.O. Box 1
State Route 114
Radford, VA 24141

Pace Job #: 7358269

Pace Sample ID: 7358269-001

Client Sample ID: Outfall 029

VPDES Permit #: VA0000248

Receiving Water Body Name: New River

Sample Type: 24-Hour Composite
Collected From: **Date**: 01-26-21 **Time**: 0001
Collected To: **Date**: 01-26-21 **Time**: 2359

Bioassay Tests Performed: 48-Hr Static Screen Non-Renewal

Test Procedure: EPA Methods Manual 821-R-02-012; October 2002
ENV-SOP-BEAV-TOX-ACUTE-REV.01

Test Method: *Ceriodaphnia dubia* 2002.0

Measured Effect: Death or erratic behavior

Test Organisms: *Ceriodaphnia dubia* **Age**: < 24 Hrs

Last Reference Test Date: 01-14-21

Reference Toxicant Used and Results: KCL-Potassium Chloride, acceptable results

Dilution Water Used: Moderately Hard Synthetic Fresh Water

Test Beginning: **Date**: 01-28-21 **Time**: 1200

Test Ending: **Date**: 01-30-21 **Time**: 1040

PACE ANALYTICAL
TOXICITY TEST CONDITIONS

Client Name: BAE Systems

Pace Sample ID: 7358269-001
Client Sample ID: Outfall 029
VPDES Permit #: VA0000248

Test Species: *Ceriodaphnia dubia*
Organism Source: In-house Cultures

Exposure Chamber
- Container Type: Tripour disp.
- Total vessel capacity: 50 ml
- Test solution volume: 30 ml
- Water depth: Constant X
  - Cyclic ___

Aeration During Test
- None: X
- Slow: ____
- Moderate: ____
- Vigorous: ____
- Time aeration began: ____

Feeding Schedule
- Not fed: ___
- Fed daily: ___
- Fed prior to test: X

Aeration Prior To Test Initiation
- Moderate: X
- Minutes: 12

Photoperiod
- 16Hr/8Hr: X
- Other (specify): _____

Place Test Conducted
- Environmental Chamber: X

Vessel type and volume used to deliver effluent and diluent to test chambers: 500 ml volumetric flask and a 250ml graduated cylinder

Material(s) used to place test organisms into test chambers: Large bore pipets

Condition of surviving organisms at end of test: Healthy

Comments: _____

Concentration (%)	Diluent (mls)	Effluent (mls)	Total (mls)
Control	500	0	500
100.0	0	500	500

PACE ANALYTICAL
TEST RESULTS

Baseline Test

Pace Sample ID: 7358269-001
Client Sample ID: Outfall 029-Baseline

Client Name: BAE Systems
VPDES Permit #: VA0000248

Ceriodaphnia dubia

Statistical Test Method	Pass/Fail	Qualifier Data
None Needed	Fail	

Only 3 of 20 test organisms were alive at 24 hours into the test. All test organisms died in the 100.0% effluent by the end of the test at 48 hours. All test organisms survived in the control.

Key:
TUA - Toxicity Units - Acute
LC50 - Lethal Concentration to 50% of population

Qualifiers:
P - Initial pH falls outside the range of 6.0 - 9.0
H - 36 Hour Hold Time Exceeded
T - Initial Temperature exceeded 0 - 6° Range

DATE 02/04/21

APPROVED Michael Lester
Michael Lester
Bioassay Lab Manager

PACE ANALYTICAL
TEST RESULTS

Pace Sample ID: 7358269-001
Client Sample ID: Outfall 029-C-18

Client Name: BAE Systems
VPDES Permit #: VA0000248

Carbon 18 Test

Ceriodaphnia dubia

Statistical Test Method	Pass/Fail	Qualifier Data
None Needed	Fail	

Only 4 of 20 organisms were alive at 24 hours into the test. At 48 hours, all test organisms were dead in the 100.0% effluent. All test organisms survived in the control.

Key:
TUA - Toxicity Units - Acute
LC50 - Lethal Concentration to 50% of population

Qualifiers:
P - Initial pH falls outside the range of 6.0 - 9.0
H - 36 Hour Hold Time Exceeded
T - Initial Temperature exceeded 0 - 6° Range

DATE 02/04/21

APPROVED Michael Lester

Michael Lester
Bioassay Lab Manager

PACE ANALYTICAL
TEST RESULTS

Pace Sample ID: 7358269-001
Client Sample ID: Outfall 029 EDTA 0.6

Client Name: BAE Systems
VPDES Permit #: VA0000248

EDTA 0.6 Milliliter Test

Ceriodaphnia dubia

Statistical Test Method	Pass/Fail	Qualifier Data
None Needed	Fail	

Only 3 of 20 test organisms were alive at 24 hours into the test. At 48 hours, all test organisms were dead in the 100.0% effluent. All organisms survived in the control.

Key:
TUA - Toxicity Units - Acute
LC50 - Lethal Concentration to 50% of population

Qualifiers:
P - Initial pH falls outside the range of 6.0 - 9.0
H - 36 Hour Hold Time Exceeded
T - Initial Temperature exceeded 0 - 6° Range

DATE 02/04/21

APPROVED Michael Lester

Michael Lester
Bioassay Lab Manager

PACE ANALYTICAL
TEST RESULTS

Pace Sample ID: 7358269-001
Client Sample ID: Outfall 029 EDTA 1.6

Client Name: BAE Systems
VPDES Permit #: VA0000248

EDTA 1.6 Milliliters Test

Ceriodaphnia dubia

Statistical Test Method	Pass/Fail	Qualifier Data
None Needed	Fail	

Only 2 of 20 test organisms were alive at 24 hours into the test. At 48 hours, all test organisms were dead in the 100.0% effluent. All test organisms survived in the control.

Key:
TUA - Toxicity Units - Acute
LC50 - Lethal Concentration to 50% of population

Qualifiers:
P - Initial pH falls outside the range of 6.0 - 9.0
H - 36 Hour Hold Time Exceeded
T - Initial Temperature exceeded 0 - 6° Range

DATE: 02/04/21

APPROVED Michael Lester

Michael Lester
Bioassay Lab Manager

PACE ANALYTICAL
TEST RESULTS

Pace Sample ID: 7358269-001
Client Sample ID: Outfall 029 STC 2.0

Client Name: BAE Systems
VPDES Permit #: VA0000248

STC 2.0 Milliliters Test

Ceriodaphnia dubia

Statistical Test Method	Pass/Fail	Qualifier Data
None Needed	Fail	

13 of 20 test organisms were dead at 24 hours into the test. At 48 hours, all test organisms were dead in the 100.0% effluent. All test organisms survived in the control.

Key:
TUA - Toxicity Units - Acute
LC50 - Lethal Concentration to 50% of population

Qualifiers:
P - Initial pH falls outside the range of 6.0 - 9.0
H - 36 Hour Hold Time Exceeded
T - Initial Temperature exceeded 0 - 6° Range

DATE 02/04/21

APPROVED Michael Lester

Michael Lester
Bioassay Lab Manager

PACE ANALYTICAL
TEST RESULTS

Pace Sample ID: 7358269-001
Client Sample ID: Outfall 029 STC 5.0

Client Name: BAE Systems
VPDES Permit #: VA0000248

STC 5.0 Milliliters Test

Ceriodaphnia dubia

Statistical Test Method	Pass/Fail	Qualifier Data
None Needed	Fail	

13 of 20 test organisms were dead at 24 hours into the test. At 48 hours, all test organisms were dead in the 100.0% effluent. All test organisms survived in the control.

Key:
TUA - Toxicity Units - Acute
LC50 - Lethal Concentration to 50% of population

Qualifiers:
P - Initial pH falls outside the range of 6.0 - 9.0
H - 36 Hour Hold Time Exceeded
T - Initial Temperature exceeded 0 - 6° Range

DATE 02/04/21

APPROVED Michael Lester

Michael Lester
Bioassay Lab Manager

PACE TOXICITY TEST DATA

Client: BAE Systems	**Test Beginning**:	**Date**: 01-28-21	**Time**: 1200
Client Sample ID: Outfall 029- Baseline	**Test Ending**:	**Date**: 01-30-21	**Time**: 1040
Pace Sample ID: 7358269-001	**Dilution Water**: Moderately Hard Synthetic Fresh Water		
NPDES Permit #: VA0000248	**Test Organism**: *Ceriodaphnia dubia*		**Age**: <24 Hrs
Bioassay Test: 48-Hr Static Screen Non-Renewal	**Isolation Date**: 01-27-21	**Time**: 0740	
Sample Collection Data	**# Replicates**: 4	**# Organisms/Rep**: 5	
Sample Volume: 3 Gallon **Sample Type**: Composite	**Effluent**		**Dilution Water**
Collected From: **Date**: 01-26-21 **Time**: 0001	**Alkalinity** NA	**Chlorine** 0.00	**Alkalinity** NA
Collected To: **Date**: 01-26-21 **Time**: 2359	**Hardness** NA	**Dechlorinated** NA	**Hardness** NA

Test Concentration (%)	Number of Live Organisms			Dissolved Oxygen (mg/l)			pH (SU)			Conductivity (umhos)			Test Temperature (°C)		
	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs
Control A	5	5	5	7.6	7.6	7.7	8.13	8.07	8.05	354		346	26.3	24.4	23.7
Control B	5	5	5												
Control C	5	5	5												
Control D	5	5	5												
100.0% A	5	0	0	7.0	7.6	7.4	8.49	8.50	8.56	656		653	25.8	25.0	24.1
100.0% B	5	1	0												
100.0% C	5	2	0												
100.0% D	5	0	0												
Initials	ML	DL	TG												
Time	1200	1125	1040												
Comments:															

PACE TOXICITY TEST DATA

Client: BAE Systems	**Test Beginning**:	**Date**: 01-28-21	**Time**: 1210
Client Sample ID: Outfall 029 C-18	**Test Ending**:	**Date**: 01-30-21	**Time**: 1040
Pace Sample ID: 7359269-001	**Dilution Water**: Moderately Hard Synthetic Fresh Water		
NPDES Permit #: VA0000248	**Test Organism**: *Ceriodaphnia dubia*		**Age**:<24 Hrs
Bioassay Test: 48-Hr Static Screen Non-Renewal	**Isolation Date**: 01-27-21	**Time**: 0740	
Sample Collection Data	**# Replicates**: 4	**# Organisms/Rep**: 5	
Sample Volume: 3 Gallon **Sample Type**: Composite	**Effluent**		**Dilution Water**
Collected From: **Date** 01-26-21 **Time**: 0001	**Alkalinity** NA	**Chlorine** 0.00	**Alkalinity** NA
Collected To: **Date** :01-26-21 **Time**: 2359	**Hardness** NA	**Dechlorinated** NA	**Hardness** NA

Test Concentration (%)	Number of Live Organisms			Dissolved Oxygen (mg/l)			pH (SU)			Conductivity (umhos)			Test Temperature (°C)		
	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs
Control A	5	5	5	7.0	7.6	7.7	8.13	8.07	8.05	354		346	26.3	24.4	23.7
Control B	5	5	5												
Control C	5	5	5												
Control D	5	5	5												
100.0% A	5	0	0	7.9	7.7	7.6	8.56	8.55	8.60	671		653	20.3	25.0	24.0
100.0% B	5	2	0												
100.0% C	5	2	0												
100.0% D	5	0	0												
Initials	ML	DL	TG												
Time	1210	1125	1040												
Comments:															

PACE TOXICITY TEST DATA

Client: BAE Systems	**Test Beginning**:	**Date**: 01-28-21	**Time**: 1140
Client Sample ID: Outfall 029 EDTA 0.6	**Test Ending**:	**Date**: 01-30-21	**Time**: 1050
Pace Sample ID: 7358269-001	**Dilution Water**: Moderately Hard Synthetic Fresh Water		
NPDES Permit #: VA0000248	**Test Organism**: *Ceriodaphnia dubia*		**Age**: < 24 Hrs
Bioassay Test: 48-Hr Static Screen Non-Renewal	**Isolation Date**: 01-27-21	**Time**: 0740	
Sample Collection Data	**# Replicates**: 4	**# Organisms/Rep**: 5	
Sample Volume: 3 Gallon **Sample Type**: Composite	**Effluent**		**Dilution Water**
Collected From: **Date**: 01-26-21 **Time**: 0001	**Alkalinity** NA	**Chlorine** 0.00	**Alkalinity** NA
Collected To: **Date**: 01-26-21 **Time**: 2359	**Hardness** NA	**Dechlorinated** NA	**Hardness** NA

Test Concentration (%)	Number of Live Organisms			Dissolved Oxygen (mg/l)			pH (SU)			Conductivity (umhos)			Test Temperature (°C)		
	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs
Control A	5	5	5	6.9	7.5	7.7	8.19	8.11	8.15	366		355	25.8	25.0	24.5
Control B	5	5	5												
Control C	5	5	5												
Control D	5	5	5												
100.0% A	5	0	0	7.5	7.6	7.5	8.15	8.47	8.58	668		676	25.4	25.1	24.6
100.0% B	5	3	0												
100.0% C	5	0	0												
100.0% D	5	0	0												
Initials	DL	DL	TG												
Time	1140	1110	1050												
Comments:															

PACE TOXICITY TEST DATA

Client: BAE Systems	**Test Beginning**:	**Date**: 01-28-21	**Time**: 1140
Client Sample ID: Outfall 029 EDTA 1.6	**Test Ending**:	**Date**: 01-30-21	**Time**: 1050
Pace Sample ID: 7358269-001	**Dilution Water**: Moderately Hard Synthetic Fresh Water		
NPDES Permit #: VA0000248	**Test Organism**: *Ceriodaphnia dubia*		**Age**: <24 Hrs.
Bioassay Test: 48-Hr Static Screen Non-Renewal	**Isolation Date**: 01-27-21	**Time**: 0740	
Sample Collection Data	**# Replicates**: 4	**# Organisms/Rep**: 5	
Sample Volume: 3 Gallon **Sample Type**: Composite	**Effluent**		**Dilution Water**
Collected From: **Date**: 01-26-21 **Time**: 0001	**Alkalinity** NA	**Chlorine** 0.00	**Alkalinity** NA
Collected To: **Date**: 01-26-21 **Time**: 2359	**Hardness** NA	**Dechlorinated** NA	**Hardness** NA

Test Concentration (%)	Number of Live Organisms			Dissolved Oxygen (mg/l)			pH (SU)			Conductivity (umhos)			Test Temperature (°C)		
	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs
Control A	5	5	5	6.9	7.5	7.7	8.19	8.11	8.15	366		355	25.8	25.0	24.4
Control B	5	5	5												
Control C	5	5	5												
Control D	5	5	5												
100.0% A	5	0	0	7.4	7.6	7.7	8.22	8.45	8.52	668		648	25.4	25.1	24.4
100.0% B	5	2	0												
100.0% C	5	0	0												
100.0% D	5	0	0												
Initials	DL	DL	TG												
Time	1140	1110	1050												
Comments:															

PACE TOXICITY TEST DATA

Client: BAE Systems	**Test Beginning**:	**Date**: 01-28-21	**Time**: 1145
Client Sample ID: Outfall 029 STC 2.0	**Test Ending**:	**Date**: 01-30-21	**Time**: 1045
Pace Sample ID: 7358269-001	**Dilution Water**: Moderately Hard Synthetic Fresh Water		
NPDES Permit #: VA0000248	**Test Organism**: *Ceriodaphnia dubia*		**Age**: <24 Hrs
Bioassay Test: 48-Hr Static Screen Non-Renewal	**Isolation Date**: 01-27-21	**Time**: 0845	
Sample Collection Data	**# Replicates**: 4	**# Organisms/Rep**: 5	
Sample Volume: 3 Gallon **Sample Type**: Composite	**Effluent**		**Dilution Water**
Collected From: **Date**: 01-26-21 **Time**: 0001	**Alkalinity** NA	**Chlorine** 0.00	**Alkalinity** NA
Collected To: **Date**: 01-26-21 **Time**: 2359	**Hardness** NA	**Dechlorinated** NA	**Hardness** NA

Test Concentration (%)	Number of Live Organisms			Dissolved Oxygen (mg/l)			pH (SU)			Conductivity (umhos)			Test Temperature (°C)		
	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs
Control A	5	5	5	7.0	7.7	7.5	8.14	8.07	8.17	360		358	26.0	24.7	24.3
Control B	5	5	5												
Control C	5	5	5												
Control D	5	5	5												
100.0% A	5	3	0	7.3	7.6	7.6	8.26	8.47	8.51	670		640	24.7	25.0	24.3
100.0% B	5	2	0												
100.0% C	5	2	0												
100.0% D	5	0	0												
Initials	DL	DL	TG												
Time	1145	1120	1045												
Comments:															

PACE TOXICITY TEST DATA

Client: BAE Systems | **Test Beginning**: **Date**: 01-28-21 **Time**: 1145

Client Sample ID: Outfall 029 STC 5.0 | **Test Ending**: **Date**: 01-30-21 **Time**: 1045

Pace Sample ID: 7358269-001 | **Dilution Water**: Moderately Hard Synthetic Fresh Water

NPDES Permit #: VA0000248 | **Test Organism**: *Ceriodaphnia dubia* **Age**: <24 Hrs

Bioassay Test: 48-Hr Static Screen Non-Renewal | **Isolation Date**: 01-27-21 **Time**: 0845

Sample Collection Data | **# Replicates**: 4 **# Organisms/Rep**: 5

Sample Volume: 3 Gallon **Sample Type**: Composite | **Effluent** | **Dilution Water**

Collected From: **Date**: 01-26-21 **Time**: 0001 | **Alkalinity** NA **Chlorine** 0.00 **Alkalinity** NA

Collected To: **Date**: 01-26-21 **Time**: 2359 | **Hardness** NA **Dechlorinated** NA **Hardness** NA

Test Concentration (%)	Number of Live Organisms			Dissolved Oxygen (mg/l)			pH (SU)			Conductivity (umhos)			Test Temperature (°C)		
	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs
Control A	5	5	5	7.0	7.7	7.7	8.14	8.07	89.05	360		357	26.0	24.7	23.9
Control B	5	5	5												
Control C	5	5	5												
Control D	5	5	5												
100.0% A	5	3	0	7.5	7.6	7.7	8.27	8.44	8.50	696		665	24.7	24.9	24.3
100.0% B	5	0	0												
100.0% C	5	4	0												
100.0% D	5	0	0												
Initials	DL	DL	TG												
Time	1145	1120	1045												
Comments:															

Pace Analytical Services, LLC
225 Industrial Park RD
Beaver, WV 25813
(800)999-0105

February 04, 2021

Mr. Jody Hawks
BAE SYSTEMS, ORDINANCE SYSTEMS INC.
PO BOX 1/STATE ROUTE 114
RADFORD
Radford, VA 24141

RE: Project: 029-Q1 TOX - TIE TEST
Pace Project No.: 7358269

Dear Mr. Hawks:

Enclosed are the analytical results for sample(s) received by the laboratory on January 27, 2021. The results relate only to the samples included in this report. Results reported herein conform to the applicable TNI/NELAC Standards and the laboratory's Quality Manual, where applicable, unless otherwise noted in the body of the report.

The test results provided in this final report were generated by each of the following laboratories within the Pace Network:

- Pace Analytical Services - WestVirginia

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Todd Crone
todd.crone@pacelabs.com
800-999-0105
Project Manager

Enclosures

cc: Mr. William (Andy) Wirt, BAE SYSTEMS, ORDNANCE SYSTEMS INC.

PRELIMINARY

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, LLC.

Pace Analytical Services, LLC
225 Industrial Park RD
Beaver, WV 25813
(800)999-0105

CERTIFICATIONS

Project: 029-Q1 TOX - TIE TEST
Pace Project No.: 7358269

Pace Analytical Services Beaver
225 Industrial Park Drive, Beaver, WV 25813
Virginia VELAP 460148
West Virginia DEP 060
West Virginia DHHR 00412CM
North Carolina DEQ 466
Kentucky Wastewater Certification KY90039
Pennsylvania DEP 68-00839

PRELIMINARY

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, LLC.

Pace Analytical Services, LLC
225 Industrial Park RD
Beaver, WV 25813
(800)999-0105

SAMPLE SUMMARY

Project: 029-Q1 TOX - TIE TEST
Pace Project No.: 7358269

Lab ID	Sample ID	Matrix	Date Collected	Date Received
7358269001	**OUTFALL 029**	Water	01/26/21 23:59	01/27/21 12:37

PRELIMINARY

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, LLC.

Pace Analytical Services, LLC
225 Industrial Park RD
Beaver, WV 25813
(800)999-0105

SAMPLE ANALYTE COUNT

Project: 029-Q1 TOX - TIE TEST
Pace Project No.: 7358269

Lab ID	Sample ID	Method	Analysts	Analytes Reported	Laboratory
7358269001	**OUTFALL 029**	EPA 200.7	LMM	35	PASI-BVWV

PASI-BVWV = Pace Analytical Services - WestVirginia

PRELIMINARY

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, LLC.

Pace Analytical Services, LLC
225 Industrial Park RD
Beaver, WV 25813
(800)999-0105

ANALYTICAL RESULTS

Project: 029-Q1 TOX - TIE TEST
Pace Project No.: 7358269

Sample: OUTFALL 029 **Lab ID: 7358269001** Collected: 01/26/21 23:59 Received: 01/27/21 12:37 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
200.7 Metals, Total	Analytical Method: EPA 200.7 Preparation Method: EPA 200.7							
	Pace Analytical Services - WestVirginia							
Aluminum	**755**	ug/L	20.0	1	01/29/21 10:50	01/29/21 20:36	7429-90-5	
Antimony	ND	ug/L	20.0	1	01/29/21 10:50	01/29/21 20:36	7440-36-0	
Arsenic	ND	ug/L	20.0	1	01/29/21 10:50	01/29/21 20:36	7440-38-2	
Barium	**33.0**	ug/L	5.0	1	01/29/21 10:50	01/29/21 20:36	7440-39-3	
Beryllium	ND	ug/L	1.0	1	01/29/21 10:50	01/29/21 20:36	7440-41-7	
Boron	ND	ug/L	50.0	1	01/29/21 10:50	01/29/21 20:36	7440-42-8	
Cadmium	ND	ug/L	1.0	1	01/29/21 10:50	01/29/21 20:36	7440-43-9	
Calcium	**24600**	ug/L	500	1	01/29/21 10:50	01/29/21 20:36	7440-70-2	
Chromium	ND	ug/L	5.0	1	01/29/21 10:50	01/29/21 20:36	7440-47-3	
Cobalt	ND	ug/L	5.0	1	01/29/21 10:50	01/29/21 20:36	7440-48-4	
Copper	**7.5**	ug/L	5.0	1	01/29/21 10:50	01/29/21 20:36	7440-50-8	
Hardness, Calcium	**61500**	ug/L	1250	1	01/29/21 10:50	01/29/21 20:36		N3
Hardness, Magnesium	**35700**	ug/L	2060	1	01/29/21 10:50	01/29/21 20:36		N3
Iron	ND	ug/L	50.0	1	01/29/21 10:50	01/29/21 20:36	7439-89-6	
Lead	**28.9**	ug/L	10.0	1	01/29/21 10:50	01/29/21 20:36	7439-92-1	
Lithium	ND	ug/L	100	1	01/29/21 10:50	01/29/21 20:36	7439-93-2	N2
Magnesium	**8670**	ug/L	500	1	01/29/21 10:50	01/29/21 20:36	7439-95-4	
Manganese	ND	ug/L	5.0	1	01/29/21 10:50	01/29/21 20:36	7439-96-5	
Molybdenum	ND	ug/L	5.0	1	01/29/21 10:50	01/29/21 20:36	7439-98-7	
Nickel	ND	ug/L	5.0	1	01/29/21 10:50	01/29/21 20:36	7440-02-0	
Phosphorus	ND	ug/L	500	1	01/29/21 10:50	01/29/21 20:36	7723-14-0	N2
Potassium	**15400**	ug/L	500	1	01/29/21 10:50	01/29/21 20:36	7440-09-7	
Selenium	ND	ug/L	20.0	1	01/29/21 10:50	01/29/21 20:36	7782-49-2	
Silica	**7260**	ug/L	210	1	01/29/21 10:50	01/29/21 20:36	7631-86-9	
Silicon	**3390**	ug/L	100	1	01/29/21 10:50	01/29/21 20:36	7440-21-3	N2
Silver	ND	ug/L	5.0	1	01/29/21 10:50	01/29/21 20:36	7440-22-4	
Sodium	**93400**	ug/L	500	1	01/29/21 10:50	01/29/21 20:36	7440-23-5	
Strontium	**125**	ug/L	10.0	1	01/29/21 10:50	01/29/21 20:36	7440-24-6	N2
Sulfur	**22000**	ug/L	200	1	01/29/21 10:50	01/29/21 20:36		N3
Thallium	ND	ug/L	10.0	1	01/29/21 10:50	01/29/21 20:36	7440-28-0	
Tin	ND	ug/L	100	1	01/29/21 10:50	01/29/21 20:36	7440-31-5	
Titanium	ND	ug/L	10.0	1	01/29/21 10:50	01/29/21 20:36	7440-32-6	
Total Hardness by 2340B	**97200**	ug/L		1	01/29/21 10:50	01/29/21 20:36		
Vanadium	ND	ug/L	10.0	1	01/29/21 10:50	01/29/21 20:36	7440-62-2	
Zinc	ND	ug/L	20.0	1	01/29/21 10:50	01/29/21 20:36	7440-66-6	

PRELIMINARY

Pace Analytical Services, LLC
225 Industrial Park RD
Beaver, WV 25813
(800)999-0105

QUALIFIERS

Project: 029-Q1 TOX - TIE TEST
Pace Project No.: 7358269

DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to dilution of the sample aliquot.

ND - Not Detected at or above adjusted reporting limit.

TNTC - Too Numerous To Count

J - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.

MDL - Adjusted Method Detection Limit.

PQL - Practical Quantitation Limit.

RL - Reporting Limit - The lowest concentration value that meets project requirements for quantitative data with known precision and bias for a specific analyte in a specific matrix.

S - Surrogate

1,2-Diphenylhydrazine decomposes to and cannot be separated from Azobenzene using Method 8270. The result for each analyte is a combined concentration.

Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.

LCS(D) - Laboratory Control Sample (Duplicate)

MS(D) - Matrix Spike (Duplicate)

DUP - Sample Duplicate

RPD - Relative Percent Difference

NC - Not Calculable.

SG - Silica Gel - Clean-Up

U - Indicates the compound was analyzed for, but not detected.

N-Nitrosodiphenylamine decomposes and cannot be separated from Diphenylamine using Method 8270. The result reported for each analyte is a combined concentration.

Pace Analytical is TNI accredited. Contact your Pace PM for the current list of accredited analytes.

TNI - The NELAC Institute.

ANALYTE QUALIFIERS

N2	The lab does not hold NELAC/TNI accreditation for this parameter.
N3	Accreditation is not offered by the relevant laboratory accrediting body for this parameter.

PRELIMINARY

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, LLC.

Pace Analytical Services, LLC
225 Industrial Park RD
Beaver, WV 25813
(800)999-0105

QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: 029-Q1 TOX - TIE TEST
Pace Project No.: 7358269

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
7358269001	**OUTFALL 029**	EPA 200.7	57241	EPA 200.7	57313

PRELIMINARY

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, LLC.

ENTHALPY ANALYTICAL
formerly Air, Water & Soil Laboratories

1941 Reymet Road ● Richmond, Virginia 23237 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Laboratory Order ID 21E1169

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford, VA 24141	Date Received:	May 21, 2021 10:26
		Date Issued:	June 2, 2021 15:28
		Project Number:	[none]
Submitted To:	Sheree Andrews	Purchase Order:	RFAC-032621-01-RLL
Client Site I.D.:	029 2nd Quarter Toxicity		

Enclosed are the results of analyses for samples received by the laboratory on 05/21/2021 10:26. If you have any questions concerning this report, please feel free to contact the laboratory.

Sincerely,

Ted Soyars

Ted Soyars
Technical Director

End Notes:

The test results listed in this report relate only to the samples submitted to the laboratory and as received by the Laboratory.

Unless otherwise noted, the test results for solid materials are calculated on a wet weight basis. Analyses for pH, dissolved oxygen, temperature, residual chlorine and sulfite that are performed in the laboratory do not meet NELAC requirements due to extremely short holding times. These analyses should be performed in the field. The results of field analyses performed by the Sampler included in the Certificate of Analysis are done so at the client's request and are not included in the laboratory's fields of certification nor have they been audited for adherence to a reference method or procedure.

The signature on the final report certifies that these results conform to all applicable NELAC standards unless otherwise specified. For a complete list of the Laboratory's NELAC certified parameters please contact customer service.

This report shall not be reproduced except in full without the expressed and written approval of an authorized representative of Air Water & Soil Laboratories, Inc.

NELAP ACCREDITED TNI LABORATORY

ENTHALPY ANALYTICAL
formerly Air, Water & Soil Laboratories

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued:	June 02, 2021 15:28
		Project Number:	[none]
		Purchase Order:	RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	029 2nd Quarter Toxicity		

ANALYTICAL REPORT FOR SAMPLES

Laboratory Order ID 21E1169

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
029 TOX	21E1169-01	Waste Water	04/29/2021 00:00	05/21/2021 10:26

Analysis for Baseline Acute Test, Mock Effluent Test, HLB-SPE, and UV-irradiation was subcontracted to Coastal Bioanalysts.
The subcontracted results are attached at the end of this Certificate of Analysis.

ENTHALPY ANALYTICAL
formerly Air, Water & Soil Laboratories

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued:	June 02, 2021 15:28
		Project Number:	[none]
		Purchase Order:	RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	029 2nd Quarter Toxicity		

Laboratory Order ID: 21E1169

Analytical Results

Sample I.D. 029 TOX **Laboratory Sample ID:** 21E1169-01

Composite Start-End Date/Time: 04/29/2021 00:00 - 04/29/2021 00:00

Field Residual Cl: **Field pH:**

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Subcontracted Analysis									
Chronic Toxicity	01	EPA	Attached		--	1	06/02/21 14:04	06/02/21 14:04	N/A

Analytical Summary

Sample ID	Preparation Factors Initial / Final	Method	Batch ID	Sequence ID	Calibration ID
Subcontracted Analysis		**Preparation Method:**	***** DEFAULT PREP *****		
21E1169-01	1.00 mL / 1.00 mL	EPA	BEF0062		

ENTHALPY ANALYTICAL
formerly Air, Water & Soil Laboratories

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued:	June 02, 2021 15:28
		Project Number:	[none]
		Purchase Order:	RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	029 2nd Quarter Toxicity		

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued:	June 02, 2021 15:28
		Project Number:	[none]
		Purchase Order:	RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	029 2nd Quarter Toxicity		

Certified Analyses included in this Report

Analyte **Certifications**

Code	Description	Laboratory ID	Expires
MdDOE	Maryland DE Drinking Water	341	12/31/2021
NC	North Carolina DENR	495	12/31/2021
NCDEQ	North Carolina DEQ	495	12/31/2021
NCDOH	North Carolina Department of Health	51714	07/31/2021
NHDES	NELAP-New Hampshire Certificate #224221	2242	02/25/2022
NJDEP	NELAP-New Jersey DEP	VA015	06/30/2021
NYDOH	New York DOH Drinking Water	12096	04/01/2022
PADEP	NELAP-Pennsylvania Certificate #006	68-03503	10/31/2021
VELAP	NELAP-Virginia Certificate #11064	460021	06/14/2021
WVDEP	West Virginia DEP	350	06/30/2021

ENTHALPY ANALYTICAL
formerly Air, Water & Soil Laboratories

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued:	June 02, 2021 15:28
		Project Number:	[none]
		Purchase Order:	RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	029 2nd Quarter Toxicity		

Summary of Data Qualifiers

Attached	Attached
RPD	Relative Percent Difference
Qual	Qualifers
-RE	Denotes sample was re-analyzed
D.F.	Dilution Factor. Please also see the Preparation Factor in the Analysis Summary section.
TIC	Tentatively Identified Compounds are compounds that are identified by comparing the analyte mass spectral pattern with the NIST spectral library. A TIC spectral match is reported when the pattern is at least 75% consistent with the published pattern. Compound concentrations are estimated and are calculated using an internal standard response factor of 1.
PCBs, Total	Total PCBs are defined as the sum of detected Aroclors 1016, 1221, 1232, 1248, 1254, 1260, 1262, and 1268.

ENTHALPY ANALYTICAL
formerly *Air, Water & Soil Laboratories*

1941 REYMET ROAD
RICHMOND, VIRGINIA 23237
(804) 358-8295 PHONE
(804)358-8297 FAX

Chain of Custody
Effective: Nov 15, 2018

CHAIN OF CUSTODY

COMPANY NAME: BAE Systems, Inc. - RFAAP	INVOICE TO: Accounts Payable	PROJECT NAME: 029 2nd Quarter Toxicity
CONTACT: Sheree Andrews	INVOICE CONTACT:	SITE NAME:
ADDRESS: Route 114 Radford, Va 24141	INVOICE ADDRESS:	PROJECT NUMBER:
PHONE #: 1-540-717-4092	INVOICE PHONE #:	P.O. #:
FAX #: / EMAIL: Sheree.andrews@baesystems.com		Pretreatment Program:
Is sample for compliance reporting? YES	Regulatory State: Va / Is sample from a chlorinated supply? YES NO	PWS I.D. #:
SAMPLER NAME (PRINT): Denise Vaughn	SAMPLER SIGNATURE: Denise Vaughn	Turn Around Time: Circle 10 5 Days or _Day(s)

Matrix Codes: WW=Waste Water/Storm Water GW=Ground Water DW=Drinking Water S=Soil/Solids OR=Organic A=Air WP=Wipe OT=Other_____

COMMENTS: Preservative Codes: N=Nitric Acid C=Hydrochloric Acid S=Sulfuric Acid H=Sodium Hydroxide A=Ascorbic Acid Z=Zinc Acetate T=Sodium Thiosulfate M=Methanol

CLIENT SAMPLE I.D.	Grab	Composite	Field Filtered (Dissolved Metals)	Composite Start Date	Composite Start Time	Grab Date or Composite Stop Date	Grab Time or Composite Stop Time	Time Preserved 4.30.21	Matrix (See Codes)	Number of Containers	ANALYSIS / (PRESERVATIVE): Acute Toxicity - Ceriodaphnia dubia							
1) 029 Tox		X		4.29.21	0000	4.29.21	2359	0915	WW	2	X							
2)																		
3)																		
4)																		
5)																		
6)																		
7)																		
8)																		
9)																		
10)																		

BAE Systems, Inc. 21E1169
Toxicity
Recd: 05/21/2021 Due: 06/14/2021
v130325002

BAE Systems, Inc. 21E0308
Toxicity
Recd: 04/30/2021 Due: 05/14/2021
v130325002

RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME
Denise Vaughn	4.30.21 / 0941		4/30/21 0941
RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME
	4/30/21 1331		
RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME

QC Data Package
Level III ☐
Level IV ☐

LAB USE ONLY Therm ID: 271 COOLER TEMP 0.8 °C
Custody Seals used and intact? (Y / N) Received on ice? (Y / N)

BAE Systems, Inc. 21D1297
Toxicity
Recd: 04/30/2021 Due: 05/07/2021
v130325002 Toxicity 04.29.21

ENTHALPY ANALYTICAL
formerly Air, Water & Soil Laboratories

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued:	June 02, 2021 15:28
		Project Number:	[none]
		Purchase Order:	RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	029 2nd Quarter Toxicity		

Sample Conditions Checklist

Samples Received at:	
How were samples received?	AWS Courier
Were Custody Seals used? If so, were they received intact?	No
Are the custody papers filled out completely and correctly?	No
Do all bottle labels agree with custody papers?	No
Is the temperature blank or representative sample within acceptable limits or received on ice, and recently taken?	No
Are all samples within holding time for requested laboratory tests?	No
Is a sufficient amount of sample provided to perform the tests included?	No
Are all samples in appropriate containers for the analyses requested?	No
Were volatile organic containers received?	No
Are all volatile organic and TOX containers free of headspace?	NA
Is a trip blank provided for each VOC sample set? VOC sample sets include EPA8011, EPA504, EPA8260, EPA624, EPA8015 GRO, EPA8021, EPA524, and RSK-175.	NA
Are all samples received appropriately preserved? Note that metals containers do not require field preservation but lab preservation may delay analysis.	No

Work Order Comments

ENTHALPY ANALYTICAL
formerly Air, Water & Soil Laboratories

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued: Project Number: Purchase Order:	June 02, 2021 15:28 [none] RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	029 2nd Quarter Toxicity		

Samples logged on 15 Day TAT. THM 30 April 2021/14.23

Per Jody Hawks, analyze sample 029 TOX for futher toxicity testing is to include the following:

Baseline Acute Test
Mock Effluent Test
HLB-SPE
UV-irradiation

Original work order number is 21D129 and the sample has been detained at Coastal Bioanalysts.

KLC 5-27-2021.

Coastal Bioanalysts, Inc.

Report of Analysis: Whole Effluent Toxicity (WET): Phase I Toxicity Identification Evaluation Tests

Submitted To:	**Prepared By:**
Katrina Cooke Senior Project Manager Enthalpy Analytical/Air, Water and Soil Laboratories 1941 Reymet Road Richmond, VA 23237	Coastal Bioanalysts, Inc. 6400 Enterprise Court Gloucester, VA 23061 (804) 694-8285 www.coastalbio.com Contact: Peter F. De Lisle, Technical Director

METHODS

TIE test methods followed the EPA Phase I acute TIE protocols (*Methods for Aquatic Toxicity Identification Evaluations: Phase I Toxicity Characterization Procedures, 2nd ed.* February 1991. EPA/600/6-91/003). Additional detailed information, including summary procedures, is provided in the attached bench sheets.

RESULTS

Test	Test Date	LC50 (% sample)	95% C.L.
Initial	5/1/21	21.5	17.0-25.8
Baseline 2	5/27/21	61.6	54.4-69.7
SPE HLB	5/27/21	60.6	51.7-71.0
UV	5/27/21	47.4	39.6-56.0
Mock Sample	5/27/21	>100	<1.00

Sample toxicity decreased significantly, as indicated by non-overlapping 95% confidence limits of corresponding initial and baseline LC50 values, during the 27-day storage period. However, there was still residual toxicity present. The HLB SPE columns and UV-irradiation did not remove residual toxicity. A mock sample, made up of the same major cations and anions as the original sample, was not toxic.

DISCUSSION

The TIE procedures used in this study were selected based on:

1. Suspicion that nitroglycerin (NG) degradation products (NGDP) may be present in trace amounts. Nitroglycerin is toxic to *Ceriodaphnia dubia* (LC50 = 17.83 mg/l; Burton *et al.* 1993). The more soluble degradation products may be more toxic, and are readily adsorbed by Water Oasis HLB SPE columns (Martel et al., 2010)
2. The results of previous TIE testing. All ambient pH EPA TIE manipulations had shown no effect; UV treatment and testing of a mock solution (for toxicity due to ion imbalance) were added since biological interference and ion imbalance are common problems which are not addressed by the standard EPA suite of tests.

Because there was a threefold decrease in toxicity between the initial test (4.65 TUa) and the baseline test (1.62 TUa), loss of toxicity during storage due to higher concentrations of NGDP in the initial test cannot be ruled out. However, NGDP does not appear to be responsible for the residual toxicity.

The ionic composition of the mock sample could not be perfectly matched to the 029 sample due to the fact that ions other than the seven common ions typically associated with TDS toxicity were present in relatively high

VELAP# 460030
EPA# VA01116

concentrations. In preparing the mock solution, discrepancies in the ion balance were made up with the relatively non-toxic Na-Cl combination, which produced a lower overall TDS concentration. However, the measured conductivity of the sample, versus the estimated conductivity from the ion analyses, indicate that K, Na, Mg, Ca, Cl, SO_4 and HCO_3 only comprise about 66% of the total ions present. If initial toxicity was due to other anions and cations comprising the remaining 34% of sample ions, one would not expect large losses to occur during storage unless major changes in speciation occurred.

Test Solution	Major ion TDS* (mg/l)	Conductivity (µS/cm) estimated from TDS	Measured conductivity (µS/cm)	% Difference
029 Sample	331.8	519	785	+51%
029 Mock Sample	241.2	377	389	+3%

*Measured value for sample; nominal for mock sample.

Typically, the ambient pH TIE procedures will shed light on causes of toxicity, but if not then use of samples that are pH adjusted prior to manipulations may shed light on sources (e.g., Tier 2; EPA 1991). Therefore, it may be useful to conduct the full Phase 1 acute TIE procedures (including pH adjustments) on future samples. The SPE procedures should employ C18 SPE columns and (at ambient pH) HLB SPE columns. Also, conducting a full anion-cation scan of samples, and preparing and testing a mock sample that includes all anions and cations (in addition to K, Na, Mg, Ca, Cl, SO_4 and HCO_3) that occur at significant concentrations in the sample, may be useful.

Literature Cited

Burton, D.T., S.D Turley, and G.T. Peters. 1993. Toxicity of Nitroguanidine, Nitroglycerin, Hexahydro-1,3,5-trinitro-1,3,5 triazine (RDX), and 2,4,6-trinitrotoluene (TNT) to Selected Freshwater Aquatic Organisms. Final Report to U.S. Army Medical Research and Development Command, Fort Detrik, MD. 261 pp.

EPA 1991. *Toxicity Identification Evaluation: Characterization of Chronically Toxic Effluents, Phase I.* June 1992. EPA/600/6-91/005F.

Martel, R., A. Bellavance-Godin, R. Le´vesque, and S. Cote´. 2010. Determination of Nitroglycerin and Its Degradation Products by Solid-Phase Extraction and LC–UV. Chromatographia 71: 285–289

Coastal Bioanalysts, Inc.

QA/QC

Acute Test QA/QC	Reference Toxicant: KCl	Units: mg/l	Test Organism Source: CBI Stock Cultures		
Species-Method (Ref. Test Date)	**Data Source**	**% Control Survival**	**48-h LC50**	**95% C.L./A.L. For LC50**	**RTT in Control?**
C. dubia 2002.0	RTT	100	479	438-524	Yes
(5/3/21-5/5/21)	CC	100	535	468-601	

Note: RTT = Reference Toxicant Test, CC = Control Chart.

The results of analysis contained within this report relate only to the sample as received in the laboratory. This report shall not be reproduced except in full without written approval from the laboratory. Unless noted below, these test results meet all requirements of NELAP.

APPROVED: Peter F. De Lisle

Digitally signed by Peter F. De Lisle
DN: cn=Peter F. De Lisle, o=Coastal Bioanalysts, Inc., ou=Toxicology, email=pfd@coastalbio.com, c=US
Date: 2021.06.02 13:51:26 -04'00'

Peter F. De Lisle, Ph.D.
Technical Director

Deviations from, additions to, or exclusions from the test method, non-standard conditions or data qualifiers and, as appropriate, a statement of compliance/non-compliance: **NONE**

Please leave feedback regarding our services at: http://coastalbio.com/survey

GLOSSARY OF TERMS AND ABBREVIATIONS

A.L. (Acceptance Limits): The results of a given reference toxicant test are compared to the control chart mean value ± 2 standard deviations. These limits approximate the 95% probability limits for the "true" reference toxicant value.

Chronic Value (ChrV): The geometric mean of the NOEC and LOEC. Units are same as test concentration units.

C.L. (Confidence Limits): These are the probability limits, based on the data set and statistical model employed, that the "true value" lies within the limits specified. Typically limits are based on 95% or 99% probabilities.

Control chart: A cumulative summary chart of results from QC tests with reference toxicants. The results of a given reference toxicant test are compared to the control chart mean value and 95% Acceptance Limits (A.L.) (mean ± 2 standard deviations).

IC25: The concentration of sample or chemical, calculated from the data set using statistical models, causing a 25% reduction in test organism growth, reproduction, etc. The lower the IC25, the more toxic the chemical or sample. Units are same as test concentration units.

LC50: The concentration of sample or chemical, calculated from the data set using statistical models, causing a 50% reduction in test organism survival. The lower the LC50, the more toxic the chemical or sample. Units are same as test concentration units. Note: The LC50 value must always be associated with the duration of exposure. Thus 48-h LC50, 96-h LC50, etc. are calculated.

LOEC: Lowest-observable-effect-concentration. The lowest concentration of sample or chemical in a chronic test dilution series in which the test organisms exhibit a statistically significant reduction in any of the test end points (e.g. growth, survival, reproduction) compared to control organisms. Units are same as test concentration units.

PMSD: Percent Minimum Significant Difference: The minimum difference which can exist between a test treatment and the controls in a particular test and be statistically significant; a measure of test sensitivity. The lower the PMSD the more sensitive the test.

N/A: Not applicable.

N/D: Not determined or measured.

VELAP# 460030
EPA# VA01116

NELAP ACCREDITED LABORATORY

NOAEC: No-observable-acute-effect-concentration. The highest concentration of sample or chemical in an acute test dilution series in which the test organisms exhibit no statistically significant reduction in the test end point (e.g. survival) compared to control organisms. Units are same as test concentration units.

NOEC: No-observable-effect-concentration. The highest concentration of sample or chemical in a chronic test dilution series in which the test organisms exhibit no statistically significant reduction in any of the test end points (e.g. growth, survival, reproduction) compared to control organisms. Some regulatory definitions also require that the NOEC be less than the LOEC. Units are same as test concentration units.

Q.L.: Quantitation Limit. Level, concentration, or quantity of a target variable (analyte) that can be reported at a specified degree of confidence.

T.U.: Toxic units. Expresses the relative toxicity of an effluent in such a manner that the larger the toxic unit value the more toxic the effluent. $T.U._{Ac}$ = 100/LC50. $T.U._{Chr}$ = 100/NOEC. A dimensionless unit.

C. dubia daily biological measurements (EPA 2002.0) Template version ACD-STAT-5trt-061113

TRTMNT (% Effl)	Rep	#Live Day 0	#Live Day 1	#Live Day 2	Final Mean % Live		
C	A	5	4	4	95.0		
	B	5	5	5			
Lab	C	5	5	5			
Control	D	5	5	5			
#1	A	5	5	5	100.0		
6.25	B	5	5	5			
% Effl	C	5	5	5			
	D	5	5	5			
# 2	A	5	5	5	90.0		
12.5	B	5	5	5			
% Effl	C	5	4	4			
	D	5	4	4			
# 3	A	5	5	5	35.0		
25.0	B	5	5	2			
% Effl	C	5	2	0			
	D	5	2	0			
# 4	A	5	5	0	0.0		
50.0	B	5	5	0			
% Effl	C	5	0	0			
	D	5	0	0			
# 5	A	5	5	0	0.0		
100	B	5	4	0			
% Effl	C	5	0	0		Test Duration:	48h 16m
	D	5	0	0			TAC 48+/-0.5h
INITIALS:		AK	CPV	LT	% CONTROL SURVIVAL:		95.0
DATE & TIME:		5/1/21 10:41	5/2/21 9:29	5/3/21 10:57			TAC = 90%
CHANGES & NOTES (INITIALS, DATE, SPECIFIC CHANGE MADE							

SPECIES:	Ceriodaphnia dubia		
ACCLIMATION WATER:	Mod. Hard Synthetic Freshwater		
FEEDING PRIOR TO TEST:	YCT + Selenastrum capricornutum		
FEEDING DURING TEST:	None -YCT + Selenastrum 2+ h before test		
SOURCE:	CBI Stock cultures		
ACCLIMATION TEMP (o C):	25		
BROOD RELEASE START DATE & TIME:	4/30/21 22:00		
BROOD RELEASE END DATE & TIME:	5/1/21 6:00		
DATE/TIME WATER ADDED:	5/1/21 10:35		
DATE/TIME ANIMALS ADDED:	5/1/21 10:41		
ANIMAL AGE WINDOW:	8h 0m		
MAX AGE AT TEST START:	12h 41m		TAC Max. 24 h
TEST SET UP BY:		AK	
SAMPLE COLLECTION DATE &TIME:	4/29/21 23:59	SAMPLE USED	A
SAMPLE AGE AT TEST START:	34h 42m	TAC Max 36 h	
PEER REVIEW BY (INITIALS/DATE):		PB	5/6/21 11:34

TEST ID: AWSL2101ACD

Ceriodaphnia daily water quality bench sheet (EPA METHOD 2002.0) Template version ACD-STAT-5trt-061113

	TRTMNT	Day 0 Initial	Day 1	Day 2 Final	SUMMARY WATER QUALITY DATA MEAN	S.D.	MIN.	MAX.
pH (S.U.)	C	7.96	7.48	7.89	7.78	0.26	7.48	7.96
	1	7.98	7.59	7.98	7.85	0.23	7.59	7.98
	2	7.98	7.63	8.05	7.89	0.23	7.63	8.05
	3	7.98	7.70	8.09	7.92	0.20	7.70	8.09
	4	7.96	7.74	8.16	7.95	0.21	7.74	8.16
	5	7.93	7.88	8.52	8.11	0.36	7.88	8.52
Temp. (o C)	C	25	25	25	25	0.0	25	25
	1	25	25	25	25	0.0	25	25
	2	25	25	25	25	0.0	25	25
	3	25	25	25	25	0.0	25	25
	4	25	25	25	25	0.0	25	25
	5	25	25	25	25	0.0	25	25
Diss. Oxygen (mg/l)	C	8.2	7.7	8.2	8.0	0.3	7.7	8.2
	1	8.2	7.6	8.1	8.0	0.3	7.6	8.2
	2	8.2	7.5	8.3	8.0	0.4	7.5	8.3
	3	8.1	7.6	8.2	8.0	0.3	7.6	8.2
	4	8.0	7.5	8.3	7.9	0.4	7.5	8.3
	5	8.0	7.5	8.4	8.0	0.5	7.5	8.4
Cond. (uS/cm)	C	306		330	318	17.0	306	330
	1	329			329		329	329
	2	355			355		355	355
	3	405			405		405	405
	4	542			542		542	542
	5	773		830	802	40.3	773	830
Replicate measured		Flask	Surrogate	A				
Initials		AK	CPV	LT				
		TRC (mg/l) in highest conc. at end of test:		N/A				
Changes & Notes (Initials, date, specific change or notes)								

Test chamber:	30 ml plastic cup:	✓					
	Other:						
Test solution vol. (15 ml min):	15 ml:	✓					
	Other (ml):						
Illumination & photoperiod:	50-100 ft-c 16L:8D			Template Number:		3	
Number of replicates/treatment:	4						
Initial number animals/replicate:	5						
Test Aerated?	N/A	Date & Time Air Start:		N/A			

TEST ID	TRT ID:	1	2	3	4	5
AWSL2101ACD	CONC(%):	6.25	12.5	25.0	50.0	100

Acute Ceriodaphnia Test-48 Hr Survival

Start Date:		Test ID:	AWSL2101	Sample ID:	
End Date:		Lab ID:	CBI	Sample Type:	
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	CD-Ceriodaphnia dubia
Comments:	DATA ENTERED BY PB				

Conc-%	1	2	3	4
CONTROL	0.8000	1.0000	1.0000	1.0000
6.25	1.0000	1.0000	1.0000	1.0000
12.5	1.0000	1.0000	0.8000	0.8000
25	1.0000	0.4000	0.0000	0.0000
50	0.0000	0.0000	0.0000	0.0000
100	0.0000	0.0000	0.0000	0.0000

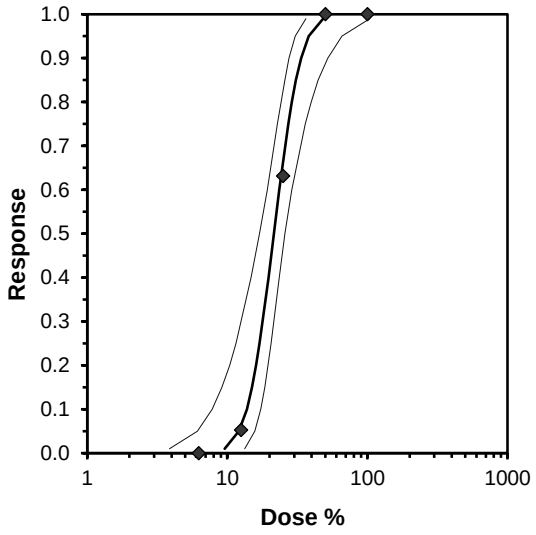
			Transform: Arcsin Square Root					Number	Total
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
CONTROL	0.9500	1.0000	1.2857	1.1071	1.3453	9.261	4	1	20
6.25	1.0000	1.0526	1.3453	1.3453	1.3453	0.000	4	0	20
12.5	0.9000	0.9474	1.2262	1.1071	1.3453	11.212	4	2	20
25	0.3500	0.3684	0.6203	0.2255	1.3453	85.386	4	13	20
50	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4	20	20
100	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 <= 0.01)	0.82543	0.844	1.22885	4.56895
Equality of variance cannot be confirmed				

Maximum Likelihood-Probit

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	6.61214	1.67518	3.32879	9.89549	0.05	0.83	7.81472	0.84	1.33255	0.15124	4
Intercept	-3.81101	2.28474	-8.2891	0.66709							
TSCR	0.02697	0.02553	-0.02307	0.077							

Point	Probits	%	95% Fiducial Limits	
EC01	2.674	9.56578	3.85851	13.2797
EC05	3.355	12.1279	6.1121	15.7403
EC10	3.718	13.7636	7.78308	17.2944
EC15	3.964	14.99	9.13924	18.4737
EC20	4.158	16.0423	10.362	19.5088
EC25	4.326	17.0037	11.517	20.4848
EC40	4.747	19.6895	14.834	23.474
EC50	5.000		17.0305	25.8422
EC60	5.253	23.4891	19.2596	28.8815
EC75	5.674	27.1993	22.8119	35.9897
EC80	5.842	28.8293	24.1561	39.6652
EC85	6.036	30.853	25.696	44.646
EC90	6.282	33.6022	27.6234	52.0927
EC95	6.645	38.134	30.5296	65.9458
EC99	7.326	48.3482	36.3846	103.893



C. dubia daily biological measurements (EPA 2002.0) Template version ACD-TIE BASELINE

TRTMNT (% Effl)	Rep	#Live Day 0	#Live Day 1	#Live Day 2	Final Mean % Live		
C	A	5	5	5	100.0		
	B	5	5	5			
Lab	C	5	5	5			
Control	D	5	5	5			
#1	A	5	5	5	100.0		
12.5	B	5	5	5			
% Effl	C	5	5	5			
	D	5	5	5			
# 2	A	5	5	5	100.0		
25	B	5	5	5			
% Effl	C	5	5	5			
	D	5	5	5			
# 3	A	5	5	5	80.0		
50.0	B	5	5	5			
% Effl	C	5	2	2			
	D	5	4	4			
# 4	A	5	3	0	0.0		
100	B	5	1	0			
% Effl	C	5	1	0		Test Duration:	48h 3m
	D	5	2	0			TAC 48+/-0.5h
INITIALS:		CPV	AK	LT	% CONTROL SURVIVAL:		100.0
DATE & TIME:		5/27/21 13:07	5/28/21 8:51	5/29/21 13:10			TAC = 90%
CHANGES & NOTES (INITIALS, DATE, SPECIFIC CHANGE MADE							

	SPECIES:	Ceriodaphnia dubia	
	ACCLIMATION WATER:	Mod. Hard Synthetic Freshwater	
	FEEDING PRIOR TO TEST:	YCT + Selenastrum capricornutum	
	FEEDING DURING TEST:	None -YCT + Selenastrum 2+ h before test	
	SOURCE:	CBI Stock cultures	
	ACCLIMATION TEMP (o C):	25	
	BROOD RELEASE START DATE & TIME:	5/26/21 16:30	
	BROOD RELEASE END DATE & TIME:	5/27/21 8:30	
	DATE/TIME WATER ADDED:	5/27/21 12:52	
	DATE/TIME ANIMALS ADDED:	5/27/21 13:07	
	ANIMAL AGE WINDOW:	16h 0m	
	MAX AGE AT TEST START:	20h 38m	TAC Max. 24 h
	TEST SET UP BY:	CPV	
	SAMPLE COLLECTION DATE &TIME:	4/29/21 23:59	SAMPLE USED A
TEST ID:	SAMPLE AGE AT TEST START:	661h 9m	TAC Max 36 h
AWSL2101TIE2-BL	PEER REVIEW BY (INITIALS/DATE):	PB	6/1/21 14:46

Ceriodaphnia daily water quality bench sheet (EPA METHOD 2002.0) Template version ACD-TIE BASELINE

	TRTMNT	Day 0 Initial	Day 1	Day 2 Final	SUMMARY WATER QUALITY DATA MEAN	S.D.	MIN.	MAX.
pH (S.U.)	C	7.99	7.61	7.38	7.66	0.31	7.38	7.99
	1	7.99	7.74	7.55	7.76	0.22	7.55	7.99
	2	8.01	7.86	7.76	7.88	0.13	7.76	8.01
	3	8.06	8.06	8.08	8.07	0.01	8.06	8.08
	4	8.11	8.39	8.32	8.27	0.15	8.11	8.39
Temp. (o C)	C	25	25	25	25	0.0	25	25
	1	25	25	25	25	0.0	25	25
	2	25	25	25	25	0.0	25	25
	3	25	25	25	25	0.0	25	25
	4	25	25	25	25	0.0	25	25
Diss. Oxygen (mg/l)	C	8.2	8.0	8.1	8.1	0.1	8.0	8.2
	1	8.2	8.0	8.0	8.1	0.1	8.0	8.2
	2	8.2	7.9	8.2	8.1	0.2	7.9	8.2
	3	8.2	7.8	8.2	8.1	0.2	7.8	8.2
	4	8.2	7.9	8.2	8.1	0.2	7.9	8.2
Cond. (uS/cm)	C	288		280	284	5.7	280	288
	1	328			328		328	328
	2	383			383		383	383
	3	504			504		504	504
	4	785		755	770	21.2	755	785
Replicate measured		Flask	Surrogate	B				
Initials		CPV	AK	LT				
		TRC (mg/l) in highest conc. at end of test:		N/A				
Changes & Notes (Initials, date, specific change or notes)								

Test chamber:	30 ml plastic cup:	✓		
	Other:			
Test solution vol. (15 ml min):	15 ml:	✓		
	Other (ml):			
Illumination & photoperiod:	50-100 ft-c 16L:8D		Template Number:	13
Number of replicates/treatment:		4		
Initial number animals/replicate:		5		
	Test Aerated?	N/A	Date & Time Air Start:	N/A

TEST ID	TRT ID:	1	2	3	4
AWSL2101TIE2-BL	CONC(%):	12.5	25	50.0	100

Acute Ceriodaphnia Test-48 Hr Survival

Start Date:		Test ID:	AWSL2101B	Sample ID:	BASELINE 2
End Date:		Lab ID:	CBI	Sample Type:	
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	CD-Ceriodaphnia dubia
Comments:	DATA ENTERED BY PB				

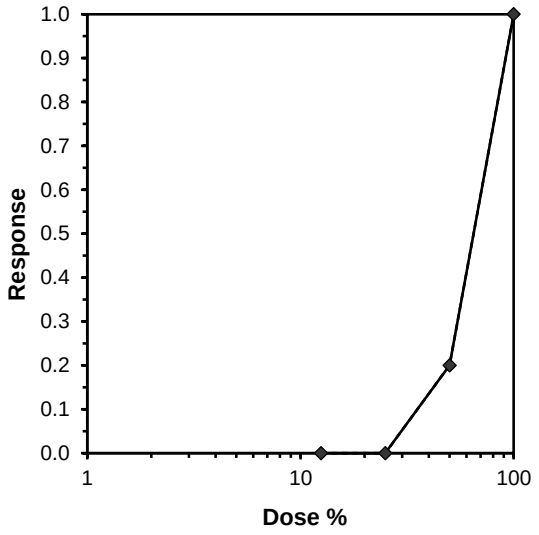
Conc-%	1	2	3	4
CONTROL	1.0000	1.0000	1.0000	1.0000
12.5	1.0000	1.0000	1.0000	1.0000
25	1.0000	1.0000	1.0000	1.0000
50	1.0000	1.0000	0.4000	0.8000
100	0.0000	0.0000	0.0000	0.0000

			Transform: Arcsin Square Root					Number	Total
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
CONTROL	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	0	20
12.5	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	0	20
25	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	0	20
50	0.8000	0.8000	1.1206	0.6847	1.3453	27.799	4	4	20
100	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 <= 0.01)	0.58396	0.844	-1.69451	7.18669
Equality of variance cannot be confirmed				

Trimmed Spearman-Karber

Trim Level	EC50	95% CL	
0.0%	61.557	54.379	69.683
5.0%	62.769	54.470	72.332
10.0%	63.797	53.654	75.858
20.0%	64.842	58.855	71.438
Auto-0.0%			



C. dubia daily biological measurements (EPA 2002.0) Template version ACD-TIE HLB SPE

TRTMNT (% Effl)	Rep	#Live Day 0	#Live Day 1	#Live Day 2	Final Mean % Live		
C	A	5	5	5	100.0		
	B	5	5	5			
Lab	C	5	5	5			
Control	D	5	5	5			
#1	A	5	5	5	100.0		
12.5	B	5	5	5			
% Effl	C	5	5	5			
	D	5	5	5			
# 2	A	5	5	4	95.0		
25	B	5	5	5			
% Effl	C	5	5	5			
	D	5	5	5			
# 3	A	5	5	2	75.0		
50.0	B	5	5	5			
% Effl	C	5	5	5			
	D	5	5	3			
# 4	A	5	5	0	5.0		
100	B	5	5	0			
% Effl	C	5	1	1		Test Duration:	48h 0m
	D	5	3	0			TAC 48+/-0.5h
INITIALS:		CPV	AK	LT	% CONTROL SURVIVAL:		100.0
DATE & TIME:		5/27/21 13:15	5/28/21 8:59	5/29/21 13:15			TAC = 90%
CHANGES & NOTES (INITIALS, DATE, SPECIFIC CHANGE MADE							

	SPECIES:	Ceriodaphnia dubia	
	ACCLIMATION WATER:	Mod. Hard Synthetic Freshwater	
Methanol A#	FEEDING PRIOR TO TEST:	YCT + Selenastrum capricornutum	
90	FEEDING DURING TEST:	None -YCT + Selenastrum 2+ h before test	
	SOURCE:	CBI Stock cultures	
SPE A#	ACCLIMATION TEMP (o C):	25	
OASIS HLB	BROOD RELEASE START DATE & TIME:	5/26/21 16:30	
	BROOD RELEASE END DATE & TIME:	5/27/21 9:00	
SPE CART VOL	DATE/TIME WATER ADDED:	5/27/21 13:04	
6ml	DATE/TIME ANIMALS ADDED:	5/27/21 13:15	
	ANIMAL AGE WINDOW:	16h 30m	
	MAX AGE AT TEST START:	20h 45m	TAC Max. 24 h
	TEST SET UP BY:	CPV	
	SAMPLE COLLECTION DATE &TIME:	4/29/21 23:59 SAMPLE USED	A
TEST ID:	SAMPLE AGE AT TEST START:	661h 16m TAC Max 36 h	
AWSL2101TIE2-SPE	PEER REVIEW BY (INITIALS/DATE):	PB	6/1/21 14:52

Ceriodaphnia daily water quality bench sheet (EPA METHOD 2002.0) Template version ACD-TIE HLB SPE

	TRTMNT	Day 0 Initial	Day 1	Day 2 Final	SUMMARY WATER QUALITY DATA MEAN	S.D.	MIN.	MAX.
pH (S.U.)	C	8.25	7.95	7.64	7.95	0.31	7.64	8.25
	1	8.19	8.02	7.70	7.97	0.25	7.70	8.19
	2	8.18	8.10	7.80	8.03	0.20	7.80	8.18
	3	8.18	8.25	7.96	8.13	0.15	7.96	8.25
	4	8.21	8.39	8.35	8.32	0.09	8.21	8.39
Temp. (o C)	C	25	25	25	25	0.0	25	25
	1	25	25	25	25	0.0	25	25
	2	25	25	25	25	0.0	25	25
	3	25	25	25	25	0.0	25	25
	4	25	25	25	25	0.0	25	25
Diss. Oxygen (mg/l)	C	8.2	7.8	8.0	8.0	0.2	7.8	8.2
	1	8.2	7.7	8.0	8.0	0.3	7.7	8.2
	2	8.2	7.8	8.1	8.0	0.2	7.8	8.2
	3	8.2	7.8	8.2	8.1	0.2	7.8	8.2
	4	8.2	7.8	8.2	8.1	0.2	7.8	8.2
Cond. (uS/cm)	C	282		286	284	2.8	282	286
	1	335			335		335	335
	2	400			400		400	400
	3	488			488		488	488
	4	788		838	813	35.4	788	838
Replicate measured		Flask	Surrogate	A				
Initials		CPV	AK	LT				
		TRC (mg/l) in highest conc. at end of test:		N/A				
Changes & Notes (Initials, date, specific change or notes)								

Test chamber:	30 ml plastic cup:	✓		
	Other:			
Test solution vol. (15 ml min):	15 ml:	✓		
	Other (ml):			
Illumination & photoperiod:	50-100 ft-c 16L:8D		Template Number:	5
Number of replicates/treatment:		4		
Initial number animals/replicate:		5		
	Test Aerated?	N/A	Date & Time Air Start:	N/A

TEST ID	TRT ID:	1	2	3	4
AWSL2101TIE2-SPE	CONC(%):	12.5	25	50.0	100

	HLB Solid Phase Extraction (SPE) Test
	NOTE: This procedure uses a Waters Oasis 500 mg HLB SPE which is a water wettable sorbant with a high affinity for more hydrophilic organic compounds.
	Because previous testing of this sample demonstrated no effect of filtration, it is not necessary to use filtered SFW and sample for this procedure.
1	Volumes based on 0.5x dilutions of 100, 50, 25 and 12.5%. Total effluent 200 ml, total SFW for blanks and dilutions 400 ml (4 reps @ 15 ml plus 25 ml water quality surrogate)
2	Attach silicone tubing (ca. 15”) to inlet side of G-R metering pump
3	Attach the outlet end of the tubing to the blue Luer-tubing adapter and then attach a small (4”) length of glass tubing to the intake (latch) end of the tubing.
4	Place the glass tubing in a small (e.g. 250 ml) flask.
5	Pump DI water (50 ml) through the system
6	Attach a 6 ml (500 mg) SPE tube to the Luer end of the adapter and position over an appropriate sized waste flask or beaker.
7	Add 12 ml of HPLC-grade methanol to the beaker and turn on pump. Pump should be set to provide a flow rate of 10 ml/min.
8	Allow the cartridge to fill with 1-2 ml of methanol before firmly attaching the adapter to the cartridge. Allow methanol to be pumped to waste. However, IF CONDUCTING THE SPE ELUATE TEST, COLLECT 3 ml OF METHANOL (Use clean scintillation vial) AFTER PASSAGE OF FIRST 5-6 ml. This will be used as the methanol blank in the eluate test. **Do not allow column to go dry.**
9	Add 50 ml deionized water just as the last of the methanol is pumped from the beaker. A small bubble in the line is O.K.; it will help you track the end of the methanol/beginning of the deionized water in the tube. However, the column must not go dry between the two.
10	DO NOT let column go dry after the addition of the deionized water (keep an eye on the column, a small volume of liquid should always lay on top of the column packing).
11	Add 450 ml of dilution water just as the last of the deionized water leaves the reservoir. A small bubble between the two in the pump tubing will enable you to tell when the dilution water is entering the column.
12	Collect 400 ml of dilution water after discarding the first 50 ml. This is tested as the SPE blank. DO NOT allow column to go dry.
13	Add 200 ml of sample just as the last of the dilution water is pumped from the reservoir. Collect the 200 ml eluate. THE COLUMN MAY GO DRY after the entire sample is collected.
14	The HLB SPE sample is tested with appropriate dilutions, using SPE blank as the diluent
15	IF CONDUCTING THE SPE ELUATE TEST: Pass 1.8 ml of methanol over column and collect into a clean scintillation vial. OTHERWISE: Retain the column for later chemical analysis if desired. Wrap in acetone/deionized water-rinsed foil and store at 4o C.
16	Record A# of methanol and SPE column, and size (g) of column, on biological page.

Acute Ceriodaphnia Test-48 Hr Survival

Start Date:		Test ID:	AWSL2101SP	Sample ID:	SPE OASIS HLB
End Date:		Lab ID:	CBI	Sample Type:	
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	CD-Ceriodaphnia dubia
Comments:	DATA ENTERED BY PB				

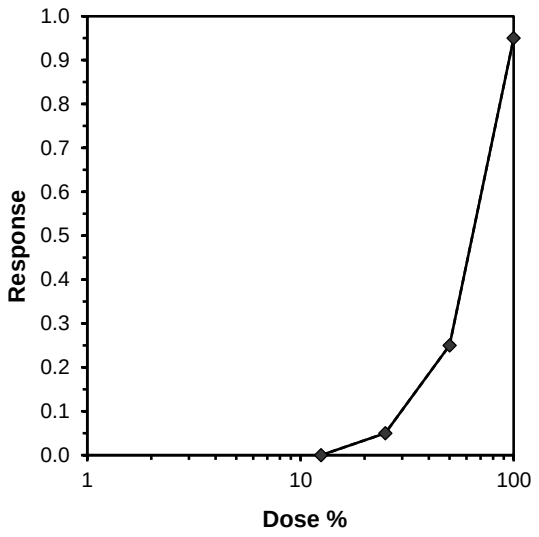
Conc-%	1	2	3	4
CONTROL	1.0000	1.0000	1.0000	1.0000
12.5	1.0000	1.0000	1.0000	1.0000
25	0.8000	1.0000	1.0000	1.0000
50	0.4000	1.0000	1.0000	0.6000
100	0.0000	0.0000	0.2000	0.0000

			Transform: Arcsin Square Root					Number	Total
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
CONTROL	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	0	20
12.5	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	0	20
25	0.9500	0.9500	1.2857	1.1071	1.3453	9.261	4	1	20
50	0.7500	0.7500	1.0653	0.6847	1.3453	31.308	4	5	20
100	0.0500	0.0500	0.2850	0.2255	0.4636	41.771	4	19	20

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.89598	0.868	-0.30424	1.87489
Equality of variance cannot be confirmed				

Trimmed Spearman-Karber

Trim Level	EC50	95% CL	
0.0%			
5.0%			
10.0%	61.853	51.768	73.903
20.0%	63.715	47.979	84.612
Auto-5.0%			



C. dubia daily biological measurements (EPA 2002.0) Template version ACD-TIE BASELINE

TRTMNT (% Effl)	Rep	#Live Day 0	#Live Day 1	#Live Day 2	Final Mean % Live		
UVC	A	5	5	5	100.0		
	B	5	5	5			
Lab	C	5	5	5			
Control	D	5	5	5			
#1	A	5	5	5	100.0		
12.5	B	5	5	5			
% Effl	C	5	5	5			
	D	5	5	5			
# 2	A	5	5	5	100.0		
25	B	5	5	5			
% Effl	C	5	5	5			
	D	5	5	5			
# 3	A	5	5	4	40.0		
50.0	B	5	5	2			
% Effl	C	5	5	1			
	D	5	5	1			
# 4	A	5	0	0	5.0		
100	B	5	1	0			
% Effl	C	5	1	1		Test Duration:	48h 11m
	D	5	5	0			TAC 48+/-0.5h
INITIALS:		CPV	AK	LT	% CONTROL SURVIVAL:		100.0
DATE & TIME:		5/27/21 13:07	5/28/21 9:02	5/29/21 13:17			TAC = 90%
CHANGES & NOTES (INITIALS, DATE, SPECIFIC CHANGE MADE		SAMPLE AND CONTROL WATER UV TREATED AT 8 WATTS/20 min/liter					

	SPECIES:	Ceriodaphnia dubia	
	ACCLIMATION WATER:	Mod. Hard Synthetic Freshwater	
	FEEDING PRIOR TO TEST:	YCT + Selenastrum capricornutum	
	FEEDING DURING TEST:	None -YCT + Selenastrum 2+ h before test	
	SOURCE:	CBI Stock cultures	
	ACCLIMATION TEMP (o C):	25	
	BROOD RELEASE START DATE & TIME:	5/26/21 16:30	
	BROOD RELEASE END DATE & TIME:	5/27/21 9:00	
	DATE/TIME WATER ADDED:	5/27/21 13:07	
	DATE/TIME ANIMALS ADDED:	5/27/21 13:07	
	ANIMAL AGE WINDOW:	16h 30m	
	MAX AGE AT TEST START:	20h 37m	TAC Max. 24 h
	TEST SET UP BY:	CPV	
	SAMPLE COLLECTION DATE &TIME:	4/29/21 23:59	SAMPLE USED A
TEST ID:	SAMPLE AGE AT TEST START:	661h 8m	TAC Max 36 h
AWSL2101TIE2-UV	PEER REVIEW BY (INITIALS/DATE):	PB	6/1/21 14:53

Ceriodaphnia daily water quality bench sheet (EPA METHOD 2002.0) Template version ACD-TIE BASELINE

	TRTMNT	Day 0 Initial	Day 1	Day 2 Final	SUMMARY WATER QUALITY DATA MEAN	S.D.	MIN.	MAX.
pH (S.U.)	C	8.26	7.90	7.85	8.00	0.22	7.85	8.26
	1	8.22	7.94	7.87	8.01	0.19	7.87	8.22
	2	8.23	8.02	7.92	8.06	0.16	7.92	8.23
	3	8.25	8.15	8.15	8.18	0.06	8.15	8.25
	4	8.31	8.45	8.33	8.36	0.08	8.31	8.45
Temp. (o C)	C	25	25	25	25	0.0	25	25
	1	25	25	25	25	0.0	25	25
	2	25	25	25	25	0.0	25	25
	3	25	25	25	25	0.0	25	25
	4	25	25	25	25	0.0	25	25
Diss. Oxygen (mg/l)	C	8.2	8.0	8.0	8.1	0.1	8.0	8.2
	1	8.2	8.0	8.0	8.1	0.1	8.0	8.2
	2	8.2	8.0	8.0	8.1	0.1	8.0	8.2
	3	8.2	7.9	8.1	8.1	0.2	7.9	8.2
	4	8.2	7.9	8.2	8.1	0.2	7.9	8.2
Cond. (uS/cm)	C	320		339	330	13.4	320	339
	1	324			324		324	324
	2	388			388		388	388
	3	447			447		447	447
	4	769		751	760	12.7	751	769
Replicate measured		Flask	Surrogate	D				
Initials		CPV	AK	LT				
		TRC (mg/l) in highest conc. at end of test:		N/A				
Changes & Notes (Initials, date, specific change or notes)								

Test chamber:	30 ml plastic cup:	✓		
	Other:			
Test solution vol. (15 ml min):	15 ml:	✓		
	Other (ml):			
Illumination & photoperiod:	50-100 ft-c 16L:8D		Template Number:	16
Number of replicates/treatment:		4		
Initial number animals/replicate:		5		
	Test Aerated?	N/A	Date & Time Air Start:	N/A

TEST ID	TRT ID:	1	2	3	4
AWSL2101TIE2-UV	CONC(%):	12.5	25	50.0	100

Acute Ceriodaphnia Test-48 Hr Survival

Start Date:		Test ID:	AWSL2101UV	Sample ID:	UV IRRADIATED SAMPLE
End Date:		Lab ID:	CBI	Sample Type:	
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	CD-Ceriodaphnia dubia
Comments:	DATA ENTERED BY PB				

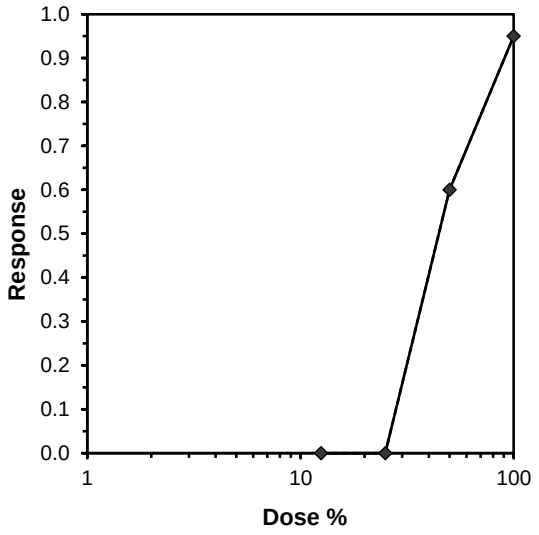
Conc-%	1	2	3	4
UV CONT	1.0000	1.0000	1.0000	1.0000
12.5	1.0000	1.0000	1.0000	1.0000
25	1.0000	1.0000	1.0000	1.0000
50	0.8000	0.4000	0.2000	0.2000
100	0.0000	0.0000	0.2000	0.0000

			Transform: Arcsin Square Root					Number	Total
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
UV CONT	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	0	20
12.5	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	0	20
25	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	0	20
50	0.4000	0.4000	0.6798	0.4636	1.1071	44.627	4	12	20
100	0.0500	0.0500	0.2850	0.2255	0.4636	41.771	4	19	20

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.69438	0.868	1.69432	6.42126
Equality of variance cannot be confirmed				

Trimmed Spearman-Karber

Trim Level	EC50	95% CL	
0.0%			
5.0%			
10.0%	46.661	38.470	56.597
20.0%	45.787	35.852	58.476
Auto-5.0%			



C. dubia daily biological measurements (EPA 2002.0) Template version ACD-TIE BASELINE

TRTMNT (% Effl)	Rep	#Live Day 0	#Live Day 1	#Live Day 2	Final Mean % Live		
C	A	5	5	5	100.0		
	B	5	5	5			
Lab	C	5	5	5			
Control	D	5	5	5			
#1	A	5	5	5	100.0		
12.5	B	5	5	5			
% Effl	C	5	5	5			
	D	5	5	5			
# 2	A	5	5	5	100.0		
25	B	5	5	5			
% Effl	C	5	5	5			
	D	5	5	5			
# 3	A	5	5	5	100.0		
50.0	B	5	5	5			
% Effl	C	5	5	5			
	D	5	5	5			
# 4	A	5	5	5	100.0		
100	B	5	5	5			
% Effl	C	5	5	5		Test Duration:	48h 6m
	D	5	5	5			TAC 48+/-0.5h
INITIALS:		CPV	AK	LT	% CONTROL SURVIVAL:		100.0
DATE & TIME:		5/27/21 13:07	5/28/21 8:54	5/29/21 13:13			TAC = 90%
CHANGES & NOTES (INITIALS, DATE, SPECIFIC CHANGE MADE		Mock sample made up using DI water and ACS reagent grade salts. See separate spreadsheet for formulation.Mock NH3 <1.0					

	SPECIES:	Ceriodaphnia dubia	
	ACCLIMATION WATER:	Mod. Hard Synthetic Freshwater	
	FEEDING PRIOR TO TEST:	YCT + Selenastrum capricornutum	
	FEEDING DURING TEST:	None -YCT + Selenastrum 2+ h before test	
	SOURCE:	CBI Stock cultures	
	ACCLIMATION TEMP (o C):	25	
	BROOD RELEASE START DATE & TIME:	5/26/21 16:30	
	BROOD RELEASE END DATE & TIME:	5/27/21 9:00	
	DATE/TIME WATER ADDED:	5/27/21 12:58	
	DATE/TIME ANIMALS ADDED:	5/27/21 13:07	
	ANIMAL AGE WINDOW:	16h 30m	
	MAX AGE AT TEST START:	20h 38m	TAC Max. 24 h
	TEST SET UP BY:	CPV	
	SAMPLE COLLECTION DATE &TIME:	Mock Sample / SAMPLE USED	A
TEST ID:	SAMPLE AGE AT TEST START:	NA / TAC Max 36 h	
AWSL2101TIE2-MOCK	PEER REVIEW BY (INITIALS/DATE):	PB	6/1/21 14:47

Ceriodaphnia daily water quality bench sheet (EPA METHOD 2002.0) Template version ACD-TIE BASELINE

	TRTMNT	Day 0 Initial	Day 1	Day 2 Final	SUMMARY WATER QUALITY DATA MEAN	S.D.	MIN.	MAX.
pH (S.U.)	C	8.33	7.98	7.83	8.05	0.26	7.83	8.33
	1	8.20	7.88	7.82	7.97	0.20	7.82	8.20
	2	8.09	7.83	7.82	7.91	0.15	7.82	8.09
	3	8.05	7.81	7.81	7.89	0.14	7.81	8.05
	4	7.98	7.77	7.78	7.84	0.12	7.77	7.98
Temp. (o C)	C	25	25	25	25	0.0	25	25
	1	25	25	25	25	0.0	25	25
	2	25	25	25	25	0.0	25	25
	3	25	25	25	25	0.0	25	25
	4	25	25	25	25	0.0	25	25
Diss. Oxygen (mg/l)	C	8.2	7.9	8.0	8.0	0.2	7.9	8.2
	1	8.2	7.8	8.0	8.0	0.2	7.8	8.2
	2	8.2	7.7	8.1	8.0	0.3	7.7	8.2
	3	8.2	7.5	8.2	8.0	0.4	7.5	8.2
	4	8.2	7.7	8.3	8.1	0.3	7.7	8.3
Cond. (uS/cm)	C	288		294	291	4.2	288	294
	1	295			295		295	295
	2	295			295		295	295
	3	329			329		329	329
	4	389		369	379	14.1	369	389
Replicate measured		Flask	Surrogate	C				
Initials		CPV	AK	LT				
		TRC (mg/l) in highest conc. at end of test:		N/A				
Changes & Notes (Initials, date, specific change or notes)								

Test chamber:	30 ml plastic cup:	✓		
	Other:			
Test solution vol. (15 ml min):	15 ml:	✓		
	Other (ml):			
Illumination & photoperiod:	50-100 ft-c 16L:8D		Template Number:	2
Number of replicates/treatment:		4		
Initial number animals/replicate:		5		
	Test Aerated?	N/A	Date & Time Air Start:	N/A

TEST ID	TRT ID:	1	2	3	4
AWSL2101TIE2-MOCK	CONC(%):	12.5	25	50.0	100

				Ca	Mg	Na	K	HCO3	SO4	Cl	
			At. Wt:	40.08	24.305	22.99	39.1	61.02	96.06	35.45	
MOCK SOLUTION PREPARA		**mg/L for 10L**									
mg/l	**Salt added**		**Form. Wt.**								
49.8	KCl	498	74.6				26.0952			23.66496	
0	NaCl	0	58.44			0				0	
66.1	NaHCO3	661	84.01			18.09157		48.00843			
42.8	MgSO4	428	120.37		8.64132				34.15868		
0	Na2SO4-10H2O	0	322			0			0		
0	MgCl2-6H2O	0	203.31		0					0	
	CaCl2-2H2O	0	147	0						0	
104.4	CaSO4-2H2O	1044	172.17	24.30432					58.24476		Total TDS
Soln TDS Conc. (mg/l):				**24.3**	**8.6**	**18.1**	**26.1**	**48.0**	**92.4**	**23.7**	241.2
Component:				**Ca**	**Mg**	**Na**	**K**	**HCO3**	**SO4**	**Cl**	
Target Value (mg/l):				24.3	8.64	118	26.1	48	90.1	16.7	331.8
Target value mM basis:				0.606287	0.355482	5.1326664	0.667519	0.786627	0.9379554	0.471086	
% Difference Target vs. Soln:				0.017778	0.015278	-84.668161	-0.018391	0.017562	2.5565372	41.706347	

Effluent and Dilution Water Log (Freshwater Tests). FWEFFL061013

											SUMMARY WATER QUALITY DATA				
Initial sample charac-terization	Bottle(1):	A1									MEAN	S.D.	MIN.	MAX.	PARAMETER
	Arrival Temp. (oC, from CoC):	1									1		1	1	Arrival Temp.
	TRC (mg/l)(2):	<DL													
	TRC Corrected(2):														
	Hardness (mg/l):	130									130		130	130	Hardness (mg/l)
	Alkalinity (mg/l):	259									259		259	259	Alkalinity (mg/l)
	NH3-N (mg/l):	<1.0													
	Color/Appearance(3):	C													
	Obvious odor?	NO													
	Date & Time:	4/29/21 16:21													
	Initials:	AK													
Sample prep measure-ments	Test Day:	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7		MEAN	S.D.	MIN.	MAX.	
	Bottle(s):	A1													
	Prep. Temp. (oC):	25									25		25	25	Temp. (oC)
	D.O. (mg/l) After Warming:	9.5													
	Aeration Time (min):	3													
	Adjusted D.O. (mg/l):	8.2									8.2		8.2	8.2	D.O. (mg/l)
	Final pH (S.U.):	8.11									8.11		8.11	8.11	pH (S.U.)
	Conductivity (uS/cm)(4):	790									790		790	790	Cond. (uS/cm)
	Final TRC (mg/l)(5):	N.D.													
	Sample Filtered (60 um)?														
	Date & Time:	5/27/21 10:58													
	Initials:	CPV													
Dilution water	Test Day:	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7		MEAN	S.D.	MIN.	MAX.	
	Vat Number:	2													
	Temperature (oC):	25									25		25	25	Temp. (oC)
	Conductivity (uS/cm):	294									294		294	294	Cond. (uS/cm)
	D.O. (mg/l):	8.2									8.2		8.2	8.2	D.O. (mg/l)
	pH (S.U.):	7.71									7.71		7.71	7.71	pH (S.U.)
	Hardness (mg/l):	96									96		96	96	Hardness (mg/l)
	Alkalinity (mg/l):	59									59		59	59	Alkalinity (mg/l)
	Date & Time:	5/27/21 7:00													
	Initials:	LT													
	Changes & Notes (Initials, date, specific change or notes)														
	Peer review Initial/Date:	PB	6/1/21 14:21	DILUTION WATER TYPE:	Mod. Hard Synthetic Freshwater (EPA)	ND=Not Determined/Measured, NA=Not Applicable. 1) Ninth character of lab sample ID on chain of custody AND bottle number in collection series. Together with Project ID constitutes entire sample bottle ID. 2) TRC MDL 0.02 mg/l; QL 0.22 mg/l. Corrected value if Mn, Cr potential positive interference. Corrected using KI and NaAsO2. 3) C-clear, O-opaque, T-turbid, S-solids (Sl-slight, M-moderate, H-heavy), Y-yellow, B-brown, Bl-black, G-green, P-pink, Gr-grey, Or-orange. 4) Measured on first use of sample only. 5) Final TRC measured only if chlorine present in initial characterization.												
PROJECT ID:	AWSL2101 TIE2	ADDITIONAL EFFLUENT TREATMENT:													

ENTHALPY ANALYTICAL

COASTAL BIOANALYSTS

1941 REYMET ROAD
RICHMOND, VIRGINIA 23237
(804) 358-8295 PHONE
(804)358-8297 FAX

Chain of Custody
Effective: Mar 10, 2021

AWSL2101-A 21-0601 CHAIN OF CUSTODY Q2-ACD PAGE 1 OF

COMPANY NAME: AIR WATER AND SOIL	INVOICE TO: AIR WATER AND SOIL	PROJECT NAME/Quote #: 21D1297
CONTACT: KATRINA COOKE	INVOICE CONTACT: KATHARINE CLARK	SITE NAME: 21D1297
ADDRESS: 1941 REYMET ROAD RICHMOND, VA 23237	INVOICE ADDRESS:	PROJECT NUMBER: 21D1297
PHONE #: 804.358.8295	INVOICE PHONE #:	P.O. #: PO-008557
FAX #: 804.358.8297	EMAIL: support@awslabs.com	Pretreatment Program:

Is sample for compliance reporting? YES NO | Regulatory State: VA | Is sample from a chlorinated supply? YES NO | PWS I.D. #: 15-21

SAMPLER NAME (PRINT): DENISE VAUGHN | SAMPLER SIGNATURE: | Turn Around Time: Circle 10 5 Days or _Day(s)

Matrix Codes: WW=Waste Water/Storm Water GW=Ground Water DW=Drinking Water S=Soil/Solids OR=Organic A=Air WP=Wipe OT=Other_____

CLIENT SAMPLE I.D.	Grab	Composite	Field Filtered (Dissolved Metals)	Composite Start Date	Composite Start Time	Grab Date or Composite Stop Date	Grab Time or Composite Stop Time	Time Preserved 4.30.21	Matrix (See Codes)	Number of Containers	ANALYSIS / (PRESERVATIVE): ACUTE TOX - CERIODAPHNIA DUBIA AND PIMEPHALES							COMMENTS: Preservative Codes: N=Nitric Acid C=Hydrochloric Acid S=Sulfuric Acid H=Sodium Hydroxide A=Ascorbic Acid Z=Zinc Acetate T=Sodium Thiosulfate M=Methanol; PLEASE NOTE PRESERVATIVE(S), INTERFERENCE CHECKS or PUMP RATE (L/min)
1) 21D1297-01 029		X		29 Apr'21	00:00	29 Apr'21	23:59	9.15	WW	2	X							
2)																		
3)																		
4)																		
5)																		
6)																		
7)																		
8)																		
9)																		
10)																		

RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME
[signature]	4-30-21 14:27	K Kurkowski	4/30/21 1227
RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME
		A Krueger	4/30/21 1615
RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME

QC Data Package
Level III ☐
Level IV ☐

LAB USE ONLY Therm ID: _____ COOLER TEMP _____°C
Custody Seals used and intact? (Y / N) Received on ice? (Y / N)

TV: AK 1°C

Unless otherwise agreed in writing, any and all products and/or services provided by Enthalpy are pursuant to the terms and conditions as set forth at https://enthalpy.com/terms-and-conditions/

EA COC_v210310.xls

ENTHALPY ANALYTICAL
formerly Air, Water & Soil Laboratories

1941 Reymet Road ● Richmond, Virginia 23237 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Laboratory Order ID 21E0308

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford, VA 24141	Date Received:	May 7, 2021 14:27
		Date Issued:	May 14, 2021 9:19
		Project Number:	[none]
Submitted To:	Sheree Andrews	Purchase Order:	RFAC-032621-01-RLL
Client Site I.D.:	029 2nd Quarter Toxicity		

Enclosed are the results of analyses for samples received by the laboratory on 05/07/2021 14:27. If you have any questions concerning this report, please feel free to contact the laboratory.

Sincerely,

Ted Soyars

Ted Soyars
Technical Director

End Notes:

The test results listed in this report relate only to the samples submitted to the laboratory and as received by the Laboratory.

Unless otherwise noted, the test results for solid materials are calculated on a wet weight basis. Analyses for pH, dissolved oxygen, temperature, residual chlorine and sulfite that are performed in the laboratory do not meet NELAC requirements due to extremely short holding times. These analyses should be performed in the field. The results of field analyses performed by the Sampler included in the Certificate of Analysis are done so at the client's request and are not included in the laboratory's fields of certification nor have they been audited for adherence to a reference method or procedure.

The signature on the final report certifies that these results conform to all applicable NELAC standards unless otherwise specified. For a complete list of the Laboratory's NELAC certified parameters please contact customer service.

This report shall not be reproduced except in full without the expressed and written approval of an authorized representative of Air Water & Soil Laboratories, Inc.

NELAP ACCREDITED TNI LABORATORY

ENTHALPY ANALYTICAL
formerly Air, Water & Soil Laboratories

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued:	May 14, 2021 9:19
		Project Number:	[none]
		Purchase Order:	RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	029 2nd Quarter Toxicity		

ANALYTICAL REPORT FOR SAMPLES

Laboratory Order ID 21E0308

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
029 Tox	21E0308-01	Waste Water	04/29/2021 00:00 to 04/29/2021 23:59	05/07/2021 14:27

Analysis for TIE Wet Acute Toxicity was subcontracted to Coastal Bioanalyst. The subcontracted results are attached at the end of this Certificate of Analysis.

This Certificate of Analysis is being reissued on May 14, 2021 to include the final TIE results from Coastal Bioanalyst.

ENTHALPY ANALYTICAL
formerly Air, Water & Soil Laboratories

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued:	May 14, 2021 9:19
		Project Number:	[none]
		Purchase Order:	RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	029 2nd Quarter Toxicity		

Laboratory Order ID: 21E0308

Analytical Results

Sample I.D. 029 Tox **Laboratory Sample ID:** 21E0308-01

Composite Start-End Date/Time: 04/29/2021 00:00 - 04/29/2021 23:59

Field Residual Cl: **Field pH:**

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Subcontracted Analysis									
Acute Toxicity CD	01	EPA	Attached		--	1	05/11/21 16:14	05/11/21 16:14	N/A

Analytical Summary

Sample ID	Preparation Factors Initial / Final	Method	Batch ID	Sequence ID	Calibration ID
Subcontracted Analysis		**Preparation Method:**	***** DEFAULT PREP *****		
21E0308-01	1.00 mL / 1.00 mL	EPA	BEE0342		

ENTHALPY ANALYTICAL
formerly Air, Water & Soil Laboratories

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued:	May 14, 2021 9:19
		Project Number:	[none]
		Purchase Order:	RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	029 2nd Quarter Toxicity		

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual

ENTHALPY ANALYTICAL
formerly Air, Water & Soil Laboratories

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued:	May 14, 2021 9:19
		Project Number:	[none]
		Purchase Order:	RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	029 2nd Quarter Toxicity		

Certified Analyses included in this Report

Analyte **Certifications**

Code	Description	Laboratory ID	Expires
MdDOE	Maryland DE Drinking Water	341	12/31/2021
NC	North Carolina DENR	495	12/31/2021
NCDEQ	North Carolina DEQ	495	12/31/2021
NCDOH	North Carolina Department of Health	51714	07/31/2021
NHDES	NELAP-New Hampshire Certificate #224221	2242	02/25/2022
NJDEP	NELAP-New Jersey DEP	VA015	06/30/2021
NYDOH	New York DOH Drinking Water	12096	04/01/2022
PADEP	NELAP-Pennsylvania Certificate #006	68-03503	10/31/2021
VELAP	NELAP-Virginia Certificate #11064	460021	06/14/2021
WVDEP	West Virginia DEP	350	06/30/2021

ENTHALPY ANALYTICAL
formerly Air, Water & Soil Laboratories

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued:	May 14, 2021 9:19
		Project Number:	[none]
		Purchase Order:	RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	029 2nd Quarter Toxicity		

Summary of Data Qualifiers

Attached	Attached
RPD	Relative Percent Difference
Qual	Qualifers
-RE	Denotes sample was re-analyzed
D.F.	Dilution Factor. Please also see the Preparation Factor in the Analysis Summary section.
TIC	Tentatively Identified Compounds are compounds that are identified by comparing the analyte mass spectral pattern with the NIST spectral library. A TIC spectral match is reported when the pattern is at least 75% consistent with the published pattern. Compound concentrations are estimated and are calculated using an internal standard response factor of 1.
PCBs, Total	Total PCBs are defined as the sum of detected Aroclors 1016, 1221, 1232, 1248, 1254, 1260, 1262, and 1268.

ENTHALPY ANALYTICAL
formerly *Air, Water & Soil Laboratories*

1941 REYMET ROAD
RICHMOND, VIRGINIA 23237
(804) 358-8295 PHONE
(804)358-8297 FAX

Chain of Custody
Effective: Nov 15, 2018

CHAIN OF CUSTODY

COMPANY NAME: BAE Systems, Inc. - RFAAP	INVOICE TO: Accounts Payable	PROJECT NAME: 029 2nd Quarter Toxicity
CONTACT: Sheree Andrews	INVOICE CONTACT:	SITE NAME:
ADDRESS: Route 114 Radford, Va 24141	INVOICE ADDRESS:	PROJECT NUMBER:
PHONE #: 1-540-717-4092	INVOICE PHONE #:	P.O. #:
FAX #: EMAIL: Sheree.andrews@baesystems.com		Pretreatment Program:
Is sample for compliance reporting? YES	Regulatory State: Va / Is sample from a chlorinated supply? YES NO	PWS I.D. #:
SAMPLER NAME (PRINT): Denise Vaughn	SAMPLER SIGNATURE: Denise Vaughn	Turn Around Time: Circle 10 5 Days or _Day(s)

Matrix Codes: WW=Waste Water/Storm Water GW=Ground Water DW=Drinking Water S=Soil/Solids OR=Organic A=Air WP=Wipe OT=Other_____

CLIENT SAMPLE I.D.	Grab	Composite	Field Filtered (Dissolved Metals)	Composite Start Date	Composite Start Time	Grab Date or Composite Stop Date	Grab Time or Composite Stop Time	Time Preserved 4.30.21	Matrix (See Codes)	Number of Containers	ANALYSIS / (PRESERVATIVE): Acute Toxicity - Ceriodaphnia dubia								COMMENTS: Preservative Codes: N=Nitric Acid C=Hydrochloric Acid S=Sulfuric Acid H=Sodium Hydroxide A=Ascorbic Acid Z=Zinc Acetate T=Sodium Thiosulfate M=Methanol; PLEASE NOTE PRESERVATIVE(S), INTERFERENCE CHECKS or PUMP RATE (L/min)
1) 029 Tox		X		4.29.21	0000	4.29.21	2359	0915	WW	2	X								
2)																			
3)																			
4)																			
5)																			
6)																			
7)																			
8)																			
9)																			
10)																			

BAE Systems, Inc. 21E0308
Toxicity
Recd: 04/30/2021 Due: 05/14/2021
v130325002

RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME
Denise Vaughn	4.30.21 / 0941	[signature]	4/30/21 0941
[signature]	4/30/21 1331	[signature]	

QC Data Package
Level III ☐
Level IV ☐

LAB USE ONLY Therm ID: 271 COOLER TEMP 0.8 °C
Custody Seals used and intact? (Y / N) Received on ice? (Y / N)

BAE Systems, Inc. 21D1297
Toxicity
Recd: 04/30/2021 Due: 05/07/2021
v130325002 Toxicity 04.29.21

ENTHALPY ANALYTICAL
formerly Air, Water & Soil Laboratories

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued:	May 14, 2021 9:19
		Project Number:	[none]
		Purchase Order:	RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	029 2nd Quarter Toxicity		

Sample Conditions Checklist

Samples Received at:	**0.80°C**
How were samples received?	AWS Courier
Were Custody Seals used? If so, were they received intact?	No
Are the custody papers filled out completely and correctly?	Yes
Do all bottle labels agree with custody papers?	Yes
Is the temperature blank or representative sample within acceptable limits or received on ice, and recently taken?	Yes
Are all samples within holding time for requested laboratory tests?	Yes
Is a sufficient amount of sample provided to perform the tests included?	Yes
Are all samples in appropriate containers for the analyses requested?	Yes
Were volatile organic containers received?	No
Are all volatile organic and TOX containers free of headspace?	NA
Is a trip blank provided for each VOC sample set? VOC sample sets include EPA8011, EPA504, EPA8260, EPA624, EPA8015 GRO, EPA8021, EPA524, and RSK-175.	NA
Are all samples received appropriately preserved? Note that metals containers do not require field preservation but lab preservation may delay analysis.	Yes

Work Order Comments

Per Sheree Andrews via email, relog 21D1297-01 for Acute Wet TIE on a 5 day TAT.
KLC 5-7-2021

Coastal Bioanalysts, Inc.

Report of Analysis: Whole Effluent Toxicity (WET): Phase I Toxicity Identification Evaluation Tests

Submitted To:	**Prepared By:**
Katrina Cooke Senior Project Manager Enthalpy Analytical/Air, Water and Soil Laboratories 1941 Reymet Road Richmond, VA 23237	Coastal Bioanalysts, Inc. 6400 Enterprise Court Gloucester, VA 23061 (804) 694-8285 www.coastalbio.com Contact: Peter F. De Lisle, Technical Director

METHODS

TIE test methods followed the EPA Phase I acute TIE protocols (*Methods for Aquatic Toxicity Identification Evaluations: Phase I Toxicity Characterization Procedures, 2nd ed.* February 1991. EPA/600/6-91/003). Additional detailed information, including summary procedures, is provided in the attached bench sheets.

RESULTS

Test	Test Date	LC50 (% sample)	95% C.L.
Initial	5/1/21	21.5	17.0-25.8
Baseline	5/7/21	9.38	2.23-13.9
Filtration	5/7/21	10.9	4.43-14.5
SPE	5/7/21	7.47	0.46-12.4
Reduced pH (~7)	5/7/21	16.0	11.7-19.8
HDPE Cubitainer (Baseline 2)	5/10/21	13.3	9.01-16.4
Glass	5/10/21	14.0	11.4-17.3
PVC	5/10/21	13.9	9.32-20.6

Sample toxicity increased slightly, as indicated by non-overlapping 95% confidence limits of corresponding initial and baseline LC50 values, during the one week storage between the initial test and Phase I acute tests. While a slight increase in LC50 value (i.e. decrease in toxicity) was seen in the reduced pH test, the difference from the baseline value was not significantly different. Three days of additional storage in glass or PVC containers did not change toxicity compared to that of sample stored in the original LDPE container.

DISCUSSION

The TIE procedures used in this study were selected based on:

1. Suspicion that nitroglycerin (NG) may be present in trace amounts. Nitroglycerin is toxic to *Ceriodaphnia dubia* (LC50 = 17.83 mg/l; Burton *et al.* 1993).
2. The results of previous TIE testing and chemical analyses (1/27/21) by Pace Laboratories indicating lack of toxicity reduction by EDTA (eliminating divalent cationic metal toxicity, e.g. Cu, Cd, Ni, Hg, Pb), thiosulfate (eliminating toxicity by many oxidants and some metals) and filtration plus SPE (potentially eliminating filterable toxicants and/or organics).

Because SPE column preparation was not described in the Pace study, the SPE and filtration procedures were repeated. Also, NG is rapidly adsorbed (~50%/3 min) from aqueous solutions by PVC, but not glass (Sokoloski *et al.* 1980; Yuen *et al.* 1979) and so tests of toxicity loss during extended storage in glass and PVC containers (compared to the original LDPE container) were performed. Additionally, relatively high concentrations of

VELAP# 460030
EPA# VA01116

aluminum were detected in the 1/27 Pace study sample, although based on the sample pH and hardness toxicity would be predicted to be low. Because EDTA will not reduce aluminum toxicity (Hockett and Mount, 1996), a test at reduced pH was conducted to evaluate aluminum as a possible toxicant.

In the test where pH of test solutions was reduced by approximately 1.2 SU (in 100% sample) through control of overlying atmospheric CO_2 (i.e. no acids added), toxicity decreased slightly (but not statically significant). Because toxicity of aluminum would increase at reduced pH (e.g. Gensemera *et al.* 2018), toxicity due to aluminum is unlikely.

Toxicity by NG does not appear to be likely based on the lack of toxicity reduction following storage in a PVC bottle and lack of toxicity reduction by C18 SPE. However, this may not rule out NG degradation products. Martel and coworkers (2010) found adsorption of NG by C18 SPE from neutral and acidic aqueous solutions to be highly efficient (100%). However, poor adsorption (<10%) of NG degradation products 1-mononitroglycerin and 2-mononitroglycerin was observed. For the degradation products of 1,2-dinitroglycerin and 1,3-dinitroglycerin only moderate adsorption (40-50%) occurred. These authors note that the more water-soluble degradation products may in fact be more toxic, based on cited studies using the Ames test. A literature search for degradation product aquatic toxicity data was not performed.

The following Phase I TIE tests were not conducted but may possibly shed light on potential sources of toxicity: filtration and SPE at reduced and elevated pH, aeration at neutral, reduced and elevated pH, and pH adjustment tests (elevated and reduced adjusted back to ambient). Also, two common sources of toxicity that the procedures do not address are biological interference (e.g. from filamentous algae, bacteria, etc.) and TDS/ion-imbalance toxicity. These two potential sources are typically evaluated by testing sanitized (e.g. sample treatment with UV irradiation or chlorination/dechlorination) or a mock ion solution respectively. Toxicity of NG degradation products could be evaluated using a SPE column more selective for these compounds (e.g. Waters Oasis HLB as identified in the Martel and coworkers study).

Literature Cited

Burton, D.T., S.D Turley, and G.T. Peters. 1993. Toxicity of Nitroguanidine, Nitroglycerin, Hexahydro-1,3,5-trinitro-1,3,5 triazine (RDX), and 2,4,6-trinitrotoluene (TNT) to Selected Freshwater Aquatic Organisms. Final Report to U.S. Army Medical Research and Development Command, Fort Detrik, MD. 261 pp.

Gensemera, R.W, J.C. Gondek, P.H. Rodriguez, J.J. Arbildua, W.A. Stubblefield, A.S. Cardwell, R.C. Santore, A.C. Ryan, W.J. Adams, and E. Nordheim. 2018 Evaluating the Effects Of pH, Hardness, and Dissolved Organic Carbon on the Toxicity of Aluminum to Freshwater Aquatic Organisms Under Circumneutral Conditions. Env. Toxicol. Chem.37:49–60.

Hockett, J.R., and D.R. Mount. 1996. Use of Metal Chelating Agents to Differentiate Among Sources of Acute Aquatic Toxicity. Env. Toxicol. Chem. 15:1687-1693.

Martel, R., A. Bellavance-Godin, R. Le´vesque, and S. Cote´. 2010. Determination of Nitroglycerin and Its Degradation Products by Solid-Phase Extraction and LC–UV. Chromatographia 71: 285–289

Sokoloski, T-D., C-C Wu, and A.M. Burkman. 1980. Rapid adsorptive loss of Nitroglycerin from Aqueous Solution to Plastic. Int. J. Pharm. 6:63-67.

Yuen, P-H, S.L. Denman, T.D. Sokoloski, and A.M. Burkman. 1979. Loss of Nitroglyerin from Aqueous Solution into Plastic Intravenous Systems, J. Pharm. Sci. 68: 1163-1166.

Coastal Bioanalysts, Inc.

QA/QC

Acute Test QA/QC	Reference Toxicant: KCl	Units: mg/l	Test Organism Source: CBI Stock Cultures		
Species-Method (Ref. Test Date)	**Data Source**	**% Control Survival**	**48-h LC50**	**95% C.L./A.L. For LC50**	**RTT in Control?**
C. dubia 2002.0	RTT	100	479	438-524	Yes
(5/3/21-5/5/21)	CC	100	535	468-601	

Note: RTT = Reference Toxicant Test, CC = Control Chart.

The results of analysis contained within this report relate only to the sample as received in the laboratory. This report shall not be reproduced except in full without written approval from the laboratory. Unless noted below, these test results meet all requirements of NELAP.

APPROVED: Peter F. De Lisle

Digitally signed by Peter F. De Lisle
DN: cn=Peter F. De Lisle, o=Coastal Bioanalysts, Inc., ou=Toxicology, email=pfd@coastalbio.com, c=US
Date: 2021.05.13 11:48:15 -04'00'

Peter F. De Lisle, Ph.D.
Technical Director

Deviations from, additions to, or exclusions from the test method, non-standard conditions or data qualifiers and, as appropriate, a statement of compliance/non-compliance: **NONE**

Please leave feedback regarding our services at: http://coastalbio.com/survey

GLOSSARY OF TERMS AND ABBREVIATIONS

A.L. (Acceptance Limits): The results of a given reference toxicant test are compared to the control chart mean value ± 2 standard deviations. These limits approximate the 95% probability limits for the "true" reference toxicant value.

Chronic Value (ChrV): The geometric mean of the NOEC and LOEC. Units are same as test concentration units.

C.L. (Confidence Limits): These are the probability limits, based on the data set and statistical model employed, that the "true value" lies within the limits specified. Typically limits are based on 95% or 99% probabilities.

Control chart: A cumulative summary chart of results from QC tests with reference toxicants. The results of a given reference toxicant test are compared to the control chart mean value and 95% Acceptance Limits (A.L.) (mean ± 2 standard deviations).

IC25: The concentration of sample or chemical, calculated from the data set using statistical models, causing a 25% reduction in test organism growth, reproduction, etc. The lower the IC25, the more toxic the chemical or sample. Units are same as test concentration units.

LC50: The concentration of sample or chemical, calculated from the data set using statistical models, causing a 50% reduction in test organism survival. The lower the LC50, the more toxic the chemical or sample. Units are same as test concentration units. Note: The LC50 value must always be associated with the duration of exposure. Thus 48-h LC50, 96-h LC50, etc. are calculated.

LOEC: Lowest-observable-effect-concentration. The lowest concentration of sample or chemical in a chronic test dilution series in which the test organisms exhibit a statistically significant reduction in any of the test end points (e.g. growth, survival, reproduction) compared to control organisms. Units are same as test concentration units.

PMSD: Percent Minimum Significant Difference: The minimum difference which can exist between a test treatment and the controls in a particular test and be statistically significant; a measure of test sensitivity. The lower the PMSD the more sensitive the test.

N/A: Not applicable.

N/D: Not determined or measured.

VELAP# 460030
EPA# VA01116

NELAP ACCREDITED LABORATORY

NOAEC: No-observable-acute-effect-concentration. The highest concentration of sample or chemical in an acute test dilution series in which the test organisms exhibit no statistically significant reduction in the test end point (e.g. survival) compared to control organisms. Units are same as test concentration units.

NOEC: No-observable-effect-concentration. The highest concentration of sample or chemical in a chronic test dilution series in which the test organisms exhibit no statistically significant reduction in any of the test end points (e.g. growth, survival, reproduction) compared to control organisms. Some regulatory definitions also require that the NOEC be less than the LOEC. Units are same as test concentration units.

Q.L.: Quantitation Limit. Level, concentration, or quantity of a target variable (analyte) that can be reported at a specified degree of confidence.

T.U.: Toxic units. Expresses the relative toxicity of an effluent in such a manner that the larger the toxic unit value the more toxic the effluent. $T.U._{Ac}$ = 100/LC50. $T.U._{Chr}$ = 100/NOEC. A dimensionless unit.

C. dubia daily biological measurements (EPA 2002.0) Template version ACD-STAT-5trt-061113

TRTMNT (% Effl)	Rep	#Live Day 0	#Live Day 1	#Live Day 2	Final Mean % Live
C	A	5	4	4	95.0
	B	5	5	5	
Lab	C	5	5	5	
Control	D	5	5	5	
#1	A	5	5	5	100.0
6.25	B	5	5	5	
% Effl	C	5	5	5	
	D	5	5	5	
# 2	A	5	5	5	90.0
12.5	B	5	5	5	
% Effl	C	5	4	4	
	D	5	4	4	
# 3	A	5	5	5	35.0
25.0	B	5	5	2	
% Effl	C	5	2	0	
	D	5	2	0	
# 4	A	5	5	0	0.0
50.0	B	5	5	0	
% Effl	C	5	0	0	
	D	5	0	0	
# 5	A	5	5	0	0.0
100	B	5	4	0	
% Effl	C	5	0	0	
	D	5	0	0	
INITIALS:		AK	CPV	LT	% CONTROL SURVIVAL:
DATE & TIME:		5/1/21 10:41	5/2/21 9:29	5/3/21 10:57	

Test Duration:	48h 16m
	TAC 48+/-0.5h
% CONTROL SURVIVAL:	95.0
	TAC = 90%

CHANGES & NOTES (INITIALS, DATE, SPECIFIC CHANGE MADE	

SPECIES:	Ceriodaphnia dubia		
ACCLIMATION WATER:	Mod. Hard Synthetic Freshwater		
FEEDING PRIOR TO TEST:	YCT + Selenastrum capricornutum		
FEEDING DURING TEST:	None -YCT + Selenastrum 2+ h before test		
SOURCE:	CBI Stock cultures		
ACCLIMATION TEMP (o C):	25		
BROOD RELEASE START DATE & TIME:	4/30/21 22:00		
BROOD RELEASE END DATE & TIME:	5/1/21 6:00		
DATE/TIME WATER ADDED:	5/1/21 10:35		
DATE/TIME ANIMALS ADDED:	5/1/21 10:41		
ANIMAL AGE WINDOW:	8h 0m		
MAX AGE AT TEST START:	12h 41m		TAC Max. 24 h
TEST SET UP BY:		AK	
SAMPLE COLLECTION DATE &TIME:	4/29/21 23:59	SAMPLE USED	A
SAMPLE AGE AT TEST START:	34h 42m	TAC Max 36 h	
PEER REVIEW BY (INITIALS/DATE):		PB	5/6/21 11:34

TEST ID: AWSL2101ACD

Ceriodaphnia daily water quality bench sheet (EPA METHOD 2002.0) Template version ACD-STAT-5trt-061113

	TRTMNT	Day 0 Initial	Day 1	Day 2 Final	SUMMARY WATER QUALITY DATA MEAN	S.D.	MIN.	MAX.
pH (S.U.)	C	7.96	7.48	7.89	7.78	0.26	7.48	7.96
	1	7.98	7.59	7.98	7.85	0.23	7.59	7.98
	2	7.98	7.63	8.05	7.89	0.23	7.63	8.05
	3	7.98	7.70	8.09	7.92	0.20	7.70	8.09
	4	7.96	7.74	8.16	7.95	0.21	7.74	8.16
	5	7.93	7.88	8.52	8.11	0.36	7.88	8.52
Temp. (o C)	C	25	25	25	25	0.0	25	25
	1	25	25	25	25	0.0	25	25
	2	25	25	25	25	0.0	25	25
	3	25	25	25	25	0.0	25	25
	4	25	25	25	25	0.0	25	25
	5	25	25	25	25	0.0	25	25
Diss. Oxygen (mg/l)	C	8.2	7.7	8.2	8.0	0.3	7.7	8.2
	1	8.2	7.6	8.1	8.0	0.3	7.6	8.2
	2	8.2	7.5	8.3	8.0	0.4	7.5	8.3
	3	8.1	7.6	8.2	8.0	0.3	7.6	8.2
	4	8.0	7.5	8.3	7.9	0.4	7.5	8.3
	5	8.0	7.5	8.4	8.0	0.5	7.5	8.4
Cond. (uS/cm)	C	306		330	318	17.0	306	330
	1	329			329		329	329
	2	355			355		355	355
	3	405			405		405	405
	4	542			542		542	542
	5	773		830	802	40.3	773	830
Replicate measured		Flask	Surrogate	A				
Initials		AK	CPV	LT				
		TRC (mg/l) in highest conc. at end of test:		N/A				
Changes & Notes (Initials, date, specific change or notes)								

Test chamber:	30 ml plastic cup:	✓					
	Other:						
Test solution vol. (15 ml min):	15 ml:	✓					
	Other (ml):						
Illumination & photoperiod:	50-100 ft-c 16L:8D			Template Number:		3	
Number of replicates/treatment:	4						
Initial number animals/replicate:	5						
Test Aerated?	N/A	Date & Time Air Start:		N/A			

TEST ID	TRT ID:	1	2	3	4	5
AWSL2101ACD	CONC(%):	6.25	12.5	25.0	50.0	100

Acute Ceriodaphnia Test-48 Hr Survival

Start Date:		Test ID:	AWSL2101	Sample ID:	
End Date:		Lab ID:	CBI	Sample Type:	
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	CD-Ceriodaphnia dubia
Comments:	DATA ENTERED BY PB				

Conc-%	1	2	3	4
CONTROL	0.8000	1.0000	1.0000	1.0000
6.25	1.0000	1.0000	1.0000	1.0000
12.5	1.0000	1.0000	0.8000	0.8000
25	1.0000	0.4000	0.0000	0.0000
50	0.0000	0.0000	0.0000	0.0000
100	0.0000	0.0000	0.0000	0.0000

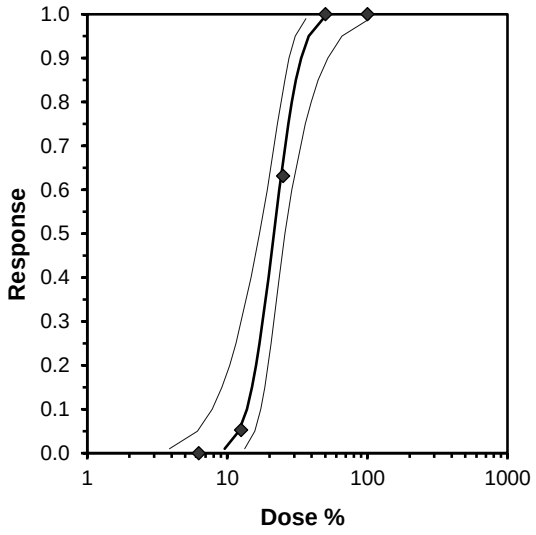
			Transform: Arcsin Square Root					Number	Total
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
CONTROL	0.9500	1.0000	1.2857	1.1071	1.3453	9.261	4	1	20
6.25	1.0000	1.0526	1.3453	1.3453	1.3453	0.000	4	0	20
12.5	0.9000	0.9474	1.2262	1.1071	1.3453	11.212	4	2	20
25	0.3500	0.3684	0.6203	0.2255	1.3453	85.386	4	13	20
50	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4	20	20
100	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 <= 0.01)	0.82543	0.844	1.22885	4.56895
Equality of variance cannot be confirmed				

Maximum Likelihood-Probit

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	6.61214	1.67518	3.32879	9.89549	0.05	0.83	7.81472	0.84	1.33255	0.15124	4
Intercept	-3.81101	2.28474	-8.2891	0.66709							
TSCR	0.02697	0.02553	-0.02307	0.077							

Point	Probits	%	95% Fiducial Limits	
EC01	2.674	9.56578	3.85851	13.2797
EC05	3.355	12.1279	6.1121	15.7403
EC10	3.718	13.7636	7.78308	17.2944
EC15	3.964	14.99	9.13924	18.4737
EC20	4.158	16.0423	10.362	19.5088
EC25	4.326	17.0037	11.517	20.4848
EC40	4.747	19.6895	14.834	23.474
EC50	5.000			
EC60	5.253	23.4891	19.2596	28.8815
EC75	5.674	27.1993	22.8119	35.9897
EC80	5.842	28.8293	24.1561	39.6652
EC85	6.036	30.853	25.696	44.646
EC90	6.282	33.6022	27.6234	52.0927
EC95	6.645	38.134	30.5296	65.9458
EC99	7.326	48.3482	36.3846	103.893



C. dubia daily biological measurements (EPA 2002.0) Template version ACD-TIE BASELINE

TRTMNT (% Effl)	Rep	#Live Day 0	#Live Day 1	#Live Day 2	Final Mean % Live		
C	A	5	5	5	100.0		
	B	5	5	5			
Lab	C	5	5	5			
Control	D	5	5	5			
#1	A	5	5	4	40.0		
12.5	B	5	4	0			
% Effl	C	5	0	0			
	D	5	5	4			
# 2	A	5	5	1	5.0		
25	B	5	5	0			
% Effl	C	5	0	0			
	D	5	2	0			
# 3	A	5	0	0	5.0		
50.0	B	5	5	0			
% Effl	C	5	1	0			
	D	5	3	1			
# 4	A	5	5	0	0.0		
100	B	5	2	0			
% Effl	C	5	0	0		Test Duration:	47h 56m
	D	5	5	0			TAC 48+/-0.5h
INITIALS:		LT	LT	AK	% CONTROL SURVIVAL:		100.0
DATE & TIME:		5/7/21 12:47	5/8/21 7:12	5/9/21 12:43			TAC = 90%
CHANGES & NOTES (INITIALS, DATE, SPECIFIC CHANGE MADE							

SPECIES:	Ceriodaphnia dubia		
ACCLIMATION WATER:	Mod. Hard Synthetic Freshwater		
FEEDING PRIOR TO TEST:	YCT + Selenastrum capricornutum		
FEEDING DURING TEST:	None -YCT + Selenastrum 2+ h before test		
SOURCE:	CBI Stock cultures		
ACCLIMATION TEMP (o C):	25		
BROOD RELEASE START DATE & TIME:	5/6/21 22:00		
BROOD RELEASE END DATE & TIME:	5/7/21 6:00		
DATE/TIME WATER ADDED:	5/7/21 12:42		
DATE/TIME ANIMALS ADDED:	5/7/21 12:47		
ANIMAL AGE WINDOW:	8h 0m		
MAX AGE AT TEST START:	14h 48m		TAC Max. 24 h
TEST SET UP BY:		LT	
SAMPLE COLLECTION DATE &TIME:	4/29/21 23:59	SAMPLE USED	A
SAMPLE AGE AT TEST START:	180h 49m	TAC Max 36 h	
PEER REVIEW BY (INITIALS/DATE):		PB	5/12/21 15:27

TEST ID: AWSL2101-BL

Ceriodaphnia daily water quality bench sheet (EPA METHOD 2002.0) Template version ACD-TIE BASELINE

	TRTMNT	Day 0 Initial	Day 1	Day 2 Final	SUMMARY WATER QUALITY DATA MEAN	S.D.	MIN.	MAX.
pH (S.U.)	C	7.86	8.06	7.84	7.92	0.12	7.84	8.06
	1	7.90	8.05	8.01	7.99	0.08	7.90	8.05
	2	7.92	8.05	8.19	8.05	0.14	7.92	8.19
	3	7.93	8.27	8.44	8.21	0.26	7.93	8.44
	4	8.19	8.49	8.70	8.46	0.26	8.19	8.70
Temp. (o C)	C	25	25	25	25	0.0	25	25
	1	25	25	25	25	0.0	25	25
	2	25	25	25	25	0.0	25	25
	3	25	25	25	25	0.0	25	25
	4	25	25	25	25	0.0	25	25
Diss. Oxygen (mg/l)	C	8.2	8.0	8.0	8.1	0.1	8.0	8.2
	1	8.2	8.0	7.9	8.0	0.2	7.9	8.2
	2	8.2	8.2	8.2	8.2	0.0	8.2	8.2
	3	8.2	8.3	8.2	8.2	0.1	8.2	8.3
	4	8.2	8.4	8.2	8.3	0.1	8.2	8.4
Cond. (uS/cm)	C	280		302	291	15.6	280	302
	1	332			332		332	332
	2	395			395		395	395
	3	525			525		525	525
	4	758		802	780	31.1	758	802
Replicate measured		Flask	Surrogate	D				
Initials		LT	LT	AK				
		TRC (mg/l) in highest conc. at end of test:		N/A				
Changes & Notes (Initials, date, specific change or notes)								

Test chamber:	30 ml plastic cup:	✓		
	Other:			
Test solution vol. (15 ml min):	15 ml:	✓		
	Other (ml):			
Illumination & photoperiod:	50-100 ft-c 16L:8D		Template Number:	7
Number of replicates/treatment:		4		
Initial number animals/replicate:		5		
	Test Aerated?	N/A	Date & Time Air Start:	N/A

TEST ID	TRT ID:	1	2	3	4
AWSL2101-BL	CONC(%):	12.5	25	50.0	100

Acute Ceriodaphnia Test-48 Hr Survival

Start Date:		Test ID:	AWSL2101BL	Sample ID:	BASELINE
End Date:		Lab ID:	CBI	Sample Type:	
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	CD-Ceriodaphnia dubia
Comments:	DATA ENTERED BY PB				

Conc-%	1	2	3	4
CONTROL	1.0000	1.0000	1.0000	1.0000
12.5	0.8000	0.0000	0.0000	0.8000
25	0.2000	0.0000	0.0000	0.0000
50	0.0000	0.0000	0.0000	0.2000
100	0.0000	0.0000	0.0000	0.0000

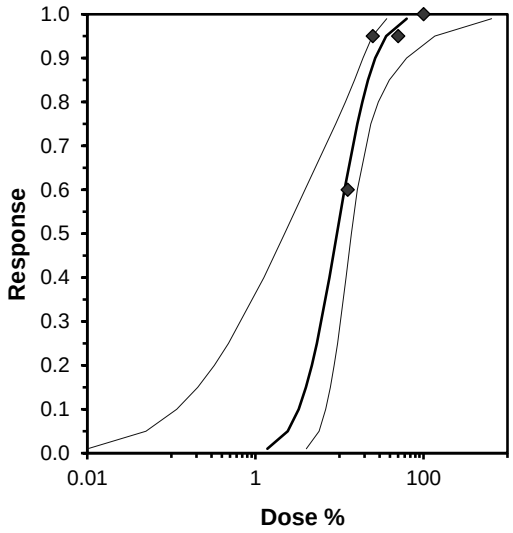
			Transform: Arcsin Square Root					Number	Total
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
CONTROL	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	0	20
12.5	0.4000	0.4000	0.6663	0.2255	1.1071	76.390	4	12	20
25	0.0500	0.0500	0.2850	0.2255	0.4636	41.771	4	19	20
50	0.0500	0.0500	0.2850	0.2255	0.4636	41.771	4	19	20
100	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 > 0.01)	0.86029	0.844	0.05598	0.90811
Equality of variance cannot be confirmed				

Maximum Likelihood-Probit

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	2.80771	0.93407	0.97694	4.63848	0	1.8574	5.99148	0.4	0.97226	0.35616	4
Intercept	2.27018	1.21237	-0.10607	4.64643							
TSCR											

Point	Probits	%	95% Fiducial Limits	
EC01	2.674	1.3922	0.01007	4.03682
EC05	3.355	2.43458	0.04976	5.71304
EC10	3.718	3.27958	0.11632	6.89062
EC15	3.964	4.00978	0.206	7.83086
EC20	4.158	4.70441	0.32404	8.67938
EC25	4.326	5.39549	0.47739	9.49136
EC40	4.747	7.62125	1.25749	11.9832
EC50	5.000			
EC60	5.253	11.5476	3.89582	16.42
EC75	5.674	16.3112	9.03349	23.5502
EC80	5.842	18.7074	11.8323	28.966
EC85	6.036	21.9481	15.1731	39.3819
EC90	6.282	26.8349	19.1154	62.9125
EC95	6.645	36.1488	24.7105	137.227
EC99	7.326	63.2145	36.6016	647.632



C. dubia daily biological measurements (EPA 2002.0) Template version ACD-TIE FILTRATION

TRTMNT (% Effl)	Rep	#Live Day 0	#Live Day 1	#Live Day 2	Final Mean % Live		
C	A	5	5	5	100.0		
	B	5	5	5			
Lab	C	5	5	5			
Control	D	5	5	5			
#1	A	5	3	0	40.0		
12.5	B	5	5	4			
% Effl	C	5	1	0			
	D	5	5	4			
# 2	A	5	5	0	10.0		
25	B	5	5	0			
% Effl	C	5	2	2			
	D	5	5	0			
# 3	A	5	0	0	0.0		
50.0	B	5	5	0			
% Effl	C	5	0	0			
	D	5	5	0			
# 4	A	5	0	0	0.0		
100	B	5	5	0			
% Effl	C	5	0	0		Test Duration:	48h 25m
	D	5	0	0			TAC 48+/-0.5h
INITIALS:		LT.AK	LT	AK	% CONTROL SURVIVAL:		100.0
DATE & TIME:		5/7/21 15:01	5/8/21 7:07	5/9/21 15:26			TAC = 90%
CHANGES & NOTES (INITIALS, DATE, SPECIFIC CHANGE MADE							

SPECIES:	Ceriodaphnia dubia		
ACCLIMATION WATER:	Mod. Hard Synthetic Freshwater		
FEEDING PRIOR TO TEST:	YCT + Selenastrum capricornutum		
FEEDING DURING TEST:	None -YCT + Selenastrum 2+ h before test		
SOURCE:	CBI Stock cultures		
ACCLIMATION TEMP (o C):	25		
BROOD RELEASE START DATE & TIME:	5/6/21 22:00		
BROOD RELEASE END DATE & TIME:	5/7/21 6:00		
DATE/TIME WATER ADDED:	5/7/21 14:17		
DATE/TIME ANIMALS ADDED:	5/7/21 15:01		
ANIMAL AGE WINDOW:	8h 0m		
MAX AGE AT TEST START:	17h 1m		TAC Max. 24 h
TEST SET UP BY:		LT.AK	
SAMPLE COLLECTION DATE &TIME:	4/29/21 23:59	SAMPLE USED	A
SAMPLE AGE AT TEST START:	183h 2m	TAC Max 36 h	
PEER REVIEW BY (INITIALS/DATE):		PB	5/11/21 12:03

TEST ID: AWSL2101-FILT

Ceriodaphnia daily water quality bench sheet (EPA METHOD 2002.0) Template version ACD-TIE FILTRATION

	TRTMNT	Day 0 Initial	Day 1	Day 2 Final	SUMMARY WATER QUALITY DATA MEAN	S.D.	MIN.	MAX.
pH (S.U.)	C	7.94	7.96	7.89	7.93	0.04	7.89	7.96
	1	8.00	7.96	7.99	7.98	0.02	7.96	8.00
	2	8.06	7.96	8.16	8.06	0.10	7.96	8.16
	3	8.14	8.23	8.45	8.27	0.16	8.14	8.45
	4	8.25	8.51	8.62	8.46	0.19	8.25	8.62
Temp. (o C)	C	25	25	25	25	0.0	25	25
	1	25	25	25	25	0.0	25	25
	2	25	25	25	25	0.0	25	25
	3	25	25	25	25	0.0	25	25
	4	25	25	25	25	0.0	25	25
Diss. Oxygen (mg/l)	C	8.2	8.0	8.2	8.1	0.1	8.0	8.2
	1	8.2	8.1	8.2	8.2	0.1	8.1	8.2
	2	8.2	8.3	8.4	8.3	0.1	8.2	8.4
	3	8.2	8.4	8.3	8.3	0.1	8.2	8.4
	4	8.2	8.4	8.4	8.3	0.1	8.2	8.4
Cond. (uS/cm)	C	280		318	299	26.9	280	318
	1	349			349		349	349
	2	433			433		433	433
	3	530			530		530	530
	4	746		766	756	14.1	746	766
Replicate measured		Flask	Surrogate	C				
Initials		LT	LT	AK				
		TRC (mg/l) in highest conc. at end of test:		N/A				
Changes & Notes (Initials, date, specific change or notes)								

Test chamber:	30 ml plastic cup:	✓		
	Other:			
Test solution vol. (15 ml min):	15 ml:	✓		
	Other (ml):			
Illumination & photoperiod:	50-100 ft-c 16L:8D		Template Number:	16
Number of replicates/treatment:		4		
Initial number animals/replicate:		5		
	Test Aerated?	N/A	Date & Time Air Start:	N/A

TEST ID	TRT ID:	1	2	3	4
AWSL2101-FILT	CONC(%):	12.5	25	50.0	100

	Filtration Test (also collect filtered sample for SPE Column Test)
1	Volumes based on 0.5x dilutions of 100, 50, 25 and 12.5%. Total effluent 200 ml, total SFW for blanks and dilutions 400 ml (4 reps @ 15 ml plus 25 ml water quality surrogate)
2	Connect a ca. 18” piece of Teflon tubing to the Cole-Parmer peristaltic pump
3	Place inlet end of the tube in a 1000 ml flask
4	Connect to the outlet end of the tubing a 47 mm in-line polycarbonate filter holder
5	Place a 47 mm 1 um mesh GFF filter into the holder, wetting with deionized water before screwing shut.
6	Turn on the pump and pour 500 ml of deionized water into the 1000 ml flask. Discard filtrate.
7	After all the deionized water is pumped out of the flask add 900 ml of dilution water. Discard first 50 ml then collect 400 ml for the filtration blank/diluent and then 450 ml for the C18 SPE test. Volumes filtered are reduced if the C18 SPE is not run.
8	After all of the dilution water is pumped from the flask begin adding effluent. A total of 450 ml will be needed. Collect 200 ml for the filtration test and retain the other 250 ml of filtered sample for use in the C18 SPE test
9	Pour test, including filtration blank. 15 ml x 4 reps plus 20 ml for initial water quality. **Dilutions are prepared with the filtration blank water**.
10	Add animals.
11	Retain the filter for later chemical analysis if desired. Wrap in deionized water-rinsed foil and store at 4o C.

Acute Ceriodaphnia Test-48 Hr Survival

Start Date:		Test ID:	AWSL2101F	Sample ID:	FILTRATION
End Date:		Lab ID:	CBI	Sample Type:	
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	CD-Ceriodaphnia dubia
Comments:	DATA ENTERED BY PB				

Conc-%	1	2	3	4
CONTROL	1.0000	1.0000	1.0000	1.0000
12.5	0.0000	0.8000	0.0000	0.8000
25	0.0000	0.0000	0.4000	0.0000
50	0.0000	0.0000	0.0000	0.0000
100	0.0000	0.0000	0.0000	0.0000

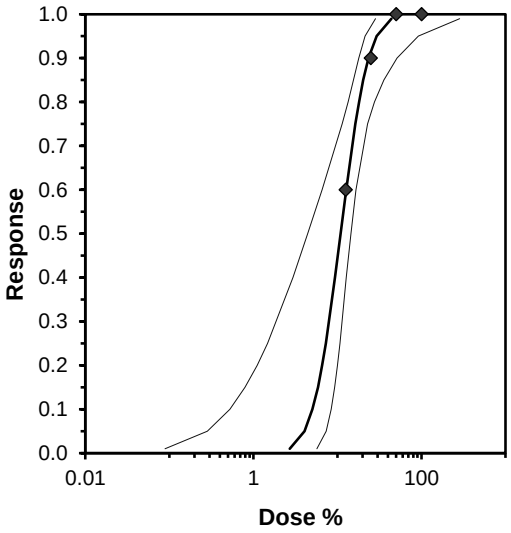
			Transform: Arcsin Square Root					Number	Total
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
CONTROL	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	0	20
12.5	0.4000	0.4000	0.6663	0.2255	1.1071	76.390	4	12	20
25	0.1000	0.1000	0.3403	0.2255	0.6847	67.468	4	18	20
50	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4	20	20
100	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 > 0.01)	0.88995	0.805	0.15974	-0.42428
Equality of variance cannot be confirmed				

Maximum Likelihood-Probit

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	3.84074	1.2754	1.34096	6.34053	0	0.19513	5.99148	0.91	1.03799	0.26037	4
Intercept	1.01334	1.5737	-2.07112	4.09779							
TSCR											

Point	Probits	%	95% Fiducial Limits	
EC01	2.674	2.70577	0.08891	5.7034
EC05	3.355	4.07126	0.28412	7.36659
EC10	3.718	5.06198	0.52662	8.46241
EC15	3.964	5.86328	0.79737	9.30643
EC20	4.158	6.58967	1.10737	10.0497
EC25	4.326	7.28415	1.46594	10.748
EC40	4.747	9.37627	2.94668	12.8407
EC50	5.000			
EC60	5.253	12.7045	6.55353	16.5662
EC75	5.674	16.3534	11.3772	22.9162
EC80	5.842	18.0769	13.3789	27.5902
EC85	6.036	20.3163	15.5211	35.666
EC90	6.282	23.5324	17.9635	51.3144
EC95	6.645	29.2589	21.4147	91.6524
EC99	7.326	44.0247	28.4134	285.121



C. dubia daily biological measurements (EPA 2002.0) Template version ACD-TIE C18 SPE

TRTMNT (% Effl)	Rep	#Live Day 0	#Live Day 1	#Live Day 2	Final Mean % Live		
C	A	5	5	5	100.0		
	B	5	5	5			
Lab	C	5	5	5			
Control	D	5	5	5			
#1	A	5	5	3	25.0		
12.5	B	5	5	0			
% Effl	C	5	2	2			
	D	5	5	0			
# 2	A	5	5	0	15.0		
25	B	5	5	0			
% Effl	C	5	4	3			
	D	5	5	0			
# 3	A	5	5	0	0.0		
50.0	B	5	0	0			
% Effl	C	5	5	0			
	D	5	5	0			
# 4	A	5	5	0	0.0		
100	B	5	0	0			
% Effl	C	5	4	0		Test Duration:	48h 26m
	D	5	5	0			TAC 48+/-0.5h
INITIALS:		AK.LT	LT	AK	% CONTROL SURVIVAL:		100.0
DATE & TIME:		5/7/21 14:53	5/8/21 7:06	5/9/21 15:18			TAC = 90%
CHANGES & NOTES (INITIALS, DATE, SPECIFIC CHANGE MADE							

SPECIES:	Ceriodaphnia dubia		
ACCLIMATION WATER:	Mod. Hard Synthetic Freshwater		
FEEDING PRIOR TO TEST:	YCT + Selenastrum capricornutum		
FEEDING DURING TEST:	None -YCT + Selenastrum 2+ h before test		
SOURCE:	CBI Stock cultures		
ACCLIMATION TEMP (o C):	25		
BROOD RELEASE START DATE & TIME:	5/6/21 22:00		
BROOD RELEASE END DATE & TIME:	5/7/21 6:00		
DATE/TIME WATER ADDED:	5/7/21 14:51		
DATE/TIME ANIMALS ADDED:	5/7/21 14:53		
ANIMAL AGE WINDOW:	8h 0m		
MAX AGE AT TEST START:	16h 53m		TAC Max. 24 h
TEST SET UP BY:		AK.LT	
SAMPLE COLLECTION DATE &TIME:	4/29/21 23:59	SAMPLE USED	A
TEST ID: SAMPLE AGE AT TEST START:	182h 54m	TAC Max 36 h	
AWSL2101-SPE PEER REVIEW BY (INITIALS/DATE):		PB	5/11/21 12:05

Ceriodaphnia daily water quality bench sheet (EPA METHOD 2002.0) Template version ACD-TIE C18 SPE

	TRTMNT	Day 0 Initial	Day 1	Day 2 Final	SUMMARY WATER QUALITY DATA MEAN	S.D.	MIN.	MAX.
pH (S.U.)	C	7.85	7.86	8.22	7.98	0.21	7.85	8.22
	1	7.84	7.85	8.19	7.96	0.20	7.84	8.19
	2	7.85	7.85	8.20	7.97	0.20	7.85	8.20
	3	7.87	7.93	8.32	8.04	0.24	7.87	8.32
	4	8.19	8.45	8.63	8.42	0.22	8.19	8.63
Temp. (o C)	C	25	25	25	25	0.0	25	25
	1	25	25	25	25	0.0	25	25
	2	25	25	25	25	0.0	25	25
	3	25	25	25	25	0.0	25	25
	4	25	25	25	25	0.0	25	25
Diss. Oxygen (mg/l)	C	8.2	8.2	8.0	8.1	0.1	8.0	8.2
	1	8.2	8.2	8.0	8.1	0.1	8.0	8.2
	2	8.2	8.3	8.1	8.2	0.1	8.1	8.3
	3	8.2	8.3	8.0	8.2	0.2	8.0	8.3
	4	8.2	8.3	7.9	8.1	0.2	7.9	8.3
Cond. (uS/cm)	C	280		306	293	18.4	280	306
	1	329			329		329	329
	2	380			380		380	380
	3	495			495		495	495
	4	739		787	763	33.9	739	787
Replicate measured		Flask	Surrogate	D				
Initials		LT	LT	AK				
		TRC (mg/l) in highest conc. at end of test:		N/A				
Changes & Notes (Initials, date, specific change or notes)								

Test chamber:	30 ml plastic cup:	✓		
	Other:			
Test solution vol. (15 ml min):	15 ml:	✓		
	Other (ml):			
Illumination & photoperiod:	50-100 ft-c 16L:8D		Template Number:	1
Number of replicates/treatment:		4		
Initial number animals/replicate:		5		
	Test Aerated?	N/A	Date & Time Air Start:	N/A

TEST ID	TRT ID:	1	2	3	4
AWSL2101-SPE	CONC(%):	12.5	25	50.0	100

	C18 Solid Phase Extraction (SPE) Test
1	Volumes based on 0.5x dilutions of 100, 50, 25 and 12.5%. Total effluent 200 ml, total SFW for blanks and dilutions 400 ml (4 reps @ 15 ml plus 25 ml water quality surrogate)
2	Attach silicone tubing (ca. 15”) to inlet side of G-R metering pump
3	Attach the outlet end of the tubing to the blue Luer-tubing adapter and then attach a small (4”) length of glass tubing to the intake (latch) end of the tubing.
4	Place the glass tubing in a small (e.g. 250 ml) flask.
5	Pump DI water (50 ml) through the system
6	Attach a 6 ml (1 g) SPE tube to the Luer end of the adapter and position over an appropriate sized waste flask or beaker.
7	Add 12 ml of HPLC-grade methanol to the beaker and turn on pump. Pump should be set to provide a flow rate of 10 ml/min.
8	Allow the cartridge to fill with 1-2 ml of methanol before firmly attaching the adapter to the cartridge. Allow methanol to be pumped to waste. However, IF CONDUCTING THE SPE ELUATE TEST, COLLECT 3 ml OF METHANOL (Use clean scintillation vial) AFTER PASSAGE OF FIRST 5-6 ml. This will be used as the methanol blank in the eluate test. **Do not allow column to go dry.**
9	Add 50 ml deionized water just as the last of the methanol is pumped from the beaker. A small bubble in the line is O.K.; it will help you track the end of the methanol/beginning of the deionized water in the tube. However, the column must not go dry between the two.
10	DO NOT let column go dry after the addition of the deionized water (keep an eye on the column, a small volume of liquid should always lay on top of the column packing).
11	Add 450 ml of **filtered** dilution water just as the last of the deionized water leaves the reservoir. A small bubble between the two in the pump tubing will enable you to tell when the dilution water is entering the column.
12	Collect 400 ml of dilution water after discarding the first 50 ml. This is tested as the SPE blank. DO NOT allow column to go dry.
13	Add 200 ml of **filtered** sample just as the last of the dilution water is pumped from the reservoir. Collect the 200 ml eluate. THE COLUMN MAY GO DRY after the entire sample is collected.
14	The filtered SPE sample is tested with appropriate dilutions, using SPE blank as the diluent
15	IF CONDUCTING THE SPE ELUATE TEST: Pass 1.8 ml of methanol over column and collect into a clean scintillation vial. OTHERWISE: Retain the column for later chemical analysis if desired. Wrap in acetone/deionized water-rinsed foil and store at 4o C.
16	Record A# of methanol and SPE column, and size (g) of column, on biological page.

Acute Ceriodaphnia Test-48 Hr Survival

Start Date:		Test ID:	AWSL2101SP	Sample ID:	SPE
End Date:		Lab ID:	CBI	Sample Type:	
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	CD-Ceriodaphnia dubia
Comments:	DATA ENTERED BY PB				

Conc-%	1	2	3	4
CONTROL	1.0000	1.0000	1.0000	1.0000
12.5	0.6000	0.0000	0.4000	0.0000
25	0.0000	0.0000	0.6000	0.0000
50	0.0000	0.0000	0.0000	0.0000
100	0.0000	0.0000	0.0000	0.0000

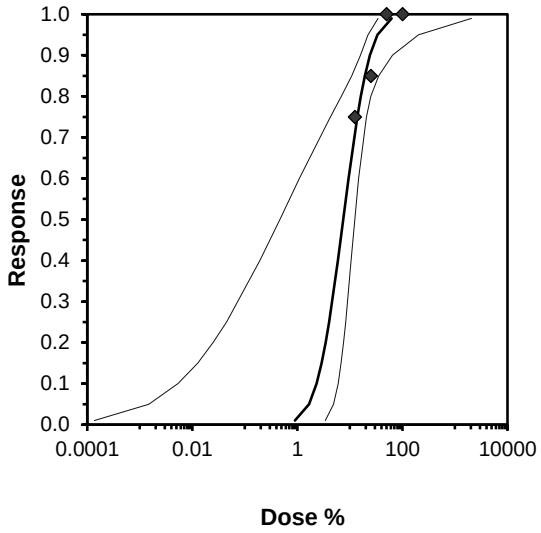
			Transform: Arcsin Square Root					Number	Total
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
CONTROL	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	0	20
12.5	0.2500	0.2500	0.5055	0.2255	0.8861	65.988	4	15	20
25	0.1500	0.1500	0.3907	0.2255	0.8861	84.546	4	17	20
50	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4	20	20
100	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 > 0.01)	0.8886	0.805	0.92656	0.18989
Equality of variance cannot be confirmed				

Maximum Likelihood-Probit

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	2.52564	0.95553	0.65279	4.39849	0	1.33439	5.99148	0.51	0.87331	0.39594	6
Intercept	2.79434	1.24105	0.36187	5.2268							
TSCR											

Point	Probits	%	95% Fiducial Limits	
EC01	2.674	0.89581	0.00014	3.40113
EC05	3.355	1.66742	0.00149	4.90135
EC10	3.718	2.32216	0.00534	5.96768
EC15	3.964	2.90364	0.01259	6.82414
EC20	4.158	3.46798	0.0249	7.59967
EC25	4.326	4.03879	0.04463	8.34322
EC40	4.747	5.92922	0.19299	10.6238
EC50	5.000			
EC60	5.253	9.41061	1.09354	14.6006
EC75	5.674	13.8154	4.27227	20.5793
EC80	5.842	16.0894	6.88804	25.1198
EC85	6.036	19.2164	10.8458	35.1212
EC90	6.282	24.0284	15.8536	64.8517
EC95	6.645	33.4634	22.1924	201.825
EC99	7.326	62.2874	34.4494	2055.42



C. dubia daily biological measurements (EPA 2002.0) Template version ACD-TIE LOW PH

TRTMNT (% Effl)	Rep	#Live Day 0	#Live Day 1	#Live Day 2	Final Mean % Live		
C	A	5	5	5	100.0		
	B	5	5	5			
Lab	C	5	5	5			
Control	D	5	5	5			
#1	A	5	5	3	65.0		
12.5	B	5	4	2			
% Effl	C	5	5	3			
	D	5	5	5			
# 2	A	5	5	2	25.0		
25	B	5	5	3			
% Effl	C	5	4	0			
	D	5	2	0			
# 3	A	5	5	0	0.0		
50.0	B	5	0	0			
% Effl	C	5	4	0			
	D	5	5	0			
# 4	A	5	2	0	0.0		
100	B	5	3	0			
% Effl	C	5	5	0		Test Duration:	47h 39m
	D	5	0	0			TAC 48+/-0.5h
INITIALS:		LT	LT	AK	% CONTROL SURVIVAL:		100.0
DATE & TIME:		5/7/21 16:14	5/8/21 7:16	5/9/21 15:52			TAC = 90%
CHANGES & NOTES (INITIALS, DATE, SPECIFIC CHANGE MADE							

	SPECIES:	Ceriodaphnia dubia	
	ACCLIMATION WATER:	Mod. Hard Synthetic Freshwater	
	FEEDING PRIOR TO TEST:	YCT + Selenastrum capricornutum	
	FEEDING DURING TEST:	None -YCT + Selenastrum 2+ h before test	
	SOURCE:	CBI Stock cultures	
	ACCLIMATION TEMP (o C):	25	
	BROOD RELEASE START DATE & TIME:	5/6/21 22:00	
	BROOD RELEASE END DATE & TIME:	5/7/21 6:00	
	DATE/TIME WATER ADDED:	5/7/21 12:50	
	DATE/TIME ANIMALS ADDED:	5/7/21 16:14	
	ANIMAL AGE WINDOW:	8h 0m	
	MAX AGE AT TEST START:	18h 14m	TAC Max. 24 h
	TEST SET UP BY:	LT	
	SAMPLE COLLECTION DATE &TIME:	4/29/21 23:59	SAMPLE USED A
TEST ID:	SAMPLE AGE AT TEST START:	184h 15m	TAC Max 36 h
AWSL2101-LPH	PEER REVIEW BY (INITIALS/DATE):	PB	5/11/21 12:04

Ceriodaphnia daily water quality bench sheet (EPA METHOD 2002.0) Template version ACD-TIE LOW PH

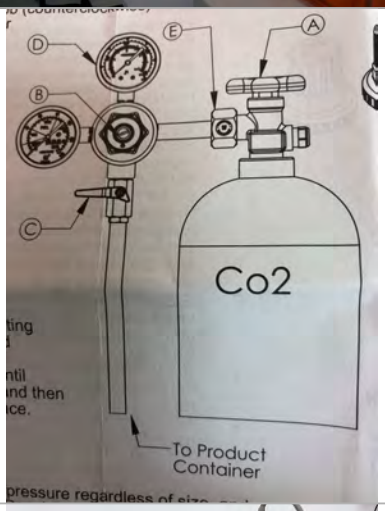
	TRTMNT	Day 0 Initial	Day 1	Day 2 Final	SUMMARY WATER QUALITY DATA MEAN	S.D.	MIN.	MAX.
pH (S.U.)	C	7.57	7.12	6.93	7.21	0.33	6.93	7.57
	1	7.50	7.15	6.90	7.18	0.30	6.90	7.50
	2	7.48	7.12	6.83	7.14	0.33	6.83	7.48
	3	7.45	7.18	6.81	7.15	0.32	6.81	7.45
	4	7.71	7.19	6.90	7.27	0.41	6.90	7.71
Temp. (o C)	C	25	25	25	25	0.0	25	25
	1	25	25	25	25	0.0	25	25
	2	25	25	25	25	0.0	25	25
	3	25	25	25	25	0.0	25	25
	4	25	25	25	25	0.0	25	25
Diss. Oxygen (mg/l)	C	8.2	7.9	8.0	8.0	0.2	7.9	8.2
	1	8.2	7.9	8.0	8.0	0.2	7.9	8.2
	2	8.2	7.9	8.1	8.1	0.2	7.9	8.2
	3	8.2	8.0	8.0	8.1	0.1	8.0	8.2
	4	8.2	8.1	8.3	8.2	0.1	8.1	8.3
Cond. (uS/cm)	C	280		315	298	24.7	280	315
	1	337			337		337	337
	2	400			400		400	400
	3	515			515		515	515
	4	740		759	750	13.4	740	759
Replicate measured		Flask	Surrogate	A				
Initials		LT	LT	AK				
		TRC (mg/l) in highest conc. at end of test:		N/A				
Changes & Notes (Initials, date, specific change or notes)								

Test chamber:	30 ml plastic cup:	✓		
	Other:			
Test solution vol. (15 ml min):	15 ml:	✓		
	Other (ml):			
Illumination & photoperiod:	50-100 ft-c 16L:8D		Template Number:	11
Number of replicates/treatment:	4			
Initial number animals/replicate:	5			
Test Aerated?	N/A	Date & Time Air Start:	N/A	

TEST ID	TRT ID:	1	2	3	4
AWSL2101-LPH	CONC(%):	12.5	25	50.0	100

	Low pH (pH 7) Test
1	Volumes based on 0.5x dilutions of 100, 50, 25 and 12.5%. Total effluent 200 ml, total SFW for blanks and dilutions 400 ml (4 reps @ 15 ml plus 25 ml water quality surrogate)
2	Place 30 cm x 30 cm x 30 cm Plexiglass dessicator on bench next to gas tank. Connect tubing from flow meters to one of the barbed outlets; the other barbed outlet should be left open. (Fig. 1)
3	Set the CO2 flow (Fig 2 and 3):
4	**CAREFULLY FOLLOW THESE INSTRUCTIONS TO AVOID DAMAGE TO FLOW REGULATOR VALVES**
5	Disconnect, at tank regulator end, the silicone tubing between the CO2 regulator and the Cole-Parmer flow regulator (to avoid accidental pressures greater than 10 psi). See Fig 3.
6	Close brass valve (lever in horizontal position) on line that feeds gas to the Cole Parmer flow unit (valve "C" Fig. 2).
7	Turn regulator knob (red valve, Fig. 3; "B" Fig. 2) on CO2 tank 2 turns counter clockwise to turn off (regulator valves are backwards compared to most other valves). The gas must not be turned on with an open regulator valve.
8	Turn on gas by opening fully (turn counter clockwise) brass valve on top of tank (valve "A" Fig.2). The pressure should register ca 1000 psi on the left most pressure gauge "P"
9	Turn the regulator valve slowly clockwise to open the regulator valve (remember it is backwards) until ca. 5 psi registers on the pressure gauge "PG" (above red regulator knob Fig. 3; "D" Fig. 2; psi is the outer, red scale). **Do not set $\geq$ 10 psi because these pressures will damage the flow controller.**
10	Plug in controller power unit and set the flow on the set point module to zero flow. This is necessary for the regulator to establish the zero-flow baseline.
11	Reconnect the tubing between the tank regulator and the Cole-Parmer controller and open (lever vertical) the brass valve ("C" Fig. 2).
12	Turn the knob on the Cole-Parmer set point module to the desired flow (e.g. 4.00 for 4 ml/min). The reading on the controller should fluctuate about $\pm$ 1% of the set point. The reading on the "CO2" glass Gilmont flow meter should also read ca. 4 ml/min. (NOTE: when first starting flow you may need to gently tap the glass flow meter if the ball is stuck).
13	Set the Air flow (Fig 3):
14	The central lab air system supplies the air.
15	Open the valve on the lab PVC air line on wall supplying the tube connected to the "air" Gilmont flow meter, until the steel ball on the glass Gilmont air flow meter reads 85. This reading corresponds to 190 ml/min (see the nomogram for glass-steel ball reading conversions posted next to the meter).
16	The air flow should not vary significantly once set, but may "bounce a bit"
17	Typically you do not need to pH adjust the sample and dilution water using acid or base. The cups of solutions will usually equilibrate to ~7 pH after being placed in chamber for a few hours. However, if adjustments to sample and dilution water are made prior to pouring dilutions, be sure to record acid/base A#s, volumes. Of acid/base used and volumes of sample/diluent on biological page.
18	Pour test concentrations in replicate beakers and place into Plexiglass dessicator; shut unit door and seal tight by closing the 4 latches. A control group (adjusted dilution water only) must be tested. Note: A surrogate beaker for each treatment and control is also poured for use in pH checks.
19	After a few hours check pH values (if first time of use) to see if stable. Make very small adjustments in the CO2 portion of the mixture as necessary.
20	When desired pH values are attained test organisms may be added or transferred from old solutions.
	When the test is completed:
1	Disconnect tubing between the CO2 tank regulator and Cole-Parmer controller (to avoid accidental pressures greater than 10 psi).
2	Turn the gas to CO2 tank off by turning the brass valve on the top of the tank (valve A) clockwise.
3	Bleed off gas from the regulator by turning the red knob on the regulator valve clockwise. You will hear gas escaping.
4	Both regulator vales on each tank should read "0" psi.
5	Close red knob by turning counter-clockwise several turns.

Table 1

FIG 1				
FIG 2				
FIG 3				

Acute Ceriodaphnia Test-48 Hr Survival

Start Date:		Test ID:	AWSL2101LP	Sample ID:	LOW PH
End Date:		Lab ID:	CBI	Sample Type:	
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	CD-Ceriodaphnia dubia
Comments:	DATA ENTERED BY PB				

Conc-%	1	2	3	4
CONTROL	1.0000	1.0000	1.0000	1.0000
12.5	0.6000	0.4000	0.6000	1.0000
25	0.4000	0.6000	0.0000	0.0000
50	0.0000	0.0000	0.0000	0.0000
100	0.0000	0.0000	0.0000	0.0000

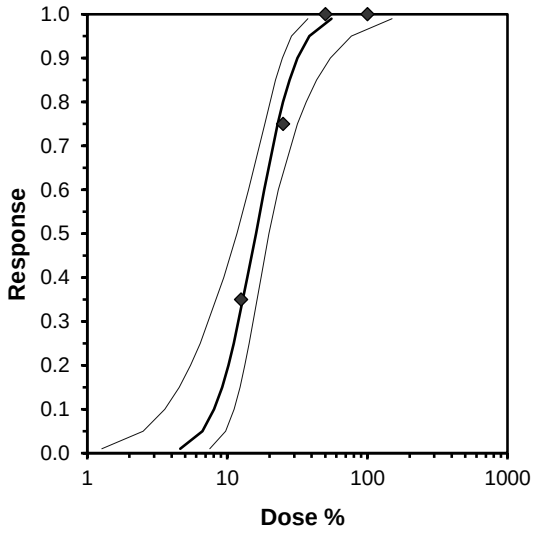
			Transform: Arcsin Square Root					Number	Total
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
CONTROL	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	0	20
12.5	0.6500	0.6500	0.9505	0.6847	1.3453	29.432	4	7	20
25	0.2500	0.2500	0.5055	0.2255	0.8861	65.988	4	15	20
50	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4	20	20
100	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 > 0.01)	0.8858	0.805	0.54977	-0.28105
Equality of variance cannot be confirmed				

Maximum Likelihood-Probit

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	4.30894	1.0334	2.28348	6.33441	0	0.70508	5.99148	0.7	1.20323	0.23208	5
Intercept	-0.18467	1.33525	-2.80175	2.43242							
TSCR											

Point	Probits	%	95% Fiducial Limits	
EC01	2.674	4.60623	1.27188	7.48671
EC05	3.355	6.62984	2.50065	9.6988
EC10	3.718	8.05039	3.57339	11.1723
EC15	3.964	9.17704	4.53565	12.3204
EC20	4.158	10.1839	5.47065	13.3443
EC25	4.326	11.1353	6.41156	14.3201
EC40	4.747	13.9456	9.42806	17.3541
EC50	5.000			
EC60	5.253	18.2822	14.1822	23.1189
EC75	5.674	22.8963	18.4633	31.646
EC80	5.842	25.0353	20.1524	36.465
EC85	6.036	27.7821	22.1342	43.3718
EC90	6.282	31.6702	24.6942	54.4149
EC95	6.645	38.456	28.7376	76.9692
EC99	7.326	55.3505	37.5651	149.974



C. dubia daily biological measurements (EPA 2002.0) Template version ACD-TIE BASELINE

TRTMNT (% Effl)	Rep	#Live Day 0	#Live Day 1	#Live Day 2	Final Mean % Live		
C	A	5	5	5	100.0		
	B	5	5	5			
Lab	C	5	5	5			
Control	D	5	5	5			
#1	A	5	5	2	55.0		
12.5	B	5	5	3			
% Effl	C	5	5	3			
	D	5	4	3			
# 2	A	5	5	0	10.0		
25	B	5	5	2			
% Effl	C	5	0	0			
	D	5	5	0			
# 3	A	5	0	0	0.0		
50.0	B	5	0	0			
% Effl	C	5	5	0			
	D	5	0	0			
# 4	A	5	4	0	0.0		
100	B	5	3	0			
% Effl	C	5	4	0		Test Duration:	47h 34m
	D	5	5	0			TAC 48+/-0.5h
INITIALS:		AK	CPV/LT	LT	% CONTROL SURVIVAL:		100.0
DATE & TIME:		5/10/21 13:30	5/11/21 8:58	5/12/21 13:05			TAC = 90%
CHANGES & NOTES (INITIALS, DATE, SPECIFIC CHANGE MADE		EXTENDED STORAGE OF SAMPLE IN LDPE CUBITAINER					

	SPECIES:	Ceriodaphnia dubia		
	ACCLIMATION WATER:	Mod. Hard Synthetic Freshwater		
	FEEDING PRIOR TO TEST:	YCT + Selenastrum capricornutum		
	FEEDING DURING TEST:	None -YCT + Selenastrum 2+ h before test		
	SOURCE:	CBI Stock cultures		
	ACCLIMATION TEMP (o C):	25		
	BROOD RELEASE START DATE & TIME:	5/9/21 22:00		
	BROOD RELEASE END DATE & TIME:	5/10/21 6:00		
	DATE/TIME WATER ADDED:	5/10/21 12:43		
	DATE/TIME ANIMALS ADDED:	5/10/21 13:30		
	ANIMAL AGE WINDOW:	8h 0m		
	MAX AGE AT TEST START:	15h 31m		TAC Max. 24 h
	TEST SET UP BY:		AK	
	SAMPLE COLLECTION DATE &TIME:	4/29/21 23:59	SAMPLE USED	A
TEST ID:	SAMPLE AGE AT TEST START:	253h 32m	TAC Max 36 h	
AWSL2102-CUBE	PEER REVIEW BY (INITIALS/DATE):		PB	5/12/21 14:29

Ceriodaphnia daily water quality bench sheet (EPA METHOD 2002.0) Template version ACD-TIE BASELINE

	TRTMNT	Day 0 Initial	Day 1	Day 2 Final	SUMMARY WATER QUALITY DATA MEAN	S.D.	MIN.	MAX.
pH (S.U.)	C	7.74	7.64	7.61	7.66	0.07	7.61	7.74
	1	7.92	7.61	7.72	7.75	0.16	7.61	7.92
	2	8.04	7.66	7.82	7.84	0.19	7.66	8.04
	3	8.24	7.82	7.90	7.99	0.22	7.82	8.24
	4	8.41	8.05	8.35	8.27	0.19	8.05	8.41
Temp. (o C)	C	25	25	25	25	0.0	25	25
	1	25	25	25	25	0.0	25	25
	2	25	25	25	25	0.0	25	25
	3	25	25	25	25	0.0	25	25
	4	25	25	25	25	0.0	25	25
Diss. Oxygen (mg/l)	C	8.2	8.0	8.2	8.1	0.1	8.0	8.2
	1	8.2	8.1	8.2	8.2	0.1	8.1	8.2
	2	8.2	8.1	8.3	8.2	0.1	8.1	8.3
	3	8.2	8.1	8.3	8.2	0.1	8.1	8.3
	4	8.2	8.1	8.3	8.2	0.1	8.1	8.3
Cond. (uS/cm)	C	291		330	311	27.6	291	330
	1	347			347		347	347
	2	408			408		408	408
	3	530			530		530	530
	4	780		744	762	25.5	744	780
Replicate measured		Flask	Surrogate	D				
Initials		AK	CPV	LT				
		TRC (mg/l) in highest conc. at end of test:		N/A				
Changes & Notes (Initials, date, specific change or notes)								

Test chamber:	30 ml plastic cup:	✓		
	Other:			
Test solution vol. (15 ml min):	15 ml:	✓		
	Other (ml):			
Illumination & photoperiod:	50-100 ft-c 16L:8D		Template Number:	12
Number of replicates/treatment:		4		
Initial number animals/replicate:		5		
	Test Aerated?	N/A	Date & Time Air Start:	N/A

TEST ID	TRT ID:	1	2	3	4
AWSL2102-CUBE	CONC(%):	12.5	25	50.0	100

Acute Ceriodaphnia Test-48 Hr Survival

Start Date:		Test ID:	AWSL2101C	Sample ID:	CUBITAINER
End Date:		Lab ID:	CBI	Sample Type:	
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	CD-Ceriodaphnia dubia
Comments:	DATA ENTERED BY PB				

Conc-%	1	2	3	4
CONTROL	1.0000	1.0000	1.0000	1.0000
12.5	0.4000	0.6000	0.6000	0.6000
25	0.0000	0.4000	0.0000	0.0000
50	0.0000	0.0000	0.0000	0.0000
100	0.0000	0.0000	0.0000	0.0000

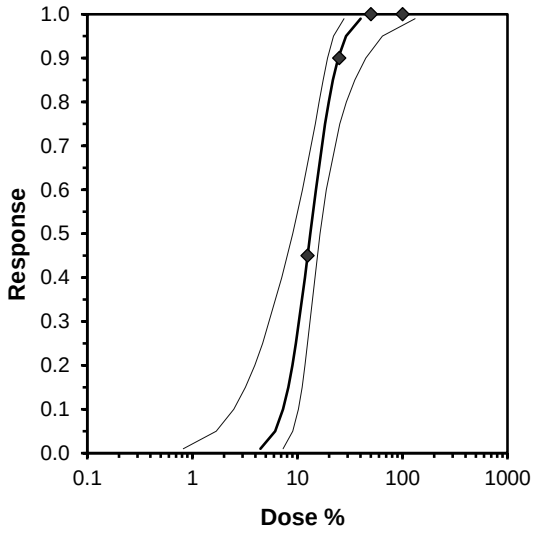
			Transform: Arcsin Square Root					Number	Total
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
CONTROL	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	0	20
12.5	0.5500	0.5500	0.8357	0.6847	0.8861	12.047	4	9	20
25	0.1000	0.1000	0.3403	0.2255	0.6847	67.468	4	18	20
50	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4	20	20
100	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 > 0.01)	0.8112	0.805	1.61622	4.0801
Equality of variance cannot be confirmed				

Maximum Likelihood-Probit

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	4.87634	1.39662	2.13896	7.61372	0	0.06984	5.99148	0.97	1.1253	0.20507	3
Intercept	-0.48734	1.70772	-3.83447	2.85979							
TSCR											

Point	Probits	%	95% Fiducial Limits	
EC01	2.674	4.44867	0.82012	7.30706
EC05	3.355	6.13742	1.69216	9.06356
EC10	3.718	7.286	2.48267	10.195
EC15	3.964	8.18005	3.20919	11.0587
EC20	4.158	8.96822	3.92876	11.817
EC25	4.326	9.70466	4.66536	12.5305
EC40	4.747	11.8398	7.10659	14.7027
EC50	5.000			
EC60	5.253	15.0402	11.1702	18.8121
EC75	5.674	18.3492	14.7889	25.3959
EC80	5.842	19.856	16.1139	29.3487
EC85	6.036	21.7692	17.591	35.1694
EC90	6.282	24.4405	19.4064	44.6994
EC95	6.645	29.0143	22.138	64.6657
EC99	7.326	40.0284	27.7843	131.866



C. dubia daily biological measurements (EPA 2002.0) Template version ACD-TIE BASELINE

TRTMNT (% Effl)	Rep	#Live Day 0	#Live Day 1	#Live Day 2	Final Mean % Live		
C	A	5	5	5	100.0		
	B	5	5	5			
Lab	C	5	5	5			
Control	D	5	5	5			
#1	A	5	4	4	60.0		
12.5	B	5	5	3			
% Effl	C	5	5	5			
	D	5	5	0			
# 2	A	5	0	0	0.0		
25	B	5	0	0			
% Effl	C	5	5	0			
	D	5	5	0			
# 3	A	5	0	0	0.0		
50.0	B	5	0	0			
% Effl	C	5	5	0			
	D	5	5	0			
# 4	A	5	5	0	0.0		
100	B	5	5	0			
% Effl	C	5	4	0		Test Duration:	47h 34m
	D	5	5	0			TAC 48+/-0.5h
INITIALS:		AK	CPV	LT	% CONTROL SURVIVAL:		100.0
DATE & TIME:		5/10/21 13:36	5/11/21 9:05	5/12/21 13:11			TAC = 90%
CHANGES & NOTES (INITIALS, DATE, SPECIFIC CHANGE MADE		EXTENDED STORAGE OF SAMPLE IN GLASS FLASK (300 ml)					

	SPECIES:	Ceriodaphnia dubia		
	ACCLIMATION WATER:	Mod. Hard Synthetic Freshwater		
	FEEDING PRIOR TO TEST:	YCT + Selenastrum capricornutum		
	FEEDING DURING TEST:	None -YCT + Selenastrum 2+ h before test		
	SOURCE:	CBI Stock cultures		
	ACCLIMATION TEMP (o C):	25		
	BROOD RELEASE START DATE & TIME:	5/9/21 22:00		
	BROOD RELEASE END DATE & TIME:	5/10/21 6:00		
	DATE/TIME WATER ADDED:	5/10/21 12:44		
	DATE/TIME ANIMALS ADDED:	5/10/21 13:36		
	ANIMAL AGE WINDOW:	8h 0m		
	MAX AGE AT TEST START:	15h 37m		TAC Max. 24 h
	TEST SET UP BY:		AK	
	SAMPLE COLLECTION DATE &TIME:	4/29/21 23:59	SAMPLE USED	A
TEST ID:	SAMPLE AGE AT TEST START:	253h 38m	TAC Max 36 h	
AWSL2101-GLASS	PEER REVIEW BY (INITIALS/DATE):		PB	5/12/21 14:30

Ceriodaphnia daily water quality bench sheet (EPA METHOD 2002.0) Template version ACD-TIE BASELINE

	TRTMNT	Day 0 Initial	Day 1	Day 2 Final	SUMMARY WATER QUALITY DATA MEAN	S.D.	MIN.	MAX.
pH (S.U.)	C	7.80	8.05	7.64	7.83	0.21	7.64	8.05
	1	8.01	8.04	7.67	7.91	0.21	7.67	8.04
	2	8.14	8.02	7.75	7.97	0.20	7.75	8.14
	3	8.20	8.05	7.85	8.03	0.18	7.85	8.20
	4	8.29	8.17	8.34	8.27	0.09	8.17	8.34
Temp. (o C)	C	25	25	25	25	0.0	25	25
	1	25	25	25	25	0.0	25	25
	2	25	25	25	25	0.0	25	25
	3	25	25	25	25	0.0	25	25
	4	25	25	25	25	0.0	25	25
Diss. Oxygen (mg/l)	C	8.2	8.0	8.2	8.1	0.1	8.0	8.2
	1	8.2	8.1	8.2	8.2	0.1	8.1	8.2
	2	8.2	8.1	8.2	8.2	0.1	8.1	8.2
	3	8.2	8.0	8.3	8.2	0.2	8.0	8.3
	4	8.2	8.1	8.3	8.2	0.1	8.1	8.3
Cond. (uS/cm)	C	308		320	314	8.5	308	320
	1	342			342		342	342
	2	402			402		402	402
	3	554			554		554	554
	4	779		745	762	24.0	745	779
Replicate measured		Flask	Surrogate	D				
Initials		AK	CPV	LT				
		TRC (mg/l) in highest conc. at end of test:		N/A				
Changes & Notes (Initials, date, specific change or notes)								

Test chamber:	30 ml plastic cup:	✓			
	Other:				
Test solution vol. (15 ml min):	15 ml:	✓			
	Other (ml):				
Illumination & photoperiod:	50-100 ft-c 16L:8D		Template Number:	16	
Number of replicates/treatment:	4				
Initial number animals/replicate:	5				
Test Aerated?	N/A	Date & Time Air Start:	N/A		

TEST ID	TRT ID:	1	2	3	4
AWSL2101-GLASS	CONC(%):	12.5	25	50.0	100

Acute Ceriodaphnia Test-48 Hr Survival

Start Date:		Test ID:	AWSL2101G	Sample ID:	GLASS
End Date:		Lab ID:	CBI	Sample Type:	
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	CD-Ceriodaphnia dubia
Comments:	DATA ENTERED BY PB				

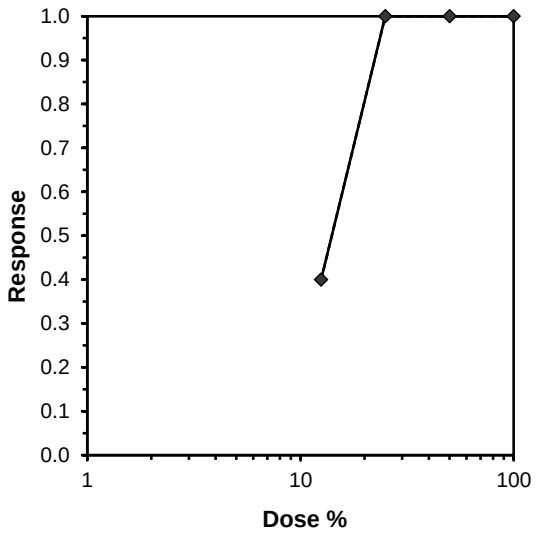
Conc-%	1	2	3	4
CONTROL	1.0000	1.0000	1.0000	1.0000
12.5	0.8000	0.6000	1.0000	0.0000
25	0.0000	0.0000	0.0000	0.0000
50	0.0000	0.0000	0.0000	0.0000
100	0.0000	0.0000	0.0000	0.0000

			Transform: Arcsin Square Root					Number	Total
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
CONTROL	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	0	20
12.5	0.6000	0.6000	0.8910	0.2255	1.3453	54.058	4	8	20
25	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4	20	20
50	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4	20	20
100	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 > 0.01)	0.8031	0.749	-1.15974	3.45532
Equality of variance cannot be confirmed				

Trimmed Spearman-Karber

Trim Level	EC50	95% CL	
0.0%			
5.0%			
10.0%			
20.0%			
Auto-40.0%			



C. dubia daily biological measurements (EPA 2002.0) Template version ACD-TIE BASELINE

TRTMNT (% Effl)	Rep	#Live Day 0	#Live Day 1	#Live Day 2	Final Mean % Live		
C	A	5	5	5	100.0		
	B	5	5	5			
Lab	C	5	5	5			
Control	D	5	5	5			
#1	A	5	5	2	55.0		
12.5	B	5	5	5			
% Effl	C	5	5	3			
	D	5	4	1			
# 2	A	5	5	0	15.0		
25	B	5	5	0			
% Effl	C	5	4	2			
	D	5	1	1			
# 3	A	5	0	0	25.0		
50.0	B	5	5	5			
% Effl	C	5	0	0			
	D	5	0	0			
# 4	A	5	0	0	25.0		
100	B	5	0	0			
% Effl	C	5	0	0		Test Duration:	47h 59m
	D	5	5	5			TAC 48+/-0.5h
INITIALS:		AK	CPV	LT	% CONTROL SURVIVAL:		100.0
DATE & TIME:		5/10/21 13:41	5/11/21 9:07	5/12/21 13:40			TAC = 90%
CHANGES & NOTES (INITIALS, DATE, SPECIFIC CHANGE MADE		EXTENDED STORAGE OF SAMPLE IN PVC BOTTLE (300 ml)					

	SPECIES:	Ceriodaphnia dubia		
	ACCLIMATION WATER:	Mod. Hard Synthetic Freshwater		
	FEEDING PRIOR TO TEST:	YCT + Selenastrum capricornutum		
	FEEDING DURING TEST:	None -YCT + Selenastrum 2+ h before test		
	SOURCE:	CBI Stock cultures		
	ACCLIMATION TEMP (o C):	25		
	BROOD RELEASE START DATE & TIME:	5/9/21 22:00		
	BROOD RELEASE END DATE & TIME:	5/10/21 6:00		
	DATE/TIME WATER ADDED:	5/10/21 12:43		
	DATE/TIME ANIMALS ADDED:	5/10/21 13:41		
	ANIMAL AGE WINDOW:	8h 0m		
	MAX AGE AT TEST START:	15h 41m		TAC Max. 24 h
	TEST SET UP BY:		AK	
	SAMPLE COLLECTION DATE &TIME:	4/29/21 23:59	SAMPLE USED	A
TEST ID:	SAMPLE AGE AT TEST START:	253h 42m	TAC Max 36 h	
AWSL2101-PVC	PEER REVIEW BY (INITIALS/DATE):		PB	5/12/21 14:32

Ceriodaphnia daily water quality bench sheet (EPA METHOD 2002.0) Template version ACD-TIE BASELINE

	TRTMNT	Day 0 Initial	Day 1	Day 2 Final	SUMMARY WATER QUALITY DATA MEAN	S.D.	MIN.	MAX.
pH (S.U.)	C	7.80	8.22	7.57	7.86	0.33	7.57	8.22
	1	8.08	8.18	7.65	7.97	0.28	7.65	8.18
	2	8.19	8.13	7.72	8.01	0.26	7.72	8.19
	3	8.38	8.19	7.83	8.13	0.28	7.83	8.38
	4	8.57	8.29	8.33	8.40	0.15	8.29	8.57
Temp. (o C)	C	25	25	25	25	0.0	25	25
	1	25	25	25	25	0.0	25	25
	2	25	25	25	25	0.0	25	25
	3	25	25	25	25	0.0	25	25
	4	25	25	25	25	0.0	25	25
Diss. Oxygen (mg/l)	C	8.2	7.9	8.2	8.1	0.2	7.9	8.2
	1	8.2	8.0	8.3	8.2	0.2	8.0	8.3
	2	8.2	8.0	8.3	8.2	0.2	8.0	8.3
	3	8.2	8.0	8.3	8.2	0.2	8.0	8.3
	4	8.2	8.0	8.2	8.1	0.1	8.0	8.2
Cond. (uS/cm)	C	310		299	305	7.8	299	310
	1	352			352		352	352
	2	403			403		403	403
	3	510			510		510	510
	4	784		785	785	0.7	784	785
Replicate measured		Flask	Surrogate	D				
Initials		AK	CPV	LT				
		TRC (mg/l) in highest conc. at end of test:		N/A				
Changes & Notes (Initials, date, specific change or notes)								

Test chamber:	30 ml plastic cup:	✓			
	Other:				
Test solution vol. (15 ml min):	15 ml:	✓			
	Other (ml):				
Illumination & photoperiod:	50-100 ft-c 16L:8D		Template Number:	7	
Number of replicates/treatment:	4				
Initial number animals/replicate:	5				
Test Aerated?	N/A	Date & Time Air Start:	N/A		

TEST ID	TRT ID:	1	2	3	4
AWSL2101-PVC	CONC(%):	12.5	25	50.0	100

Acute Ceriodaphnia Test-48 Hr Survival

Start Date:		Test ID:	AWSL2101P	Sample ID:	PVC
End Date:		Lab ID:	CBI	Sample Type:	
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	CD-Ceriodaphnia dubia
Comments:	DATA ENTERED BY PB				

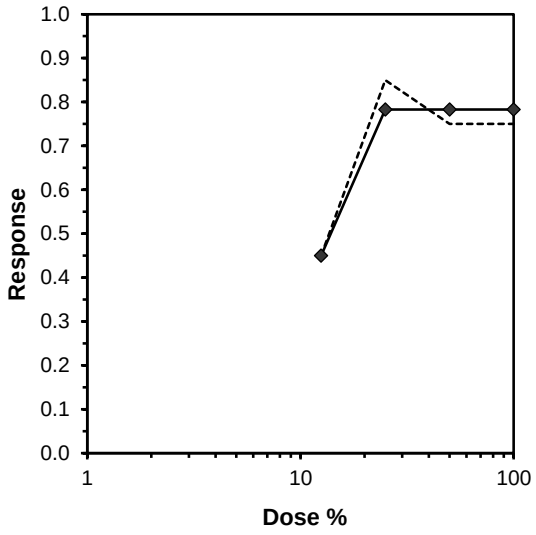
Conc-%	1	2	3	4
CONTROL	1.0000	1.0000	1.0000	1.0000
12.5	0.4000	1.0000	0.6000	0.2000
25	0.0000	0.0000	0.4000	0.2000
50	0.0000	1.0000	0.0000	0.0000
100	0.0000	0.0000	0.0000	1.0000

			Transform: Arcsin Square Root					Number	Total
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
CONTROL	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	0	20
12.5	0.5500	0.5500	0.8449	0.4636	1.3453	44.446	4	9	20
25	0.1500	0.1500	0.3998	0.2255	0.6847	55.174	4	17	20
50	0.2500	0.2500	0.5055	0.2255	1.3453	110.768	4	15	20
100	0.2500	0.2500	0.5055	0.2255	1.3453	110.768	4	15	20

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.80768	0.868	1.42924	1.34743
Equality of variance cannot be confirmed				

Trimmed Spearman-Karber

Trim Level	EC50	95% CL	
0.0%			
5.0%			
10.0%			
20.0%			
Auto-45.0%			



pd

Effluent and Dilution Water Log (Freshwater Tests). FWEFFL061013

											SUMMARY WATER QUALITY DATA				
Initial sample charac-terization	Bottle(1):	A1									MEAN	S.D.	MIN.	MAX.	PARAMETER
	Arrival Temp. (oC, from CoC):	1									1		1	1	Arrival Temp.
	TRC (mg/l)(2):	<DL													
	TRC Corrected(2):														
	Hardness (mg/l):	130									130		130	130	Hardness (mg/l)
	Alkalinity (mg/l):	259									259		259	259	Alkalinity (mg/l)
	NH3-N (mg/l):	<1.0													
	Color/Appearance(3):	C													
	Obvious odor?	NO													
	Date & Time:	4/29/21 16:21													
	Initials:	AK													
Sample prep measure-ments	Test Day:	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7		MEAN	S.D.	MIN.	MAX.	
	Bottle(s):	A1													
	Prep. Temp. (oC):	25									25		25	25	Temp. (oC)
	D.O. (mg/l) After Warming:	8.0													
	Aeration Time (min):	0													
	Adjusted D.O. (mg/l):	8.0									8.0		8.0	8.0	D.O. (mg/l)
	Final pH (S.U.):	7.91									7.91		7.91	7.91	pH (S.U.)
	Conductivity (uS/cm)(4):	771									771		771	771	Cond. (uS/cm)
	Final TRC (mg/l)(5):	N.D.													
	Sample Filtered (60 um)?														
	Date & Time:	5/1/21 10:31													
	Initials:	AK													
Dilution water	Test Day:	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7		MEAN	S.D.	MIN.	MAX.	
	Vat Number:	1													
	Temperature (oC):	25									25		25	25	Temp. (oC)
	Conductivity (uS/cm):	310									310		310	310	Cond. (uS/cm)
	D.O. (mg/l):	8.2									8.2		8.2	8.2	D.O. (mg/l)
	pH (S.U.):	7.83									7.83		7.83	7.83	pH (S.U.)
	Hardness (mg/l):	92									92		92	92	Hardness (mg/l)
	Alkalinity (mg/l):	62									62		62	62	Alkalinity (mg/l)
	Date & Time:	5/1/21 8:30													
	Initials:	AK													
	Changes & Notes (Initials, date, specific change or notes)														
	Peer review Initial/Date:	PB	5/6/21 10:18	DILUTION WATER TYPE:	Mod. Hard Synthetic Freshwater (EPA)	ND=Not Determined/Measured, NA=Not Applicable. 1) Ninth character of lab sample ID on chain of custody AND bottle number in collection series. Together with Project ID constitutes entire sample bottle ID. 2) TRC MDL 0.02 mg/l; QL 0.22 mg/l. Corrected value if Mn, Cr potential positive interference. Corrected using KI and NaAsO2. 3) C-clear, O-opaque, T-turbid, S-solids (Sl-slight, M-moderate, H-heavy), Y-yellow, B-brown, Bl-black, G-green, P-pink, Gr-grey, Or-orange. 4) Measured on first use of sample only. 5) Final TRC measured only if chlorine present in initial characterization.												
PROJECT ID:	AWSL2101	ADDITIONAL EFFLUENT TREATMENT:													

ENTHALPY ANALYTICAL

COASTAL BIOANALYSTS

1941 REYMET ROAD
RICHMOND, VIRGINIA 23237
(804) 358-8295 PHONE
(804)358-8297 FAX

Chain of Custody
Effective: Mar 10, 2021

AWSL2101-A 21-0601 CHAIN OF CUSTODY Q2-ACD PAGE 1 OF

COMPANY NAME: AIR WATER AND SOIL	INVOICE TO: AIR WATER AND SOIL	PROJECT NAME/Quote #: 21D1297
CONTACT: KATRINA COOKE	INVOICE CONTACT: KATHARINE CLARK	SITE NAME: 21D1297
ADDRESS: 1941 REYMET ROAD RICHMOND, VA 23237	INVOICE ADDRESS:	PROJECT NUMBER: 21D1297
PHONE #: 804.358.8295	INVOICE PHONE #:	P.O. #: PO-008557
FAX #: 804.358.8297	EMAIL: support@awslabs.com	Pretreatment Program:

Is sample for compliance reporting? YES NO | Regulatory State: VA | Is sample from a chlorinated supply? YES NO | PWS I.D. #: 15-21

SAMPLER NAME (PRINT): DENISE VAUGHN | SAMPLER SIGNATURE: | Turn Around Time: Circle 10 5 Days or _Day(s)

Matrix Codes: WW=Waste Water/Storm Water GW=Ground Water DW=Drinking Water S=Soil/Solids OR=Organic A=Air WP=Wipe OT=Other_____

CLIENT SAMPLE I.D.	Grab	Composite	Field Filtered (Dissolved Metals)	Composite Start Date	Composite Start Time	Grab Date or Composite Stop Date	Grab Time or Composite Stop Time	Time Preserved 4.30.21	Matrix (See Codes)	Number of Containers	ANALYSIS / (PRESERVATIVE): ACUTE TOX - CERIODAPHNIA DUBIA AND PIMEPHALES							COMMENTS: Preservative Codes: N=Nitric Acid C=Hydrochloric Acid S=Sulfuric Acid H=Sodium Hydroxide A=Ascorbic Acid Z=Zinc Acetate T=Sodium Thiosulfate M=Methanol; PLEASE NOTE PRESERVATIVE(S), INTERFERENCE CHECKS or PUMP RATE (L/min)
1) 21D1297-01 029		X		29 Apr'21	00:00	29 Apr'21	23:59	9.15	WW	2	X							
2)																		
3)																		
4)																		
5)																		
6)																		
7)																		
8)																		
9)																		
10)																		

RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME
[signature]	4-30-21 14:27	K Kurkowski	4/30/21 1227
RELINQUISHED:	DATE / TIME	RECEIVED: A Krueger	DATE / TIME 4/30/21 1615
RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME

QC Data Package
Level III ☐
Level IV ☐

LAB USE ONLY Therm ID: _____ COOLER TEMP _____°C
Custody Seals used and intact? (Y / N) Received on ice? (Y / N)

TV: AK 1°C

Unless otherwise agreed in writing, any and all products and/or services provided by Enthalpy are pursuant to the terms and conditions as set forth at https://enthalpy.com/terms-and-conditions/

EA COC_v210310.xls

ENTHALPY ANALYTICAL
formerly Air, Water & Soil Laboratories

1941 Reymet Road ● Richmond, Virginia 23237 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Laboratory Order ID 21H1405

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford, VA 24141	Date Received:	August 27, 2021 11:13
		Date Issued:	September 3, 2021 16:17
		Project Number:	[none]
Submitted To:	Sheree Andrews	Purchase Order:	RFAC-032621-01-RLL
Client Site I.D.:	029 3rd Quarter Toxicity TIE		

Enclosed are the results of analyses for samples received by the laboratory on 08/27/2021 11:13. If you have any questions concerning this report, please feel free to contact the laboratory.

Sincerely,

Ted Soyars

Ted Soyars
Technical Director

End Notes:

The test results listed in this report relate only to the samples submitted to the laboratory and as received by the Laboratory.

Unless otherwise noted, the test results for solid materials are calculated on a wet weight basis. Analyses for pH, dissolved oxygen, temperature, residual chlorine and sulfite that are performed in the laboratory do not meet NELAC requirements due to extremely short holding times. These analyses should be performed in the field. The results of field analyses performed by the Sampler included in the Certificate of Analysis are done so at the client's request and are not included in the laboratory's fields of certification nor have they been audited for adherence to a reference method or procedure.

The signature on the final report certifies that these results conform to all applicable NELAC standards unless otherwise specified. For a complete list of the Laboratory's NELAC certified parameters please contact customer service.

This report shall not be reproduced except in full without the expressed and written approval of an authorized representative of Air Water & Soil Laboratories, Inc.

NELAP ACCREDITED TNI LABORATORY

ENTHALPY ANALYTICAL
formerly Air, Water & Soil Laboratories

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued:	September 03, 2021 16:17
		Project Number:	[none]
		Purchase Order:	RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	029 3rd Quarter Toxicity TIE		

ANALYTICAL REPORT FOR SAMPLES

Laboratory Order ID 21H1405

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
029 Annual Acute CD&PP	21H1405-01	Waste Water	08/24/2021 00:00 to 08/24/2021 23:59	08/27/2021 11:13

ENTHALPY ANALYTICAL
formerly Air, Water & Soil Laboratories

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued:	September 03, 2021 16:17
		Project Number:	[none]
		Purchase Order:	RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	029 3rd Quarter Toxicity TIE		

Laboratory Order ID: 21H1405

Analytical Results

Sample I.D. 029 Annual Acute CD&PP **Laboratory Sample ID:** 21H1405-01

Composite Start-End Date/Time: 08/24/2021 00:00 - 08/24/2021 23:59

Field Residual Cl: **Field pH:**

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Subcontracted Analysis									
Acute Toxicity CD	01	EPA	Attached		--	1	09/03/21 15:26	09/03/21 15:28	N/A

Analytical Summary

Sample ID	Preparation Factors Initial / Final	Method	Batch ID	Sequence ID	Calibration ID
Subcontracted Analysis		**Preparation Method:**	***** DEFAULT PREP *****		
21H1405-01	1.00 mL / 1.00 mL	EPA	BEI0153		

ENTHALPY ANALYTICAL
formerly Air, Water & Soil Laboratories

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued:	September 03, 2021 16:17
		Project Number:	[none]
		Purchase Order:	RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	029 3rd Quarter Toxicity TIE		

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued:	September 03, 2021 16:17
		Project Number:	[none]
		Purchase Order:	RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	029 3rd Quarter Toxicity TIE		

Certified Analyses included in this Report

Analyte **Certifications**

Code	Description	Laboratory ID	Expires
MADEP	Massachusetts DEP	M-VA913	06/30/2022
MdDOE	Maryland DE Drinking Water	341	12/31/2021
NC	North Carolina DENR	495	12/31/2021
NCDEQ	North Carolina DEQ	495	12/31/2021
NCDOH	North Carolina Department of Health	51714	07/31/2022
NHDES	NELAP-New Hampshire Certificate #224221	2242	02/25/2022
NJDEP	NELAP-New Jersey DEP	VA015	06/30/2022
NYDOH	New York DOH Drinking Water	12096	04/01/2022
PADEP	NELAP-Pennsylvania Certificate #006	68-03503	10/31/2021
VELAP	NELAP-Virginia Certificate #11539	460021	06/14/2022
WVDEP	West Virginia DEP	350	10/31/2021

ENTHALPY ANALYTICAL
formerly Air, Water & Soil Laboratories

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued:	September 03, 2021 16:17
		Project Number:	[none]
		Purchase Order:	RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	029 3rd Quarter Toxicity TIE		

Summary of Data Qualifiers

Attached	Attached
RPD	Relative Percent Difference
Qual	Qualifers
-RE	Denotes sample was re-analyzed
D.F.	Dilution Factor. Please also see the Preparation Factor in the Analysis Summary section.
TIC	Tentatively Identified Compounds are compounds that are identified by comparing the analyte mass spectral pattern with the NIST spectral library. A TIC spectral match is reported when the pattern is at least 75% consistent with the published pattern. Compound concentrations are estimated and are calculated using an internal standard response factor of 1.
PCBs, Total	Total PCBs are defined as the sum of detected Aroclors 1016, 1221, 1232, 1248, 1254, 1260, 1262, and 1268.

ENTHALPY ANALYTICAL
formerly *Air, Water & Soil Laboratories*

1941 REYMET ROAD
RICHMOND, VIRGINIA 23237
(804) 358-8295 PHONE
(804)358-8297 FAX

Chain of Custody
Effective: Nov 15, 2018

CHAIN OF CUSTODY

COMPANY NAME: BAE Systems, Inc. - RFAAP	INVOICE TO: Accounts Payable	PROJECT NAME: 029 3rd Quarter Toxicity
CONTACT: Sheree Andrews	INVOICE CONTACT:	SITE NAME:
ADDRESS: Route 114 Radford, Va 24141	INVOICE ADDRESS:	PROJECT NUMBER:
PHONE #: 1-540-717-4092	INVOICE PHONE #:	P.O. #:
FAX #: / EMAIL: Sheree.andrews@baesystems.com		Pretreatment Program:
Is sample for compliance reporting? YES	Regulatory State: Va / Is sample from a chlorinated supply? YES NO	PWS I.D. #:
SAMPLER NAME (PRINT): Denise Vaughn	SAMPLER SIGNATURE: Denise Vaughn	Turn Around Time: Circle 10 5 Days or _Day(s)

Matrix Codes: WW=Waste Water/Storm Water GW=Ground Water DW=Drinking Water S=Soil/Solids OR=Organic A=Air WP=Wipe OT=Other_____

CLIENT SAMPLE I.D.	Grab	Composite	Field Filtered (Dissolved Metals)	Composite Start Date	Composite Start Time	Grab Date or Composite Stop Date	Grab Time or Composite Stop Time	Time Preserved	Matrix (See Codes)	Number of Containers	ANALYSIS / (PRESERVATIVE): Acute Toxicity - Ceriodaphnia dubia	Acute Toxicity - Pimephales							COMMENTS: Preservative Codes: N=Nitric Acid C=Hydrochloric Acid S=Sulfuric Acid H=Sodium Hydroxide A=Ascorbic Acid Z=Zinc Acetate T=Sodium Thiosulfate M=Methanol; PLEASE NOTE PRESERVATIVE(S), INTERFERENCE CHECKS or PUMP RATE (L/min)
1) 029 Annual Acute-cd&pp		X		8.24.21	0000	8.24.21	2359		WW	2	x	x							
2)																			
3)																			
4)																			
5)																			
6)																			
7)																			
8)																			
9)																			
10)																			

BAE Systems, Inc. 21H1405
Toxicity
Recd: 08/27/2021 Due: 09/20/2021
v130325002

RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME
Denise Vaughn	8.25.21 0839	[illegible] 8/25/21	0839
[illegible]	8/25/21 1304	[illegible] 8/25/21	1304

QC Data Package
Level III ☐
Level IV ☐

LAB USE ONLY Therm ID: 177 COOLER TEMP 1.2 °C
Custody Seals used and intact? (Y / N) Received on ice? (Y / N)

BAE Systems, Inc. 21H1266
Toxicity
Recd: 08/25/2021 Due: 09/01/2021
v130325002

ENTHALPY ANALYTICAL
formerly Air, Water & Soil Laboratories

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued:	September 03, 2021 16:17
		Project Number:	[none]
		Purchase Order:	RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	029 3rd Quarter Toxicity TIE		

Sample Conditions Checklist

Samples Received at:	**1.20°C**
How were samples received?	AWS Courier
Were Custody Seals used? If so, were they received intact?	No
Are the custody papers filled out completely and correctly?	Yes
Do all bottle labels agree with custody papers?	Yes
Is the temperature blank or representative sample within acceptable limits or received on ice, and recently taken?	Yes
Are all samples within holding time for requested laboratory tests?	Yes
Is a sufficient amount of sample provided to perform the tests included?	Yes
Are all samples in appropriate containers for the analyses requested?	Yes
Were volatile organic containers received?	No
Are all volatile organic and TOX containers free of headspace?	NA
Is a trip blank provided for each VOC sample set? VOC sample sets include EPA8011, EPA504, EPA8260, EPA624, EPA8015 GRO, EPA8021, EPA524, and RSK-175.	NA
Are all samples received appropriately preserved? Note that metals containers do not require field preservation but lab preservation may delay analysis.	Yes

Per Sheree Andrews, 21H1266 is to be relogged for TIE Toxicity testing.

KLC 8-27-2021

Coastal Bioanalysts, Inc.

Report of Analysis: Whole Effluent Toxicity (WET): Phase I Toxicity Identification Evaluation Tests

Submitted To:	**Prepared By:**
Katrina Cooke Senior Project Manager Enthalpy Analytical/Air, Water and Soil Laboratories 1941 Reymet Road Richmond, VA 23237	Coastal Bioanalysts, Inc. 6400 Enterprise Court Gloucester, VA 23061 (804) 694-8285 www.coastalbio.com Contact: Peter F. De Lisle, Technical Director

METHODS

TIE test methods followed the EPA Phase I acute TIE protocols (*Methods for Aquatic Toxicity Identification Evaluations: Phase I Toxicity Characterization Procedures, 2nd ed.* February 1991. EPA/600/6-91/003). Additional detailed information, including summary procedures, is provided in the attached bench sheets. Tests were conducted with fathead minnows due to higher sensitivity (compared to *Ceriodaphnia)* observed in initial tests.

RESULTS

Test	Test Date	LC50 (% sample)	95% C.L.
Initial	8/25/21	31.9	28.5-35.6
Baseline	8/27/21	38.5	27.1-55.5
Aeration	8/27/21	30.0	21.7-38.6
Filtration	8/27/21	37.9	33.2-43.2
EDTA	8/27/21	N/A*	N/A
pH 7	8/27/21	22.6	16.5-30.3
pH 9	8/27/21	27.2	20.3-36.4
SPE HLB	8/27/21	>100	N/A
Thiosulfate	8/27/21	N/A*	N/A
pH 3 Adjusted	8/27/21	55.1	38.2-92.0
pH 3 Aeration	8/27/21	51.3	36.4-77.0
pH 3 Filtration	8/27/21	38.0	24.7-59.8
pH 3 HLB SPE	8/27/21	>100	N/A
pH 11 Adjusted	8/27/21	37.7	27.4-52.0
pH 11 Aeration	8/27/21	30.9	23.3-40.9
pH 11 Filtration	8/27/21	37.9	33.2-43.2
pH 11 HLB SPE	8/27/21	>100	N/A

*EDTA and thiosulfate tests are not designed for determination of LC50. No reduction in toxicity observed for these tests.

Sample toxicity did not decrease significantly during storage between the initial and TIE testing dates, as indicated by overlapping 95% confidence limits of corresponding initial and baseline LC50 values. The HLB SPE columns removed toxicity completely at pH 3, pH 11 and ambient pH.

VELAP# 460030
EPA# VA01116

Coastal Bioanalysts, Inc.

DISCUSSION

Toxicity removal was due to adsorption of the causative toxicant by the HLB columns. The columns did not remove toxicity through simple physical filtration as indicated by the lack of toxicity removal by 1 µm glass fiber filters.

LITERATURE CITED

EPA 1991. *Toxicity Identification Evaluation: Characterization of Chronically Toxic Effluents, Phase I.* June 1992. EPA/600/6-91/005F.

QA/QC

Acute Test QA/QC	Reference Toxicant: KCl	Units: mg/l	Test Organism Source: CBI Stock Cultures		
Species-Method (Ref. Test Date)	**Data Source**	**% Control Survival**	**48-h LC50**	**95% C.L./A.L. For LC50**	**RTT in Control?**
P. promelas 2000.0	RTT	100	905	823-997	Yes
(8/3/21-8/5/21)	CC	100	1029	865-1193	

Note: RTT = Reference Toxicant Test, CC = Control Chart.

The results of analysis contained within this report relate only to the sample as received in the laboratory. This report shall not be reproduced except in full without written approval from the laboratory. Unless noted below, these test results meet all requirements of NELAP.

APPROVED: Peter F. De Lisle

Digitally signed by Peter F. De Lisle
DN: cn=Peter F. De Lisle, o=Coastal Bioanalysts, Inc., ou=Toxicology, email=pfd@coastalbio.com, c=US
Date: 2021.09.03 14:01:33 -04'00'

Peter F. De Lisle, Ph.D.
Technical Director

Deviations from, additions to, or exclusions from the test method, non-standard conditions or data qualifiers and, as appropriate, a statement of compliance/non-compliance: **NONE**

Please leave feedback regarding our services at: http://coastalbio.com/survey

GLOSSARY OF TERMS AND ABBREVIATIONS

A.L. (Acceptance Limits): The results of a given reference toxicant test are compared to the control chart mean value ± 2 standard deviations. These limits approximate the 95% probability limits for the "true" reference toxicant value.

Chronic Value (ChrV): The geometric mean of the NOEC and LOEC. Units are same as test concentration units.

C.L. (Confidence Limits): These are the probability limits, based on the data set and statistical model employed, that the "true value" lies within the limits specified. Typically limits are based on 95% or 99% probabilities.

Control chart: A cumulative summary chart of results from QC tests with reference toxicants. The results of a given reference toxicant test are compared to the control chart mean value and 95% Acceptance Limits (A.L.) (mean ± 2 standard deviations).

IC25: The concentration of sample or chemical, calculated from the data set using statistical models, causing a 25% reduction in test organism growth, reproduction, etc. The lower the IC25, the more toxic the chemical or sample. Units are same as test concentration units.

VELAP# 460030
EPA# VA01116

LC50: The concentration of sample or chemical, calculated from the data set using statistical models, causing a 50% reduction in test organism survival. The lower the LC50, the more toxic the chemical or sample. Units are same as test concentration units. Note: The LC50 value must always be associated with the duration of exposure. Thus 48-h LC50, 96-h LC50, etc. are calculated.

LOEC: Lowest-observable-effect-concentration. The lowest concentration of sample or chemical in a chronic test dilution series in which the test organisms exhibit a statistically significant reduction in any of the test end points (e.g. growth, survival, reproduction) compared to control organisms. Units are same as test concentration units.

PMSD: Percent Minimum Significant Difference: The minimum difference which can exist between a test treatment and the controls in a particular test and be statistically significant; a measure of test sensitivity. The lower the PMSD the more sensitive the test.

N/A: Not applicable.

N/D: Not determined or measured.

NOAEC: No-observable-acute-effect-concentration. The highest concentration of sample or chemical in an acute test dilution series in which the test organisms exhibit no statistically significant reduction in the test end point (e.g. survival) compared to control organisms. Units are same as test concentration units.

NOEC: No-observable-effect-concentration. The highest concentration of sample or chemical in a chronic test dilution series in which the test organisms exhibit no statistically significant reduction in any of the test end points (e.g. growth, survival, reproduction) compared to control organisms. Some regulatory definitions also require that the NOEC be less than the LOEC. Units are same as test concentration units.

Q.L.: Quantitation Limit. Level, concentration, or quantity of a target variable (analyte) that can be reported at a specified degree of confidence.

T.U.: Toxic units. Expresses the relative toxicity of an effluent in such a manner that the larger the toxic unit value the more toxic the effluent. $T.U._{Ac} = 100/LC50$. $T.U._{Chr} = 100/NOEC$. A dimensionless unit.

P. promelas daily biological measurements (EPA 2000.0) Template version APP-STAT-48h-5trt-061113

TRTMNT (%Effl)	Rep	#Live Day 0	#Live Day 1	#Live Day 2	Final Mean % Live		
C	A	10	10	10	100.0		
Lab Control	B	10	10	10			
#1	A	10	10	10	100.0		
6.25	B	10	10	10			
# 2	A	10	10	10	100.0		
12.5	B	10	10	10			
# 3	A	10	10	8	85.0		
25.0	B	10	10	9			
# 4	A	10	4	0	0.0		
50.0	B	10	2	0			
# 5	A	10	0	0	0.0	Test Duration:	48h 1m
100	B	10	0	0			TAC 48+/-0.5h
INITIALS:		AK	CPV	LT	% CONTROL SURVIVAL:		100.0
DATE & TIME:		8/25/21 15:57	8/26/21 8:54	8/27/21 15:57			TAC = 90%
CHANGES & NOTES (INITIALS, DATE, SPECIFIC CHANGE MADE							

SPECIES:	Pimephales promelas		
ACCLIMATION WATER:	Mod. Hard Synthetic Freshwater		
FEEDING PRIOR TO TEST:	Artemia nauplii ad libitum		
FEEDING DURING TEST:	None		
SOURCE:	CBI Stock cultures		
ACCLIMATION TEMP (o C):	25		
HATCH START DATE & TIME:	8/20/21 17:00		
HATCH END DATE & TIME:	8/21/21 9:00		
DATE/TIME WATER ADDED:	8/25/21 15:49		
DATE/TIME ANIMALS ADDED:	8/25/21 15:57		
ANIMAL AGE WINDOW:	16h 0m	TAC Max. 24 h	
MAX AGE AT TEST START:	5d	TAC Max. 14 d	
TEST SET UP BY:		AK	
SAMPLE COLLECTION DATE & TIME:	8/24/21 23:59	SAMPLE USED	A
SAMPLE AGE AT TEST START:	15h 58m	TAC MAX 36 h	
PEER REVIEW BY (INITIALS/DATE):		PB	8/30/21 12:43

TEST ID: AWSL2109APP

P. promelas daily water quality bench sheet (EPA METHOD 2002.0) Template version APP-STAT-48h-5trt-06113

	TRTMNT	Day 0 Initial	Day 1	Day 2 Final	SUMMARY WATER QUALITY DATA MEAN	S.D.	MIN.	MAX.
pH (S.U.)	C	7.85	8.35	7.62	7.94	0.37	7.62	8.35
	1	7.88	8.18	7.65	7.90	0.27	7.65	8.18
	2	7.94	8.14	7.67	7.92	0.24	7.67	8.14
	3	7.99	8.14	7.72	7.95	0.21	7.72	8.14
	4	8.14	8.16	8.00	8.10	0.09	8.00	8.16
	5	8.31	8.26		8.29	0.04	8.26	8.31
Temp. (o C)	C	25	25	25	25	0.0	25	25
	1	25	25	25	25	0.0	25	25
	2	25	25	25	25	0.0	25	25
	3	25	25	25	25	0.0	25	25
	4	25	25	25	25	0.0	25	25
	5	25	25		25	0.0	25	25
Diss. Oxygen (mg/l)	C	8.2	7.8	7.7	7.9	0.3	7.7	8.2
	1	8.2	7.7	7.7	7.9	0.3	7.7	8.2
	2	8.2	7.8	7.6	7.9	0.3	7.6	8.2
	3	8.2	7.8	7.7	7.9	0.3	7.7	8.2
	4	8.2	7.9	7.6	7.9	0.3	7.6	8.2
	5	8.2	7.8		8.0	0.3	7.8	8.2
Cond. (uS/cm)	C	298		306	302	5.7	298	306
	1	326			326		326	326
	2	354			354		354	354
	3	390			390		390	390
	4	506		527	517	14.8	506	527
	5	728			728		728	728
Replicate measured		B	A	B				
Initials		AK	CPV	LT				
		TRC (mg/l) in highest conc. at end of test:		NA				
Changes & Notes (Initials, date, specific change or notes)								

Test chamber:	400 ml Tri-pour bkr:	✓			
	Other:				
Test solution vol. (200 ml min):	400 ml:	✓			
	Other (ml):				
Illumination & photoperiod:	50-100 ft-c 16L:8D				
Number of replicates/treatment:	2				
Initial number animals/replicate:	10				
Test Aerated?	No	Date & Time Air Start:			

TEST ID	TRT ID:	1	2	3	4	5	D.O. Highest conc. @ aeration:
AWSL2109APP	CONC (%):	6.25	12.5	25.0	50.0	100	Total live highest conc.@ aeration

Acute Fish Test-48 Hr Survival

Start Date:		Test ID:	AWSL2109PP	Sample ID:	INITIAL
End Date:		Lab ID:	CBI	Sample Type:	
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	PP-Pimephales promelas
Comments:	DATA ENTERED BY PB				

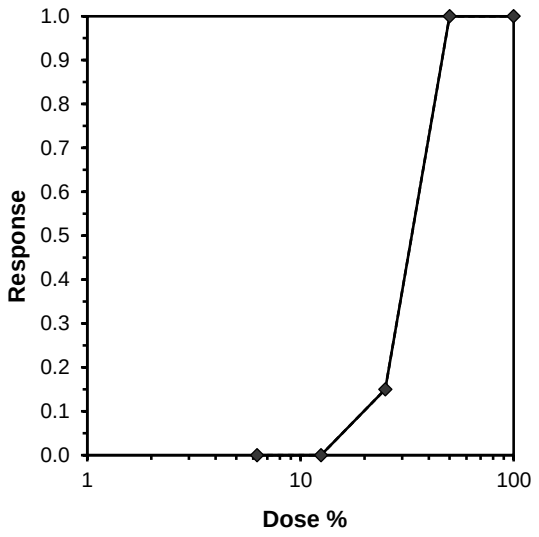
Conc-%	1	2
CONTROL	1.0000	1.0000
6.25	1.0000	1.0000
12.5	1.0000	1.0000
25	0.8000	0.9000
50	0.0000	0.0000
100	0.0000	0.0000

			Transform: Arcsin Square Root					Number	Total
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
CONTROL	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	2	0	20
6.25	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	2	0	20
12.5	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	2	0	20
25	0.8500	0.8500	1.1781	1.1071	1.2490	8.517	2	3	20
50	0.0000	0.0000	0.1588	0.1588	0.1588	0.000	2	20	20
100	0.0000	0.0000	0.1588	0.1588	0.1588	0.000	2	20	20

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Normality of the data set cannot be confirmed				
Equality of variance cannot be confirmed				

Trimmed Spearman-Karber

Trim Level	EC50	95% CL	
0.0%	31.864	28.525	35.594
5.0%	32.562	28.604	37.068
10.0%	33.061	27.944	39.114
20.0%	33.258	30.805	35.905
Auto-0.0%			



P. promelas APP-TIE BASELINE

TRTMNT (% Effl)	Rep	#Live Day 0	#Live Day 1	#Live Day 2	Final Mean % Live
C	A	5	5	5	100.0
Control	B	5	5	5	
#1	A	5	5	5	100.0
12.5	B	5	5	5	
# 2	A	5	5	4	70.0
25	B	5	5	3	
# 3	A	5	5	2	30.0
50.0	B	5	4	1	
# 4	A	5	1	1	10.0
100	B	5	0	0	
INITIALS:		LT	LT	LT	% CONTROL SURVIVAL: 100.0
DATE & TIME:		8/27/21 10:28	8/28/21 7:47	8/29/21 10:46	TAC = 90%
CHANGES & NOTES (INITIALS, DATE, SPECIFIC CHANGE MADE					

SPECIES:	Pimephales promelas		
ACCLIMATION WATER:	Mod. Hard Synthetic Freshwater		
FEEDING PRIOR TO TEST:	Artemia nauplii ad libitum		
FEEDING DURING TEST:	None		
SOURCE:	CBI Stock cultures		
ACCLIMATION TEMP (o C):	25		
HATCH START DATE & TIME:	8/26/21 17:00		
HATCH END DATE & TIME:	8/27/21 10:00		
DATE/TIME WATER ADDED:	8/27/21 10:28		
DATE/TIME ANIMALS ADDED:	8/27/21 10:28		
ANIMAL AGE WINDOW:	17h 0m	TAC Max. 24 h	
MAX AGE AT TEST START:	1d	TAC Max. 14 d	
TEST SET UP BY:		LT	
SAMPLE COLLECTION DATE &TIME:	8/24/21 23:59	SAMPLE USED	A
TEST ID:			
AWSL2109-BL	PEER REVIEW BY (INITIALS/DATE):	PB	8/30/21 16:36

P. promelas APP-TIE BASELINE

	TRTMNT	Day 0 Initial	Day 1	Day 2 Final	SUMMARY WATER QUALITY DATA MEAN	S.D.	MIN.	MAX.
pH (S.U.)	C	7.89	7.69	7.76	7.78	0.10	7.69	7.89
	1	7.91	7.79	7.76	7.82	0.08	7.76	7.91
	2	7.96	7.86	7.81	7.88	0.08	7.81	7.96
	3	8.00	8.06	8.00	8.02	0.03	8.00	8.06
	4	8.25	8.36	8.25	8.29	0.06	8.25	8.36
Temp. (o C)	C	25	25	25	25	0.0	25	25
	1	25	25	25	25	0.0	25	25
	2	25	25	25	25	0.0	25	25
	3	25	25	25	25	0.0	25	25
	4	25	25	25	25	0.0	25	25
Diss. Oxygen (mg/l)	C	8.2	8.1	8.0	8.1	0.1	8.0	8.2
	1	8.2	8.1	8.0	8.1	0.1	8.0	8.2
	2	8.2	8.1	8.0	8.1	0.1	8.0	8.2
	3	8.2	7.9	7.7	7.9	0.3	7.7	8.2
	4	8.2	7.9	7.0	7.7	0.6	7.0	8.2
Cond. (uS/cm)	C	312		320	316	5.7	312	320
	1	372			372		372	372
	2	425			425		425	425
	3	547			547		547	547
	4	725		762	744	26.2	725	762
Replicate measured		Flask	Surrogate	A				
Initials		LT	LT	LT				
		TRC (mg/l) in highest conc. at end of test:		N/A				
Changes & Notes (Initials, date, specific change or notes)								

Test chamber:	30 ml plastic cup:	✓		
	Other:			
Test solution vol. (15 ml min):	30 ml:	✓		
	Other (ml):			
Illumination & photoperiod:	50-100 ft-c 16L:8D			
Number of replicates/treatment:	2			
Initial number animals/replicate:	5			
Test Aerated?	N/A	Date & Time Air Start:	N/A	

TEST ID	TRT ID:	1	2	3	4
AWSL2109-BL	CONC(%):	12.5	25	50.0	100

Acute Fish Test-48 Hr Survival

Start Date:		Test ID:	AWSL2109B	Sample ID:	BASELINE
End Date:		Lab ID:	CBI	Sample Type:	
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	PP-Pimephales promelas
Comments:	DATA ENTERED BY PB				

Conc-%	1	2
CONTROL	1.0000	1.0000
12.5	1.0000	1.0000
25	0.8000	0.6000
50	0.4000	0.2000
100	0.2000	0.0000

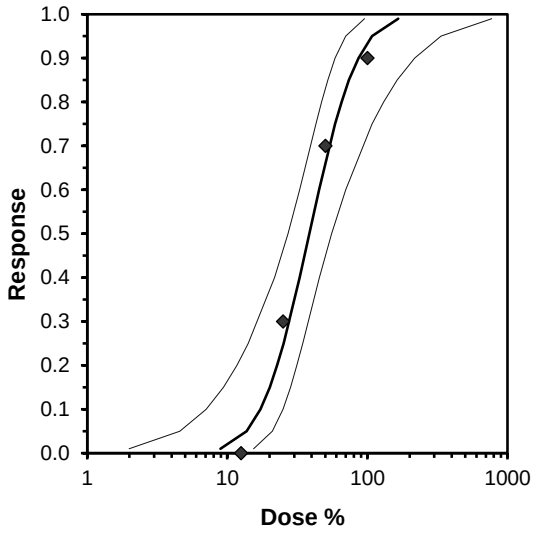
			Transform: Arcsin Square Root					Number	Total
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
CONTROL	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	2	0	10
12.5	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	2	0	10
25	0.7000	0.7000	0.9966	0.8861	1.1071	15.685	2	3	10
50	0.3000	0.3000	0.5742	0.4636	0.6847	27.225	2	7	10
100	0.1000	0.1000	0.3446	0.2255	0.4636	48.867	2	9	10

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Normality of the data set cannot be confirmed				
Equality of variance cannot be confirmed				

Maximum Likelihood-Probit

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	3.66336	0.93164	1.83736	5.48937	0	0.81622	5.99148	0.66	1.58595	0.27297	5
Intercept	-0.80991	1.49132	-3.73289	2.11307							
TSCR											

Point	Probits	%	95% Fiducial Limits	
EC01	2.674	8.9314	1.99459	15.3997
EC05	3.355	13.7072	4.57228	21.0036
EC10	3.718	17.2235	7.05402	24.9979
EC15	3.964	20.0924	9.39187	28.291
EC20	4.158	22.7096	11.7253	31.3901
EC25	4.326	25.2251	14.1051	34.5104
EC40	4.747	32.8695	21.6828	45.4092
EC50	5.000			
EC60	5.253	45.1968	32.8919	69.8631
EC75	5.674	58.8936	42.9198	108.296
EC80	5.842	65.417	47.0895	130.543
EC85	6.036	73.9382	52.1567	163.262
EC90	6.282	86.2541	58.9384	217.7
EC95	6.645	108.381	70.0496	336.329
EC99	7.326	166.334	95.417	771.974



P. promelas APP-TIE AERATION

TRTMNT (% Effl)	Rep	#Live Day 0	#Live Day 1	#Live Day 2	Final Mean % Live
C	A	5	5	5	100.0
Control	B	5	5	5	
#1	A	5	5	5	100.0
12.5	B	5	5	5	
# 2	A	5	5	4	60.0
25	B	5	5	2	
# 3	A	5	5	0	10.0
50.0	B	5	5	1	
# 4	A	5	0	0	0.0
100	B	5	0	0	
INITIALS:		LT	LT	LT	% CONTROL SURVIVAL: 100.0
DATE & TIME:		8/27/21 12:32	8/28/21 8:07	8/29/21 12:48	TAC = 90%
CHANGES & NOTES (INITIALS, DATE, SPECIFIC CHANGE MADE					

SPECIES:	Pimephales promelas		
ACCLIMATION WATER:	Mod. Hard Synthetic Freshwater		
FEEDING PRIOR TO TEST:	Artemia nauplii ad libitum		
FEEDING DURING TEST:	None		
SOURCE:	CBI Stock cultures		
ACCLIMATION TEMP (o C):	25		
HATCH START DATE & TIME:	8/24/21 17:00		
HATCH END DATE & TIME:	8/25/21 10:00		
DATE/TIME WATER ADDED:	8/27/21 12:28		
DATE/TIME ANIMALS ADDED:	8/27/21 12:32		
ANIMAL AGE WINDOW:	17h 0m	TAC Max. 24 h	
MAX AGE AT TEST START:	3d	TAC Max. 14 d	
TEST SET UP BY:	LT		
PEER REVIEW BY (INITIALS/DATE):	PB	8/30/21 13:57	

AWSL2109-AER

P. promelas APP-TIE AERATION

	TRTMNT	Day 0 Initial	Day 1	Day 2 Final	SUMMARY WATER QUALITY DATA MEAN	S.D.	MIN.	MAX.
pH (S.U.)	C	7.80	7.82	7.72	7.78	0.05	7.72	7.82
	1	7.79	7.85	7.74	7.79	0.06	7.74	7.85
	2	7.82	7.93	7.80	7.85	0.07	7.80	7.93
	3	7.99	8.15	8.05	8.06	0.08	7.99	8.15
	4	8.05	8.43		8.24	0.27	8.05	8.43
Temp. (o C)	C	25	25	25	25	0.0	25	25
	1	25	25	25	25	0.0	25	25
	2	25	25	25	25	0.0	25	25
	3	25	25	25	25	0.0	25	25
	4	25	25		25	0.0	25	25
Diss. Oxygen (mg/l)	C	8.2	8.2	8.2	8.2	0.0	8.2	8.2
	1	8.2	8.2	8.2	8.2	0.0	8.2	8.2
	2	8.2	8.1	7.8	8.0	0.2	7.8	8.2
	3	8.2	8.1	7.5	7.9	0.4	7.5	8.2
	4	8.2	8.2		8.2	0.0	8.2	8.2
Cond. (uS/cm)	C	303		324	314	14.8	303	324
	1	359			359		359	359
	2	410			410		410	410
	3	506		550	528	31.1	506	550
	4	690			690		690	690
Replicate measured		Flask	Surrogate	B				
Initials		LT	LT	LT				
		TRC (mg/l) in highest conc. at end of test:		N/A				
Changes & Notes (Initials, date, specific change or notes)								

Test chamber:	30 ml plastic cup:	✓		
	Other:			
Test solution vol. (15 ml min):	30 ml:	✓		
	Other (ml):			
Illumination & photoperiod:	50-100 ft-c 16L:8D			
Number of replicates/treatment:	2			
Initial number animals/replicate:	5			
Test Aerated?	N/A	Date & Time Air Start:	N/A	

TEST ID	TRT ID:	1	2	3	4
AWSL2109-AER	CONC(%):	12.5	25	50.0	100

P. promelas APP-TIE AERATION

	Aeration Test
1	Volumes based on 0.5x dilutions of 100, 50, 25 and 12.5%. Total effluent 200 ml, total SFW for blanks and dilutions 400 ml (2 reps @ 30 ml plus 25 ml water quality surrogate)
2	Place 200 ml of sample into a 500 ml glass cylinder. Also add 400 ml of dilution water into a separate cylinder.
3	Attach disposable glass Pasteur pipettes to new pieces of vinyl tubing. Use carbon-filtered air for aeration. Place pipettes in cylinders and aerate for 60 min.
4	After 60 min stop aeration.
5	Pour concentrations with aerated sample using aerated SFW as the diluent. Include aeration blank as control. Four reps 15 ml each plus water quality cup.

Acute Fish Test-48 Hr Survival

Start Date:		Test ID:	AWSL2109A	Sample ID:	AERATION
End Date:		Lab ID:	CBI	Sample Type:	
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	PP-Pimephales promelas
Comments:	DATA ENTERED BY PB				

Conc-%	1	2
CONTROL	1.0000	1.0000
12.5	1.0000	1.0000
25	0.8000	0.4000
50	0.0000	0.2000
100	0.0000	0.0000

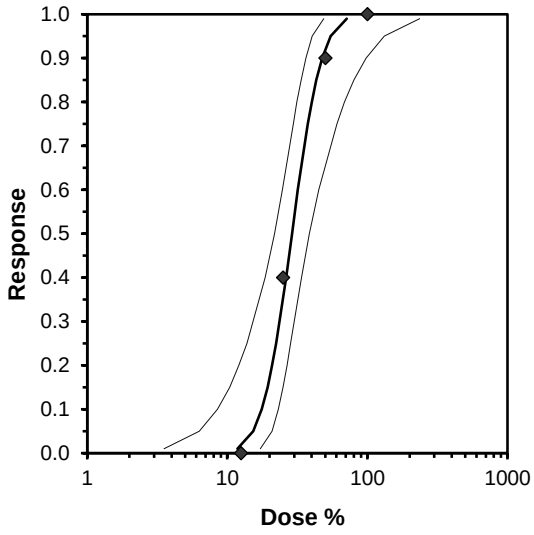
			Transform: Arcsin Square Root					Number	Total
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
CONTROL	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	2	0	10
12.5	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	2	0	10
25	0.6000	0.6000	0.8959	0.6847	1.1071	33.340	2	4	10
50	0.1000	0.1000	0.3446	0.2255	0.4636	48.867	2	9	10
100	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	2	10	10

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Normality of the data set cannot be confirmed				
Equality of variance cannot be confirmed				

Maximum Likelihood-Probit

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	5.95753	1.70472	2.61629	9.29878	0	0.32091	5.99148	0.85	1.46183	0.16785	4
Intercept	-3.70893	2.51391	-8.63619	1.21834							
TSCR											

Point	Probits	%	95% Fiducial Limits	
EC01	2.674	11.7854	3.52781	17.2069
EC05	3.355	15.3369	6.29962	20.7808
EC10	3.718	17.649	8.52345	23.1363
EC15	3.964	19.4028	10.4021	24.994
EC20	4.158	20.9201	12.1357	26.6873
EC25	4.326	22.3161	13.7951	28.3466
EC40	4.747	26.2609	18.5764	33.8471
EC50	5.000			
EC60	5.253	31.9418	24.7497	44.9857
EC75	5.674	37.5881	29.5961	60.4879
EC80	5.842	40.0963	31.4482	68.7326
EC85	6.036	43.2319	33.5898	80.161
EC90	6.282	47.5279	36.2974	97.8012
EC95	6.645	54.6929	40.4226	132.29
EC99	7.326	71.1743	48.8311	236.17



P. promelas APP-TIE FILTRATION

TRTMNT (% Effl)	Rep	#Live Day 0	#Live Day 1	#Live Day 2	Final Mean % Live
C	A	5	5	5	100.0
Control	B	5	5	5	
#1	A	5	5	5	100.0
12.5	B	5	5	5	
# 2	A	5	5	5	100.0
25	B	5	5	5	
# 3	A	5	5	0	10.0
50.0	B	5	5	1	
# 4	A	5	1	0	0.0
100	B	5	1	0	
INITIALS:		CPV	LT	LT	% CONTROL SURVIVAL: 100.0
DATE & TIME:		8/27/21 11:38	8/28/21 8:11	8/29/21 11:56	TAC = 90%
CHANGES & NOTES (INITIALS, DATE, SPECIFIC CHANGE MADE					

SPECIES:	Pimephales promelas		
ACCLIMATION WATER:	Mod. Hard Synthetic Freshwater		
FEEDING PRIOR TO TEST:	Artemia nauplii ad libitum		
FEEDING DURING TEST:	None		
SOURCE:	CBI Stock cultures		
ACCLIMATION TEMP (o C):	25		
HATCH START DATE & TIME:	8/24/21 17:00		
HATCH END DATE & TIME:	8/25/21 10:00		
DATE/TIME WATER ADDED:	8/27/21 11:37		
DATE/TIME ANIMALS ADDED:	8/27/21 11:38		
ANIMAL AGE WINDOW:	17h 0m	TAC Max. 24 h	
MAX AGE AT TEST START:	3d	TAC Max. 14 d	
TEST SET UP BY:	CPV		
AWSL2109-FILT PEER REVIEW BY (INITIALS/DATE):	PB	8/30/21 14:00	

P. promelas APP-TIE FILTRATION

	TRTMNT	Day 0 Initial	Day 1	Day 2 Final	SUMMARY WATER QUALITY DATA MEAN	S.D.	MIN.	MAX.
pH (S.U.)	C	7.88	7.96	7.71	7.85	0.13	7.71	7.96
	1	7.92	7.94	7.72	7.86	0.12	7.72	7.94
	2	7.98	7.97	7.77	7.91	0.12	7.77	7.98
	3	8.02	8.05	7.95	8.01	0.05	7.95	8.05
	4	8.26	8.48	8.25	8.33	0.13	8.25	8.48
Temp. (o C)	C	25	25	25	25	0.0	25	25
	1	25	25	25	25	0.0	25	25
	2	25	25	25	25	0.0	25	25
	3	25	25	25	25	0.0	25	25
	4	25	25	25	25	0.0	25	25
Diss. Oxygen (mg/l)	C	8.2	8.1	8.0	8.1	0.1	8.0	8.2
	1	8.2	8.1	7.7	8.0	0.3	7.7	8.2
	2	8.2	8.0	7.6	7.9	0.3	7.6	8.2
	3	8.2	8.0	7.5	7.9	0.4	7.5	8.2
	4	8.2	8.2	7.5	8.0	0.4	7.5	8.2
Cond. (uS/cm)	C	310		330	320	14.1	310	330
	1	374			374		374	374
	2	430			430		430	430
	3	552			552		552	552
	4	733		683	708	35.4	683	733
Replicate measured		Flask	Surrogate	B				
Initials		CPV	LT	LT				
		TRC (mg/l) in highest conc. at end of test:		N/A				
Changes & Notes (Initials, date, specific change or notes)								

Test chamber:	30 ml plastic cup:	✓		
	Other:			
Test solution vol. (15 ml min):	30 ml:	✓		
	Other (ml):			
Illumination & photoperiod:	50-100 ft-c 16L:8D			
Number of replicates/treatment:	2			
Initial number animals/replicate:	5			
Test Aerated?	N/A	Date & Time Air Start:	N/A	

TEST ID	TRT ID:	1	2	3	4
AWSL2109-FILT	CONC(%):	12.5	25	50.0	100

P. promelas APP-TIE FILTRATION

	Filtration Test (also collect filtered sample for SPE Column Test)
1	Volumes based on 0.5x dilutions of 100, 50, 25 and 12.5%. Total effluent 200 ml, total SFW for blanks and dilutions 400 ml (2 reps @ 30 ml plus 25 ml water quality surrogate)
2	Connect a ca. 18” piece of Teflon tubing to the Cole-Parmer peristaltic pump
3	Place inlet end of the tube in a 1000 ml flask
4	Connect to the outlet end of the tubing a 47 mm in-line polycarbonate filter holder
5	Place a 47 mm 1 um mesh GFF filter into the holder, wetting with deionized water before screwing shut.
6	Turn on the pump and pour 500 ml of deionized water into the 1000 ml flask. Discard filtrate.
7	After all the deionized water is pumped out of the flask add 900 ml of dilution water. Discard first 50 ml then collect 400 ml for the filtration blank/diluent and then 450 ml for the C18 SPE test. Volumes filtered are reduced if the C18 SPE is not run.
8	After all of the dilution water is pumped from the flask begin adding effluent. A total of 450 ml will be needed. Collect 200 ml for the filtration test and retain the other 250 ml of filtered sample for use in the C18 SPE test
9	Pour test, including filtration blank. 15 ml x 4 reps plus 20 ml for initial water quality. **Dilutions are prepared with the filtration blank water**.
10	Add animals.
11	Retain the filter for later chemical analysis if desired. Wrap in deionized water-rinsed foil and store at 4o C.

Acute Fish Test-48 Hr Survival

Start Date:		Test ID:	AWSL2109F	Sample ID:	FILTRATION
End Date:		Lab ID:	CBI	Sample Type:	
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	PP-Pimephales promelas
Comments:	DATA ENTERED BY PB				

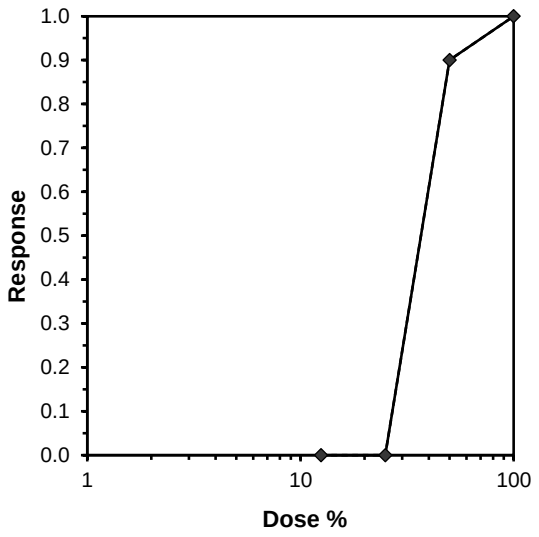
Conc-%	1	2
CONTROL	1.0000	1.0000
12.5	1.0000	1.0000
25	1.0000	1.0000
50	0.0000	0.2000
100	0.0000	0.0000

			Transform: Arcsin Square Root					Number	Total
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
CONTROL	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	2	0	10
12.5	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	2	0	10
25	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	2	0	10
50	0.1000	0.1000	0.3446	0.2255	0.4636	48.867	2	9	10
100	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	2	10	10

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Normality of the data set cannot be confirmed				
Equality of variance cannot be confirmed				

Trimmed Spearman-Karber

Trim Level	EC50	95% CL	
0.0%	37.893	33.223	43.219
5.0%	37.059	32.604	42.123
10.0%	36.743	33.878	39.851
20.0%	36.743	33.878	39.851
Auto-0.0%			



P. promelas APP-TIE EDTA

TRTMNT (% Effl)/ ppm EDTA	Rep	#Live Day 0	#Live Day 1	#Live Day 2	Final Mean % Live
C	A	5	5	4	40.0
50.0	B	5	5	0	
% Effl					
5 ppm					
#1	A	5	5	0	20.0
100.0	B	5	2	2	
% Effl					
5 ppm					
#2	A	5	5	3	50.0
50.0	B	5	5	2	
% Effl					
10 ppm					
#3	A	5	1	0	0.0
100.0	B	5	3	0	
% Effl					
10 ppm					
#4	A	5	5	3	60.0
50.0	B	5	4	3	
% Effl					
50 ppm					
#5	A	5	1	0	0.0
100.0	B	5	3	0	
% Effl					
50 ppm					
INITIALS:		LT	LT	LT	
DATE & TIME:		8/27/21 14:04	8/28/21 7:53	8/29/21 14:05	
CHANGES & NOTES (INITIALS, DATE, SPECIFIC CHANGE MADE					

	SPECIES:	Pimephales promelas	
	ACCLIMATION WATER:	Mod. Hard Synthetic Freshwater	
	FEEDING PRIOR TO TEST:	Artemia nauplii ad libitum	
EDTA B#	FEEDING DURING TEST:	None	
375	SOURCE:	CBI Stock cultures	
	ACCLIMATION TEMP (o C):	25	
Time EDTA added:	HATCH START DATE & TIME:	8/24/21 17:00	
8/27/21 11:43:29	HATCH END DATE & TIME:	8/25/21 10:00	
	DATE/TIME WATER ADDED:	8/27/21 11:28	
	DATE/TIME ANIMALS ADDED:	8/27/21 14:04	
	ANIMAL AGE WINDOW:	17h 0m	TAC Max. 24 h
	MAX AGE AT TEST START:	3d	TAC Max. 14 d
	TEST SET UP BY:	LT	
AWSL2109-EDTA	PEER REVIEW BY (INITIALS/DATE):	PB	8/30/21 13:59

P. promelas APP-TIE EDTA

	TRTMNT	Day 0 Initial	Day 1	Day 2 Final	SUMMARY WATER QUALITY DATA MEAN	S.D.	MIN.	MAX.
pH (S.U.)	C	8.22	7.85	7.93	8.00	0.19	7.85	8.22
	1	8.25	8.22	8.13	8.20	0.06	8.13	8.25
	2	8.21	8.26	8.27	8.25	0.03	8.21	8.27
	3	8.30	8.34	8.25	8.30	0.05	8.25	8.34
	4	7.94	8.40	8.28	8.21	0.24	7.94	8.40
	5	7.94	8.37	8.25	8.19	0.22	7.94	8.37
Temp. (o C)	C	25	25	25	25	0.0	25	25
	1	25	25	25	25	0.0	25	25
	2	25	25	25	25	0.0	25	25
	3	25	25	25	25	0.0	25	25
	4	25	25	25	25	0.0	25	25
	5	25	25	25	25	0.0	25	25
Diss. Oxygen (mg/l)	C	8.2	8.1	8.0	8.1	0.1	8.0	8.2
	1	8.2	8.1	7.8	8.0	0.2	7.8	8.2
	2	8.2	8.0	7.5	7.9	0.4	7.5	8.2
	3	8.2	8.0	7.3	7.8	0.5	7.3	8.2
	4	8.2	8.0	7.0	7.7	0.6	7.0	8.2
	5	8.0	8.0	7.0	7.7	0.6	7.0	8.0
Cond. (uS/cm)	C	523		522	523	0.7	522	523
	1	700			700		700	700
	2	514			514		514	514
	3	715			715		715	715
	4	509			509		509	509
	5	705		625	665	56.6	625	705
Replicate measured		Flask	Surrogate	B				
Initials		LT	LT	LT				
		TRC (mg/l) in highest conc. at end of test:		N/A				
Changes & Notes (Initials, date, specific change or notes)								

Test chamber:	30 ml plastic cup:	✓						
	Other:							
Test solution vol. (15 ml min):	15 ml:							
	Other (ml):	30						
Illumination & photoperiod:	50-100 ft-c 16L:8D		Template Number:	19				
Number of replicates/treatment:	4							
Initial number animals/replicate:	5							
Test Aerated?	N/A	Date & Time Air Start:	N/A					

TEST ID		C	1	2	3	4	5
	EDTA	5 ppm		10 ppm		50 ppm	
AWSL2109-EDTA	% EFFL	50.0	100.0	50.0	100.0	50.0	100.0

P. promelas APP-TIE EDTA

	EDTA Test
1	Usually 2 test concentrations (e.g. 100%, 50% or 1X, 2X LC50 conc.) x 3 EDTA concentration (5, 10 and 50 mg/l) are tested. **NOTE 30 ml/rep.** Thus at 100% and 50% concentrations need 450 ml of sample.
2	The EDTA and thiosulfate tests should use the same effluent concentrations and so effluent concentrations may be poured at the same time (use about 600 ml per concentration (100 ml for 2 reps x 30 ml/rep plus 20 ml water quality surrogate) x (3 EDTA plus 3 THIO))
3	Make up a stock solution of EDTA by dissolving 2.78 g of Na2-EDTA in 100 ml of deionized water (final concentration = 25 g/l EDTA = 25 mg/ml). This stock may be stored in the refrigerator for up to 6 months. Record B number on biological bench sheet.
4	For each test concentration pour into 15 cups. Four plus a WQ surrogate will be used for each of 3 EDTA concentrations. NOTE: There are no controls for the EDTA test.
5	Add the following volumes of EDTA stock solution to each cup with 30 ml of solution: 6 ul for 5 ppm, 12 ul for 10 ppm and 60 ul for 50 ppm
6	EDTA must be added a minimum of 2 hr prior to addition of animals.
7	Record the time that the EDTA is added and B#

P. promelas APP-TIE THIO

TRTMNT (% Effl)/ ppm EDTA	Rep	#Live Day 0	#Live Day 1	#Live Day 2	Final Mean % Live
C	A	5	5	2	70.0
50.0	B	5	5	5	
% Effl					
100 ppm					
#1	A	5	3	0	0.0
100.0	B	5	3	0	
% Effl					
100 ppm					
#2	A	5	0	0	0.0
50.0	B	5	3	0	
% Effl					
200 ppm					
#3	A	5	4	0	20.0
100.0	B	5	2	2	
% Effl					
200 ppm					
#4	A	5	4	0	50.0
50.0	B	5	5	5	
% Effl					
400 ppm					
#5	A	5	2	0	10.0
100.0	B	5	2	1	
% Effl					
400 ppm					
INITIALS:			LT	LT	
DATE & TIME:		8/27/21 15:02	8/28/21 8:01	8/29/21 14:36	
CHANGES & NOTES (INITIALS, DATE, SPECIFIC CHANGE MADE					

	SPECIES:	Pimephales promelas	
	ACCLIMATION WATER:	Mod. Hard Synthetic Freshwater	
	FEEDING PRIOR TO TEST:	Artemia nauplii ad libitum	
THIO B#	FEEDING DURING TEST:	None	
376	SOURCE:	CBI Stock cultures	
	ACCLIMATION TEMP (o C):	25	
Time THIO added:	HATCH START DATE & TIME:	8/24/21 17:00	
8/27/21 11:53:48	HATCH END DATE & TIME:	8/25/21 10:00	
	DATE/TIME WATER ADDED:	8/27/21 11:20	
	DATE/TIME ANIMALS ADDED:	8/27/21 15:02	
	ANIMAL AGE WINDOW:	17h 0m	TAC Max. 24 h
	MAX AGE AT TEST START:	3d	TAC Max. 14 d
	SPECIES:	Pimephales promelas	
AWSL2109-THIO	PEER REVIEW BY (INITIALS/DATE):	PB	8/30/21 14:19

P. promelas APP-TIE THIO

	TRTMNT	Day 0 Initial	Day 1	Day 2 Final	SUMMARY WATER QUALITY DATA MEAN	S.D.	MIN.	MAX.
pH (S.U.)	C	8.30	8.15	7.71	8.05	0.31	7.71	8.30
	1	8.37	8.32	8.00	8.23	0.20	8.00	8.37
	2	8.32	8.41	8.08	8.27	0.17	8.08	8.41
	3	8.45	8.39	8.05	8.30	0.22	8.05	8.45
	4	8.37	8.45	8.22	8.35	0.12	8.22	8.45
	5	8.46	8.55	8.13	8.38	0.22	8.13	8.55
Temp. (o C)	C	25	25	25	25	0.0	25	25
	1	25	25	25	25	0.0	25	25
	2	25	25	25	25	0.0	25	25
	3	25	25	25	25	0.0	25	25
	4	25	25	25	25	0.0	25	25
	5	25	25	25	25	0.0	25	25
Diss. Oxygen (mg/l)	C	8.2	8.1	8.2	8.2	0.1	8.1	8.2
	1	8.2	8.1	8.1	8.1	0.1	8.1	8.2
	2	8.2	8.0	7.6	7.9	0.3	7.6	8.2
	3	8.2	7.9	6.9	7.7	0.7	6.9	8.2
	4	8.2	7.9	6.8	7.6	0.7	6.8	8.2
	5	8.2	8.0	6.7	7.6	0.8	6.7	8.2
Cond. (uS/cm)	C	648		648	648	0.0	648	648
	1	870			870		870	870
	2	740			740		740	740
	3	895			895		895	895
	4	921			921		921	921
	5	1087		1123	1105	25.5	1087	1123
Replicate measured		Flask	Surrogate	B				
Initials		LT	LT	LT				
		TRC (mg/l) in highest conc. at end of test:		N/A				
Changes & Notes (Initials, date, specific change or notes)								

	Test chamber:	30 ml plastic cup:	✓					
		Other:						
	Test solution vol. (15 ml min):	15 ml:						
		Other (ml):	20					
	Illumination & photoperiod:	50-100 ft-c 16L:8D		Template Number:	5			
	Number of replicates/treatment:	4						
	Initial number animals/replicate:	5						
	Test Aerated?	N/A	Date & Time Air Start:	N/A				

TEST ID		C	1	2	3	4	5
	THIO	100 ppm		200 ppm		400 ppm	
AWSL2109-THIO	% EFFL	50.0	100.0	50.0	100.0	50.0	100.0

P. promelas APP-TIE THIO

	EDTA Test
1	Usually 2 test concentrations (e.g. 100%, 50% or 1X, 2X LC50 conc.) x 3 THIO concentration (100, 200 and 400 mg/l) are tested. **NOTE 30 ml/rep.**. Thus at 100% and 50%concentrations need 450 ml of sample.
2	The EDTA and thiosulfate tests should use the same effluent concentrations and so effluent concentrations may be poured at the same time (use about 600 ml per concentration (100 ml for 2 reps x 30 ml/rep plus 20 ml water quality surrogate) x (3 EDTA plus 3 THIO))
3	Make up a stock solution of sodium thiosulfate by dissolving 2.5 g of Na2 S2O3 in 100 ml of deionized water (final concentration = 25 g/l = 25 mg/ml). **Make stock fresh and use within a week.** Record B number on biological bench sheet.
4	For each test concentration pour into 15 cups. Four plus a WQ surrogate will be used for each of 3 THIO concentrations. NOTE: There are no controls for the THIO test.
5	Add the following volumes of EDTA stock solution to each cup with 20 ml of solution: 120 ul for 100 ppm, 240 ul for 200 ppm and 480 ul for 400 ppm
6	THIO must be added a minimum of 2 hr prior to addition of animals.
7	Record the time that the THIO is added and B#

P. promelas APP-TIE LO PH

TRTMNT (% Effl)	Rep	#Live Day 0	#Live Day 1	#Live Day 2	Final Mean % Live
C	A	5	5	5	100.0
Control	B	5	5	5	
#1	A	5	5	5	100.0
12.5	B	5	5	5	
# 2	A	5	5	1	20.0
25	B	5	5	1	
# 3	A	5	2	1	10.0
50.0	B	5	3	0	
# 4	A	5	0	0	0.0
100	B	5	0	0	
INITIALS:		LT	LT	LT	% CONTROL SURVIVAL: 100.0
DATE & TIME:		8/27/21 14:55	8/28/21 8:32	8/29/21 14:26	TAC = 90%
CHANGES & NOTES (INITIALS, DATE, SPECIFIC CHANGE MADE					

	SPECIES:	Pimephales promelas	
	ACCLIMATION WATER:	Mod. Hard Synthetic Freshwater	
	FEEDING PRIOR TO TEST:	Artemia nauplii ad libitum	
	FEEDING DURING TEST:	None	
	SOURCE:	CBI Stock cultures	
	ACCLIMATION TEMP (o C):	25	
	HATCH START DATE & TIME:	8/26/21 17:00	
	HATCH END DATE & TIME:	8/27/21 10:00	
	DATE/TIME WATER ADDED:	8/27/21 11:10	
	DATE/TIME ANIMALS ADDED:	8/27/21 14:55	
	ANIMAL AGE WINDOW:	17h 0m	TAC Max. 24 h
	MAX AGE AT TEST START:	1d	TAC Max. 14 d
	TEST SET UP BY:	LT	
AWSL2109-LO PH	PEER REVIEW BY (INITIALS/DATE):	PB	8/30/21 14:02

P. promelas APP-TIE LO PH

	TRTMNT	Day 0 Initial	Day 1	Day 2 Final	SUMMARY WATER QUALITY DATA MEAN	S.D.	MIN.	MAX.
pH (S.U.)	C	7.00	7.03	7.00	7.01	0.02	7.00	7.03
	1	7.20	6.98	6.99	7.06	0.12	6.98	7.20
	2	7.25	6.94	6.97	7.05	0.17	6.94	7.25
	3	7.25	6.89	6.90	7.01	0.21	6.89	7.25
	4	7.30	6.89		7.10	0.29	6.89	7.30
Temp. (o C)	C	25	25	25	25	0.0	25	25
	1	25	25	25	25	0.0	25	25
	2	25	25	25	25	0.0	25	25
	3	25	25	25	25	0.0	25	25
	4	25	25		25	0.0	25	25
Diss. Oxygen (mg/l)	C	8.2	8.0	7.9	8.0	0.2	7.9	8.2
	1	8.2	8.0	7.7	8.0	0.3	7.7	8.2
	2	8.2	8.1	7.4	7.9	0.4	7.4	8.2
	3	8.2	8.2	7.2	7.9	0.6	7.2	8.2
	4	8.2	8.2		8.2	0.0	8.2	8.2
Cond. (uS/cm)	C	312		307	310	3.5	307	312
	1	392			392		392	392
	2	447			447		447	447
	3	540		500	520	28.3	500	540
	4	786			786		786	786
Replicate measured		Flask	Surrogate	A				
Initials		LT	LT	LT				
		TRC (mg/l) in highest conc. at end of test:		N/A				
Changes & Notes (Initials, date, specific change or notes)								

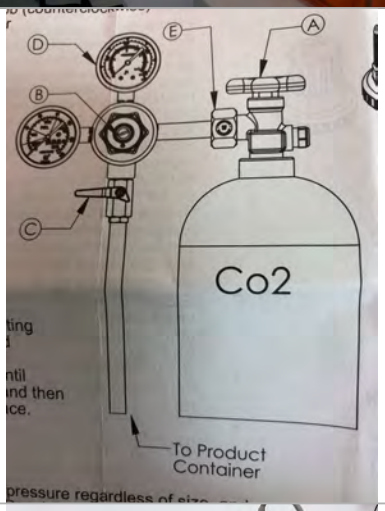
Test chamber:	30 ml plastic cup:	✓		
	Other:			
Test solution vol. (15 ml min):	30 ml:	✓		
	Other (ml):			
Illumination & photoperiod:	50-100 ft-c 16L:8D			
Number of replicates/treatment:	2			
Initial number animals/replicate:	5			
Test Aerated?	N/A	Date & Time Air Start:	N/A	

TEST ID	TRT ID:	1	2	3	4
AWSL2109-LO PH	CONC(%):	12.5	25	50.0	100

P. promelas APP-TIE LO PH

	Low pH (pH 7) Test
1	Volumes based on 0.5x dilutions of 100, 50, 25 and 12.5%. Total effluent 200 ml, total SFW for blanks and dilutions 400 ml (2 reps @ 30 ml plus 25 ml water quality surrogate)
2	Place 30 cm x 30 cm x 30 cm Plexiglass dessicator on bench next to gas tank. Connect tubing from flow meters to one of the barbed outlets; the other barbed outlet should be left open. (Fig. 1)
3	Set the CO2 flow (Fig 2 and 3):
4	**CAREFULLY FOLLOW THESE INSTRUCTIONS TO AVOID DAMAGE TO FLOW REGULATOR VALVES**
5	Disconnect, at tank regulator end, the silicone tubing between the CO2 regulator and the Cole-Parmer flow regulator (to avoid accidental pressures greater than 10 psi). See Fig 3.
6	Close brass valve (lever in horizontal position) on line that feeds gas to the Cole Parmer flow unit (valve "C" Fig. 2).
7	Turn regulator knob (red valve, Fig. 3; "B" Fig. 2) on CO2 tank 2 turns counter clockwise to turn off (regulator valves are backwards compared to most other valves). The gas must not be turned on with an open regulator valve.
8	Turn on gas by opening fully (turn counter clockwise) brass valve on top of tank (valve "A" Fig.2). The pressure should register ca 1000 psi on the left most pressure gauge "P"
9	Turn the regulator valve slowly clockwise to open the regulator valve (remember it is backwards) until ca. 5 psi registers on the pressure gauge "PG" (above red regulator knob Fig. 3; "D" Fig. 2; psi is the outer, red scale). **Do not set ≥ 10 psi because these pressures will damage the flow controller.**
10	Plug in controller power unit and set the flow on the set point module to zero flow. This is necessary for the regulator to establish the zero-flow baseline.
11	Reconnect the tubing between the tank regulator and the Cole-Parmer controller and open (lever vertical) the brass valve ("C" Fig. 2).
12	Turn the knob on the Cole-Parmer set point module to the desired flow (e.g. 4.00 for 4 ml/min). The reading on the controller should fluctuate about ± 1% of the set point. The reading on the "CO2" glass Gilmont flow meter should also read ca. 4 ml/min. (NOTE: when first starting flow you may need to gently tap the glass flow meter if the ball is stuck).
13	Set the Air flow (Fig 3):
14	The central lab air system supplies the air.
15	Open the valve on the lab PVC air line on wall supplying the tube connected to the "air" Gilmont flow meter, until the steel ball on the glass Gilmont air flow meter reads 85. This reading corresponds to 190 ml/min (see the nomogram for glass-steel ball reading conversions posted next to the meter).
16	The air flow should not vary significantly once set, but may "bounce a bit"
17	Typically you do not need to pH adjust the sample and dilution water using acid or base. The cups of solutions will usually equilibrate to ~7 pH after being placed in chamber for a few hours. However, if adjustments to sample and dilution water are made prior to pouring dilutions, be sure to record acid/base A#s, volumes. Of acid/base used and volumes of sample/diluent on biological page.
18	Pour test concentrations in replicate beakers and place into Plexiglass dessicator; shut unit door and seal tight by closing the 4 latches. A control group (adjusted dilution water only) must be tested. Note: A surrogate beaker for each treatment and control is also poured for use in pH checks.
19	After a few hours check pH values (if first time of use) to see if stable. Make very small adjustments in the CO2 portion of the mixture as necessary.
20	When desired pH values are attained test organisms may be added or transferred from old solutions.
	When the test is completed:
1	Disconnect tubing between the CO2 tank regulator and Cole-Parmer controller (to avoid accidental pressures greater than 10 psi).
2	Turn the gas to CO2 tank off by turning the brass valve on the top of the tank (valve A) clockwise.
3	Bleed off gas from the regulator by turning the red knob on the regulator valve clockwise. You will hear gas escaping.
4	Both regulator vales on each tank should read "0" psi.
5	Close red knob by turning counter-clockwise several turns.

Table 1

FIG 1			
FIG 2			
FIG 3			

Acute Fish Test-48 Hr Survival

Start Date:		Test ID:	AWSL2109L	Sample ID:	LOW PH
End Date:		Lab ID:	CBI	Sample Type:	
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	PP-Pimephales promelas
Comments:	DATA ENTERED BY PB				

Conc-%	1	2
CONTROL	1.0000	1.0000
12.5	1.0000	1.0000
25	0.2000	0.2000
50	0.2000	0.0000
100	0.0000	0.0000

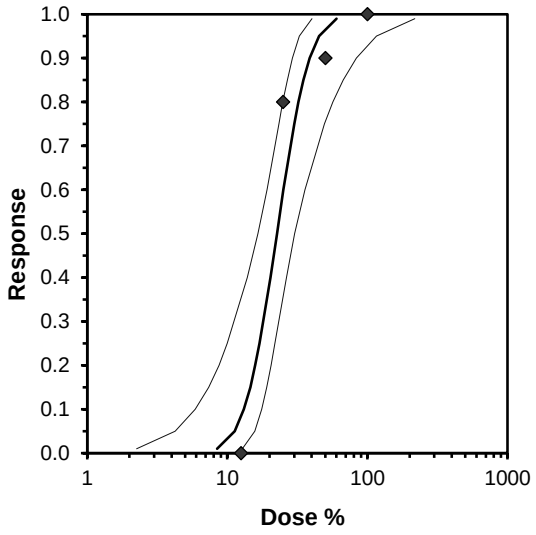
			Transform: Arcsin Square Root					Number	Total
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
CONTROL	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	2	0	10
12.5	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	2	0	10
25	0.2000	0.2000	0.4636	0.4636	0.4636	0.000	2	8	10
50	0.1000	0.1000	0.3446	0.2255	0.4636	48.867	2	9	10
100	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	2	10	10

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Normality of the data set cannot be confirmed				
Equality of variance cannot be confirmed				

Maximum Likelihood-Probit

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	5.45597	1.55838	2.40154	8.51039	0	4.32985	5.99148	0.11	1.35318	0.18329	6
Intercept	-2.38291	2.14007	-6.57745	1.81163							
TSCR											

Point	Probits	%	95% Fiducial Limits	
EC01	2.674	8.44879	2.25349	12.7582
EC05	3.355	11.2643	4.24586	15.6506
EC10	3.718	13.1308	5.91136	17.5702
EC15	3.964	14.5619	7.35467	19.0884
EC20	4.158	15.8097	8.71227	20.4745
EC25	4.326	16.9651	10.033	21.8346
EC40	4.747	20.265	13.9424	26.3686
EC50	5.000			
EC60	5.253	25.0966	19.1603	35.7724
EC75	5.674	29.9782	23.3188	49.328
EC80	5.842	32.169	24.916	56.696
EC85	6.036	34.9256	26.7696	67.0502
EC90	6.282	38.7321	29.1249	83.3001
EC95	6.645	45.1501	32.7411	115.821
EC99	7.326	60.1959	40.2141	217.947



P. promelas APP-TIE HI PH

TRTMNT (% Effl)	Rep	#Live Day 0	#Live Day 1	#Live Day 2	Final Mean % Live
C	A	5	5	5	100.0
Control	B	5	5	5	
#1	A	5	5	5	100.0
12.5	B	5	5	5	
# 2	A	5	5	1	50.0
25	B	5	5	4	
# 3	A	5	5	1	10.0
50.0	B	5	3	0	
# 4	A	5	0	0	0.0
100	B	5	0	0	
INITIALS:		LT	LT	LT	% CONTROL SURVIVAL: 100.0
DATE & TIME:		8/27/21 13:19	8/28/21 8:30	8/29/21 13:27	TAC = 90%
CHANGES & NOTES (INITIALS, DATE, SPECIFIC CHANGE MADE					

	SPECIES:	Pimephales promelas	
	ACCLIMATION WATER:	Mod. Hard Synthetic Freshwater	
	FEEDING PRIOR TO TEST:	Artemia nauplii ad libitum	
	FEEDING DURING TEST:	None	
	SOURCE:	CBI Stock cultures	
	ACCLIMATION TEMP (o C):	25	
	HATCH START DATE & TIME:	8/24/21 17:00	
	HATCH END DATE & TIME:	8/25/21 10:00	
	DATE/TIME WATER ADDED:	8/27/21 11:15	
	DATE/TIME ANIMALS ADDED:	8/27/21 13:19	
	ANIMAL AGE WINDOW:	17h 0m	TAC Max. 24 h
	MAX AGE AT TEST START:	3d	TAC Max. 14 d
	TEST SET UP BY:	LT	
AWSL2109-HI PH	PEER REVIEW BY (INITIALS/DATE):	PB	8/30/21 14:01

P. promelas APP-TIE HI PH

	TRTMNT	Day 0 Initial	Day 1	Day 2 Final	SUMMARY WATER QUALITY DATA MEAN	S.D.	MIN.	MAX.
pH (S.U.)	C	9.00	8.88	8.72	8.87	0.14	8.72	9.00
	1	8.95	8.78	8.72	8.82	0.12	8.72	8.95
	2	8.95	8.79	8.70	8.81	0.13	8.70	8.95
	3	8.96	8.77	8.75	8.83	0.12	8.75	8.96
	4	9.00	8.86		8.93	0.10	8.86	9.00
Temp. (o C)	C	25	25	25	25	0.0	25	25
	1	25	25	25	25	0.0	25	25
	2	25	25	25	25	0.0	25	25
	3	25	25	25	25	0.0	25	25
	4	25	25		25	0.0	25	25
Diss. Oxygen (mg/l)	C	8.2	8.0	8.0	8.1	0.1	8.0	8.2
	1	8.2	8.0	7.9	8.0	0.2	7.9	8.2
	2	8.2	7.9	7.7	7.9	0.3	7.7	8.2
	3	8.2	8.1	7.6	8.0	0.3	7.6	8.2
	4	8.2	8.2		8.2	0.0	8.2	8.2
Cond. (uS/cm)	C	312		321	317	6.4	312	321
	1	392			392		392	392
	2	447			447		447	447
	3	560		525	543	24.7	525	560
	4	786			786		786	786
Replicate measured		Flask	Surrogate	A				
Initials		LT	LT	LT				
		TRC (mg/l) in highest conc. at end of test:		N/A				
Changes & Notes (Initials, date, specific change or notes)		SFW pH 7.94 took 60uL to bring up to 9.04. Sample pH 8.33 took 50ul to bring up to 9.00. B stock #B374						

Test chamber:	30 ml plastic cup:	✓			
	Other:				
Test solution vol. (15 ml min):	30 ml:	✓			
	Other (ml):				
Illumination & photoperiod:	50-100 ft-c 16L:8D				
Number of replicates/treatment:	2				
Initial number animals/replicate:	5				
Test Aerated?	N/A	Date & Time Air Start:	N/A		

TEST ID	TRT ID:	1	2	3	4
AWSL2109-HI PH	CONC(%):	12.5	25	50.0	100

P. promelas APP-TIE HI PH

	High pH (pH 9) Test
1	Volumes based on 0.5x dilutions of 100, 50, 25 and 12.5%. Total effluent 200 ml, total SFW for blanks and dilutions 400 ml (2 reps @ 30 ml plus 25 ml water quality surrogate)
2	Prepare 1N NaOH by SLOWLY adding 4g of ACS reagent grade NaOH to to 100 ml of DIH2O using a stir plate. Always base to water, NOT vice-versa. Prepare in hood. Record B number on reagent prep log and A number of NaOH.
3	Adjust pH (~9) of sample using 1 N NaOH. You will need enough sample for all dilutions (200 ml should be plenty). Record a) volume of sample and volume of base used b) base normality, c) stock identity, and d) final pH values on bench sheet.
4	Adjust pH (~9) of SFW using 1 N NaOH. You will need enough SFW dilution water for a blank (control) and to pour any dilutions of the effluent (500 ml should be plenty). Record a) volume of SFW and volume of base used b) base normality, c) stock identity, and d) final pH values on bench sheet.
5	Pour test concentrations in replicate beakers and place into a Plexiglass dessicator with both inlet and outlet ports sealed (use a piece of tubing tied in a knot).
6	Place in the bottom of the dessicator a pan with about 50 ml of fresh soda lime.The soda lime has a color indicator (turns purple-blue) to indicate it is spent. (Keep bag TIGHTLY sealed; will adsorb CO2)
7	Shut unit door and seal tight by closing the 4 latches. A control group (adjusted dilution water only) must be tested. Note: A surrogate beaker for each treatment and control is also poured for use in pH checks.
8	After a few hours check pH values (if first time of use) to see if stable.
9	When desired pH values are attained test organisms may be added or transferred from old solutions.
	When the test is completed:
1	Remove soda lime from desiccator and discard in trash

Acute Fish Test-48 Hr Survival

Start Date:		Test ID:	AWSL2109H	Sample ID:	HIGH PH
End Date:		Lab ID:	CBI	Sample Type:	
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	PP-Pimephales promelas
Comments:	DATA ENTERED BY PB				

Conc-%	1	2
CONTROL	1.0000	1.0000
12.5	1.0000	1.0000
25	0.2000	0.8000
50	0.2000	0.0000
100	0.0000	0.0000

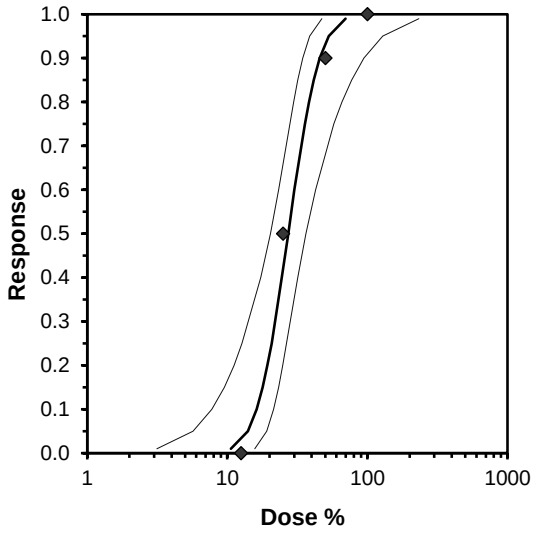
			Transform: Arcsin Square Root					Number	Total
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
CONTROL	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	2	0	10
12.5	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	2	0	10
25	0.5000	0.5000	0.7854	0.4636	1.1071	57.935	2	5	10
50	0.1000	0.1000	0.3446	0.2255	0.4636	48.867	2	9	10
100	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	2	10	10

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Normality of the data set cannot be confirmed				
Equality of variance cannot be confirmed				

Maximum Likelihood-Probit

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	5.6827	1.59665	2.55326	8.81214	0	0.74975	5.99148	0.69	1.43459	0.17597	5
Intercept	-3.15236	2.31402	-7.68783	1.38311							
TSCR											

Point	Probits	%	95% Fiducial Limits	
EC01	2.674	10.5979	3.14204	15.6781
EC05	3.355	13.9683	5.69254	19.1182
EC10	3.718	16.1836	7.761	21.397
EC15	3.964	17.8735	9.51993	23.1983
EC20	4.158	19.3415	11.151	24.8418
EC25	4.326	20.6967	12.7188	26.453
EC40	4.747	24.5477	17.2707	31.7941
EC50	5.000			
EC60	5.253	30.1422	23.2293	42.6156
EC75	5.674	35.7507	27.9788	57.7445
EC80	5.842	38.2556	29.8097	65.8274
EC85	6.036	41.3977	31.9367	77.0692
EC90	6.282	45.7204	34.6396	94.4964
EC95	6.645	52.9714	38.7837	128.783
EC99	7.326	69.8178	47.311	233.234



P. promelas APP-TIE HLB SPE

TRTMNT (% Effl)	Rep	#Live Day 0	#Live Day 1	#Live Day 2	Final Mean % Live	
C	A	5	5	5	100.0	
Control	B	5	5	5		
#1	A	5	5	5	100.0	
12.5	B	5	5	5		
# 2	A	5	5	5	100.0	
25	B	5	5	5		
# 3	A	5	5	5	100.0	
50.0	B	5	5	5		
# 4	A	5	5	5	100.0	
100	B	5	5	5		
INITIALS:		CPV	LT	LT	% CONTROL SURVIVAL:	100.0
DATE & TIME:		8/27/21 11:54	8/28/21 8:13	8/29/21 12:02		TAC = 90%
CHANGES & NOTES (INITIALS, DATE, SPECIFIC CHANGE MADE						

SPECIES:	Pimephales promelas	
ACCLIMATION WATER:	Mod. Hard Synthetic Freshwater	
FEEDING PRIOR TO TEST:	Artemia nauplii ad libitum	
FEEDING DURING TEST:	None	
SOURCE:	CBI Stock cultures	
ACCLIMATION TEMP (o C):	25	
HATCH START DATE & TIME:	8/24/21 17:00	
HATCH END DATE & TIME:	8/25/21 10:00	
DATE/TIME WATER ADDED:	8/27/21 11:51	
DATE/TIME ANIMALS ADDED:	8/27/21 11:54	
ANIMAL AGE WINDOW:	17h 0m	TAC Max. 24 h
MAX AGE AT TEST START:	3d	TAC Max. 14 d
TEST SET UP BY:	CPV	
PEER REVIEW BY (INITIALS/DATE):	PB	8/30/21 14:02

AWSL2109-HLB SPE

P. promelas APP-TIE HLB SPE

	TRTMNT	Day 0 Initial	Day 1	Day 2 Final	SUMMARY WATER QUALITY DATA MEAN	S.D.	MIN.	MAX.
pH (S.U.)	C	7.85	7.85	7.81	7.84	0.02	7.81	7.85
	1	7.93	7.86	7.75	7.85	0.09	7.75	7.93
	2	7.97	8.02	7.74	7.91	0.15	7.74	8.02
	3	8.05	8.06	7.89	8.00	0.10	7.89	8.06
	4	8.29	8.52	8.46	8.42	0.12	8.29	8.52
Temp. (o C)	C	25	25	25	25	0.0	25	25
	1	25	25	25	25	0.0	25	25
	2	25	25	25	25	0.0	25	25
	3	25	25	25	25	0.0	25	25
	4	25	25	25	25	0.0	25	25
Diss. Oxygen (mg/l)	C	8.2	8.0	8.0	8.1	0.1	8.0	8.2
	1	8.2	8.0	8.0	8.1	0.1	8.0	8.2
	2	8.2	8.0	8.0	8.1	0.1	8.0	8.2
	3	8.2	7.9	7.7	7.9	0.3	7.7	8.2
	4	8.2	8.1	7.5	7.9	0.4	7.5	8.2
Cond. (uS/cm)	C	308		313	311	3.5	308	313
	1	377			377		377	377
	2	435			435		435	435
	3	558			558		558	558
	4	738		720	729	12.7	720	738
Replicate measured		Flask	Surrogate	B				
Initials		CPV	LT	LT				
		TRC (mg/l) in highest conc. at end of test:		N/A				
Changes & Notes (Initials, date, specific change or notes)								

Test chamber:	30 ml plastic cup:	✓		
	Other:			
Test solution vol. (15 ml min):	30 ml:	✓		
	Other (ml):			
Illumination & photoperiod:	50-100 ft-c 16L:8D			
Number of replicates/treatment:	2			
Initial number animals/replicate:	5			
Test Aerated?	N/A	Date & Time Air Start:	N/A	

TEST ID	TRT ID:	1	2	3	4
AWSL2109-HLB SPE	CONC(%):	12.5	25	50.0	100

P. promelas APP-TIE HLB SPE

	HLB Solid Phase Extraction (SPE) Test
	NOTE: This procedure uses a Waters Oasis 500 mg HLB SPE which is a water wettable sorbant with a high affinity for more hydrophilic organic compounds. Because it is a water wettable sorbant it is not critical if column goes dry between solutions
1	Volumes based on 0.5x dilutions of 100, 50, 25 and 12.5%. Total effluent 200 ml, total SFW for blanks and dilutions 400 ml (2 reps @ 30 ml plus 25 ml water quality surrogate)
2	Attach silicone tubing (ca. 15") to inlet side of G-R metering pump
3	Attach the outlet end of the tubing to the blue Luer-tubing adapter and then attach a small (4") length of glass tubing to the intake (latch) end of the tubing.
4	Place the glass tubing in a small (e.g. 250 ml) flask.
5	Pump DI water (50 ml) through the system
6	Attach a 6 ml (500 mg) SPE tube to the Luer end of the adapter and position over an appropriate sized waste flask or beaker.
7	Add 12 ml of HPLC-grade methanol to the beaker and turn on pump. Pump should be set to provide a flow rate of 10 ml/min.
8	Allow the cartridge to fill with 1-2 ml of methanol before firmly attaching the adapter to the cartridge. Allow methanol to be pumped to waste. However, IF CONDUCTING THE SPE ELUATE TEST, COLLECT 3 ml OF METHANOL (Use clean scintillation vial) AFTER PASSAGE OF FIRST 5-6 ml. This will be used as the methanol blank in the eluate test. **Do not allow column to go dry.**
9	Add 50 ml deionized water just as the last of the methanol is pumped from the beaker. A small bubble in the line is O.K.; it will help you track the end of the methanol/beginning of the deionized water in the tube. However, the column must not go dry between the two.
10	DO NOT let column go dry after the addition of the deionized water (keep an eye on the column, a small volume of liquid should always lay on top of the column packing).
11	Add 450 ml of filtered dilution water just as the last of the deionized water leaves the reservoir. A small bubble between the two in the pump tubing will enable you to tell when the dilution water is entering the column.
12	Collect 400 ml of dilution water after discarding the first 50 ml. This is tested as the SPE blank. DO NOT allow column to go dry.
13	Add 200 ml of filtered sample just as the last of the dilution water is pumped from the reservoir. Collect the 200 ml eluate. THE COLUMN MAY GO DRY after the entire sample is collected.
14	The HLB SPE sample is tested with appropriate dilutions, using SPE blank as the diluent
15	IF CONDUCTING THE SPE ELUATE TEST: Pass 1.8 ml of methanol over column and collect into a clean scintillation vial. OTHERWISE: Retain the column for later chemical analysis if desired. Wrap in acetone/deionized water-rinsed foil and store at 4o C.
16	Record A# of methanol and SPE column, and size (g) of column, on biological page.

P. promelas APP-TIE PH 3 ADJUSTMENT

TRTMNT (% Effl)	Rep	#Live Day 0	#Live Day 1	#Live Day 2	Final Mean % Live
C	A	5	5	5	100.0
Control	B	5	5	5	
#1	A	5	5	5	100.0
12.5	B	5	5	5	
# 2	A	5	5	5	80.0
25	B	5	5	3	
# 3	A	5	5	4	60.0
50.0	B	5	5	2	
# 4	A	5	4	1	20.0
100	B	5	3	1	
INITIALS:		CPV	LT	LT	% CONTROL SURVIVAL: 100.0
DATE & TIME:		8/27/21 14:11	8/28/21 8:06	8/29/21 14:47	TAC = 90%
CHANGES & NOTES (INITIALS, DATE, SPECIFIC CHANGE MADE					

ADJ TO PH 3:			
Acid HCl stock B#:	SPECIES:	Pimephales promelas	
373	ACCLIMATION WATER:	Mod. Hard Synthetic Freshwater	
ul acid added 1L sample:	FEEDING PRIOR TO TEST:	Artemia nauplii ad libitum	
6500	FEEDING DURING TEST:	None	
ul acid added 2 L SFW:	SOURCE:	CBI Stock cultures	
4800	ACCLIMATION TEMP (o C):	25	
ADJ BACK TO AMBIENT PH:	HATCH START DATE & TIME:	8/24/21 17:00	
Base stock B#:	HATCH END DATE & TIME:	8/25/21 10:00	
374	DATE/TIME WATER ADDED:	8/27/21 14:11	
ul base added 200 ml sample:	DATE/TIME ANIMALS ADDED:	8/27/21 14:11	
650	ANIMAL AGE WINDOW:	17h 0m	TAC Max. 24 h
ul base added 400 ml SFW:	MAX AGE AT TEST START:	3d	TAC Max. 14 d
850	TEST SET UP BY:	CPV	
AWSL2109-3 ADJ	PEER REVIEW BY (INITIALS/DATE):	PB	8/30/21 14:14

P. promelas APP-TIE PH 3 ADJUSTMENT

	TRTMNT	Day 0 Initial	Day 1	Day 2 Final	SUMMARY WATER QUALITY DATA MEAN	S.D.	MIN.	MAX.
pH (S.U.)	C	8.22	7.50	7.78	7.83	0.36	7.50	8.22
	1	8.14	7.55	7.77	7.82	0.30	7.55	8.14
	2	8.07	7.77	7.77	7.87	0.17	7.77	8.07
	3	8.03	7.86	7.82	7.90	0.11	7.82	8.03
	4	8.00	8.10	8.08	8.06	0.05	8.00	8.10
Temp. (o C)	C	25	25	25	25	0.0	25	25
	1	25	25	25	25	0.0	25	25
	2	25	25	25	25	0.0	25	25
	3	25	25	25	25	0.0	25	25
	4	25	25	25	25	0.0	25	25
Diss. Oxygen (mg/l)	C	8.2	8.0	8.1	8.1	0.1	8.0	8.2
	1	8.2	8.0	7.8	8.0	0.2	7.8	8.2
	2	8.2	8.1	7.5	7.9	0.4	7.5	8.2
	3	8.2	8.1	7.5	7.9	0.4	7.5	8.2
	4	8.2	8.2	7.3	7.9	0.5	7.3	8.2
Cond. (uS/cm)	C	570		547	559	16.3	547	570
	1	668			668		668	668
	2	750			750		750	750
	3	882			882		882	882
	4	1180		1173	1177	4.9	1173	1180
Replicate measured		Flask	Surrogate	A				
Initials		LT	LT	LT				
		TRC (mg/l) in highest conc. at end of test:		N/A				
Changes & Notes (Initials, date, specific change or notes)								

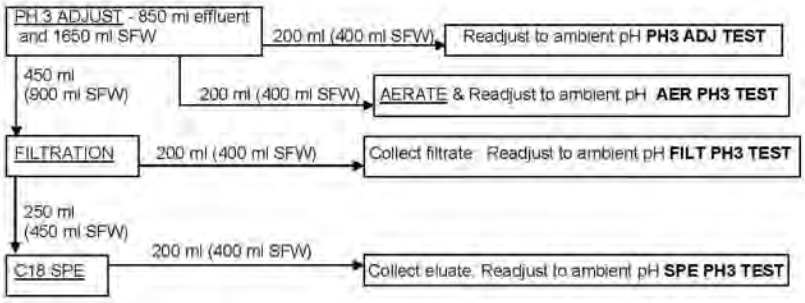
Test chamber:	30 ml plastic cup:	✓			
	Other:				
Test solution vol. (15 ml min):	30 ml:	✓			
	Other (ml):				
Illumination & photoperiod:	50-100 ft-c 16L:8D		Template Number:	20	
Number of replicates/treatment:	4				
Initial number animals/replicate:	5				
Test Aerated?	N/A	Date & Time Air Start:	N/A		

TEST ID	TRT ID:	1	2	3	4
AWSL2109-3 ADJ	CONC(%):	12.5	25	50.0	100

P. promelas APP-TIE PH 3 ADJUSTMENT

	pH 3 ADJ Test
1	Volumes based on 0.5x dilutions of 100, 50, 25 and 12.5% for each treatment (Total effluent 200 ml, total SFW for blanks and dilutions 400 ml (2 reps @ 30 ml plus 25 ml water quality surrogate))
2	Place 1000 ml of sample into a 1000 ml glass flask. Also add 2000 ml of dilution water into a separate 2000 ml flask. Add stir bars.
3	Adjust each to pH 3 using reagent grade HCl stock (1N). Record B number of acid stock and volumes used for adjustment biological bench sheet of this template.
4	Use 200 ml of sample and 400 ml of SFW for the pH 3 aeration test, and 450 ml of sample and 900 ml of SFW for pH 3 Filtration/SPE test. SEE FIGURE 1
4	Also a 200 ml volume of sample and 400 ml volume of sample is allowed to set while these other tests are set up. These are then adjusted back to ambient and tested as the pH 3 ADJ test. SEE FIGURE 1
5	Record on biological sheet of this template: B number of base (1 N NaOH) stock and volumes used to adjust sample and SFW back to ambient pH for the pH 3 ADJ test.
6	Pour concentrations with pH 3 sample and SFW adjusted back to ambient pH. Include this SFW blank as control. Four reps 15 ml each plus water quality cup.

Figure 1


PH 3 ADJUST - 850 ml effluent and 1650 ml SFW
200 ml (400 ml SFW)
Readjust to ambient pH PH3 ADJ TEST
450 ml (900 ml SFW)
200 ml (400 ml SFW)
AERATE & Readjust to ambient pH AER PH3 TEST
FILTRATION
200 ml (400 ml SFW)
Collect filtrate. Readjust to ambient pH FILT PH3 TEST
250 ml (450 ml SFW)
200 ml (400 ml SFW)
C18 SPE
Collect eluate. Readjust to ambient pH SPE PH3 TEST

Acute Fish Test-48 Hr Survival

Start Date:		Test ID:	AWSL2109C	Sample ID:	PH 3 ADJUSTED
End Date:		Lab ID:	CBI	Sample Type:	
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	PP-Pimephales promelas
Comments:	DATA ENTERED BY PB				

Conc-%	1	2
CONTROL	1.0000	1.0000
12.5	1.0000	1.0000
25	1.0000	0.6000
50	0.8000	0.4000
100	0.2000	0.2000

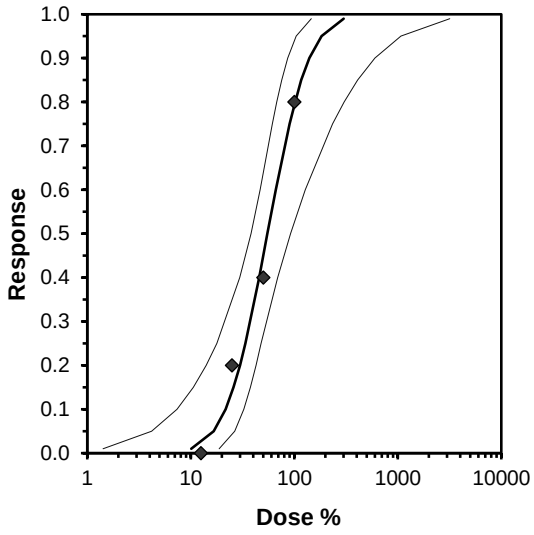
			Transform: Arcsin Square Root					Number	Total
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
CONTROL	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	2	0	10
12.5	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	2	0	10
25	0.8000	0.8000	1.1157	0.8861	1.3453	29.104	2	2	10
50	0.6000	0.6000	0.8959	0.6847	1.1071	33.340	2	4	10
100	0.2000	0.2000	0.4636	0.4636	0.4636	0.000	2	8	10

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Normality of the data set cannot be confirmed				
Equality of variance cannot be confirmed				

Maximum Likelihood-Probit

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	3.16316	0.89341	1.41209	4.91424	0	0.61784	5.99148	0.73	1.74147	0.31614	4
Intercept	-0.50854	1.51239	-3.47283	2.45575							
TSCR											

Point	Probits	%	95% Fiducial Limits	
EC01	2.674	10.1395	1.41768	18.7626
EC05	3.355	16.6518	4.17752	26.6222
EC10	3.718	21.6928	7.33709	32.4973
EC15	3.964	25.9303	10.6186	37.5639
EC20	4.158	29.881	14.1036	42.5707
EC25	4.326	33.7468	17.8021	47.9
EC40	4.747	45.8535	29.8337	69.1894
EC50	5.000	[illegible]	[illegible]	[illegible]42
EC60	5.253	66.3068	46.7254	127.976
EC75	5.674	90.0944	61.5323	235.244
EC80	5.842	101.75	67.8185	303.138
EC85	6.036	117.253	75.5836	409.415
EC90	6.282	140.157	86.1749	600.725
EC95	6.645	182.586	103.941	1067.78
EC99	7.326	299.858	145.937	3179.76



P. promelas APP-TIE PH 3 AERATION

TRTMNT (% Effl)	Rep	#Live Day 0	#Live Day 1	#Live Day 2	Final Mean % Live
C	A	5	5	5	100.0
Control	B	5	5	5	
#1	A	5	5	5	100.0
12.5	B	5	5	5	
# 2	A	5	5	4	90.0
25	B	5	5	5	
# 3	A	5	5	2	40.0
50.0	B	5	5	2	
# 4	A	5	1	0	20.0
100	B	5	5	2	
INITIALS:		CPV	LT	LT	% CONTROL SURVIVAL: 100.0
DATE & TIME:		8/27/21 14:16	8/28/21 8:05	8/29/21 14:29	TAC = 90%
CHANGES & NOTES (INITIALS, DATE, SPECIFIC CHANGE MADE					

	SPECIES:	Pimephales promelas	
	ACCLIMATION WATER:	Mod. Hard Synthetic Freshwater	
	FEEDING PRIOR TO TEST:	Artemia nauplii ad libitum	
ADJ BACK TO AMBIENT PH:	FEEDING DURING TEST:	None	
Base stock B#:	SOURCE:	CBI Stock cultures	
374	ACCLIMATION TEMP (o C):	25	
ul base added 200 ml sample:	HATCH START DATE & TIME:	8/24/21 17:00	
360	HATCH END DATE & TIME:	8/25/21 10:00	
ul base added 400 ml SFW:	DATE/TIME WATER ADDED:	8/27/21 14:15	
550	DATE/TIME ANIMALS ADDED:	8/27/21 14:16	
	ANIMAL AGE WINDOW:	17h 0m	TAC Max. 24 h
	MAX AGE AT TEST START:	3d	TAC Max. 14 d
	TEST SET UP BY:	CPV	
AWSL2109-AER PH3	PEER REVIEW BY (INITIALS/DATE):	PB	8/30/21 14:04

P. promelas APP-TIE PH 3 AERATION

	TRTMNT	Day 0 Initial	Day 1	Day 2 Final	SUMMARY WATER QUALITY DATA MEAN	S.D.	MIN.	MAX.
pH (S.U.)	C	8.00	7.62	7.70	7.77	0.20	7.62	8.00
	1	8.13	7.58	7.63	7.78	0.30	7.58	8.13
	2	8.10	7.55	7.59	7.75	0.31	7.55	8.10
	3	8.16	7.50	7.55	7.74	0.37	7.50	8.16
	4	8.19	7.46	7.38	7.68	0.45	7.38	8.19
Temp. (o C)	C	25	25	25	25	0.0	25	25
	1	25	25	25	25	0.0	25	25
	2	25	25	25	25	0.0	25	25
	3	25	25	25	25	0.0	25	25
	4	25	25	25	25	0.0	25	25
Diss. Oxygen (mg/l)	C	8.2	8.0	8.2	8.1	0.1	8.0	8.2
	1	8.2	8.0	8.1	8.1	0.1	8.0	8.2
	2	8.2	8.0	7.6	7.9	0.3	7.6	8.2
	3	8.2	8.1	7.4	7.9	0.4	7.4	8.2
	4	8.2	8.2	7.1	7.8	0.6	7.1	8.2
Cond. (uS/cm)	C	500		460	480	28.3	460	500
	1	590			590		590	590
	2	733			733		733	733
	3	820			820		820	820
	4	1114		996	1055	83.4	996	1114
Replicate measured		Flask	Surrogate	A				
Initials		LT	LT	LT				
		TRC (mg/l) in highest conc. at end of test:		N/A				
Changes & Notes (Initials, date, specific change or notes)								

Test chamber:	30 ml plastic cup:	✓		
	Other:			
Test solution vol. (15 ml min):	30 ml:	✓		
	Other (ml):			
Illumination & photoperiod:	50-100 ft-c 16L:8D			
Number of replicates/treatment:	4			
Initial number animals/replicate:	5			
Test Aerated?	N/A	Date & Time Air Start:	N/A	

TEST ID	TRT ID:	1	2	3	4
AWSL2109-AER PH3	CONC(%):	12.5	25	50.0	100

P. promelas APP-TIE PH 3 AERATION

	pH 3 Aeration Test
1	Volumes based on 0.5x dilutions of 100, 50, 25 and 12.5%. Total effluent 200 ml, total SFW for blanks and dilutions 400 ml (2 reps @ 30 ml plus 25 ml water quality surrogate)
2	Place 200 ml of sample AT PH 3 into a 500 ml glass cylinder. Also add 400 ml of dilution water AT PH 3 into a separate cylinder.
3	Attach disposable glass Pasteur pipettes to new pieces of vinyl tubing. Use carbon-filtered air for aeration. Place pipettes in cylinders and aerate for 60 min.
4	After 60 min stop aeration.
5	Record on biological sheet of this template: B number of base (1 N NaOH) stock and volumes used to adjust sample and SFW back to ambient pH for the AER pH 3 test.
6	Pour concentrations with aerated sample using aerated SFW as the diluent. Include aeration blank as control. Four reps 15 ml each plus water quality cup.

Acute Fish Test-48 Hr Survival

Start Date:		Test ID:	AWSL2109J	Sample ID:	PH 3 AERATION
End Date:		Lab ID:	CBI	Sample Type:	
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	PP-Pimephales promelas
Comments:	DATA ENTERED BY PB				

Conc-%	1	2
CONTROL	1.0000	1.0000
12.5	1.0000	1.0000
25	0.8000	1.0000
50	0.4000	0.4000
100	0.0000	0.4000

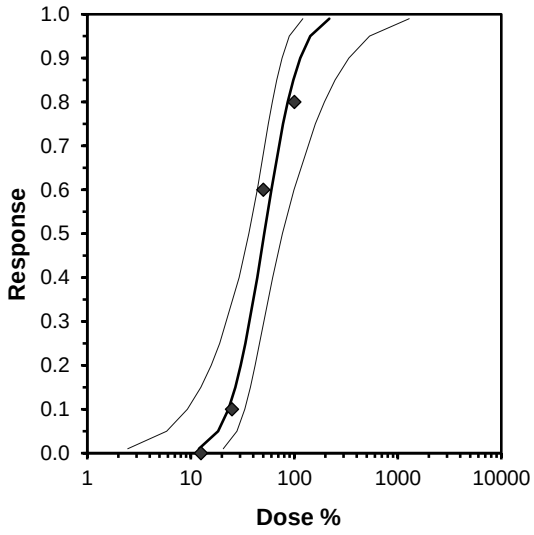
			Transform: Arcsin Square Root					Number	Total
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
CONTROL	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	2	0	10
12.5	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	2	0	10
25	0.9000	0.9000	1.2262	1.1071	1.3453	13.732	2	1	10
50	0.4000	0.4000	0.6847	0.6847	0.6847	0.000	2	6	10
100	0.2000	0.2000	0.4551	0.2255	0.6847	71.346	2	8	10

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Normality of the data set cannot be confirmed				
Equality of variance cannot be confirmed				

Maximum Likelihood-Probit

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	3.69831	0.99633	1.7455	5.65112	0	0.99238	5.99148	0.61	1.70972	0.27039	4
Intercept	-1.32308	1.68584	-4.62733	1.98117							
TSCR											

Point	Probits	%	95% Fiducial Limits	
EC01	2.674	12.0418	2.4554	20.5973
EC05	3.355	18.4061	5.87387	27.9276
EC10	3.718	23.078	9.25553	33.188
EC15	3.964	26.8829	12.4814	37.5771
EC20	4.158	30.3495	15.7174	41.7723
EC25	4.326	33.6778	19.0159	46.0762
EC40	4.747	43.7741	29.3344	61.8036
EC50	5.000			
EC60	5.253	60.0101	43.7705	99.3479
EC75	5.674	78.0007	56.2337	160.008
EC80	5.842	86.5546	61.3939	195.586
EC85	6.036	97.7161	67.664	248.42
EC90	6.282	113.827	76.0543	337.462
EC95	6.645	142.718	89.7861	535.26
EC99	7.326	218.148	121.012	1288.16



P. promelas APP-TIE PH 3 FILTRATION

TRTMNT (% Effl)	Rep	#Live Day 0	#Live Day 1	#Live Day 2	Final Mean % Live
C	A	5	5	5	100.0
Control	B	5	5	5	
#1	A	5	5	5	90.0
12.5	B	5	5	4	
# 2	A	5	5	4	70.0
25	B	5	5	3	
# 3	A	5	4	2	40.0
50.0	B	5	5	2	
# 4	A	5	1	0	10.0
100	B	5	1	1	
INITIALS:		CPV	LT	LT	% CONTROL SURVIVAL: 100.0
DATE & TIME:		8/27/21 13:58	8/28/21 8:15	8/29/21 13:20	TAC = 90%
CHANGES & NOTES (INITIALS, DATE, SPECIFIC CHANGE MADE					

	SPECIES:	Pimephales promelas	
ADJ BACK TO AMBIENT PH:	ACCLIMATION WATER:	Mod. Hard Synthetic Freshwater	
Base stock B#:	FEEDING PRIOR TO TEST:	Artemia nauplii ad libitum	
373	FEEDING DURING TEST:	None	
ul base added 200 ml sample:	SOURCE:	CBI Stock cultures	
550	ACCLIMATION TEMP (o C):	25	
ul base added 400 ml SFW:	HATCH START DATE & TIME:	8/24/21 17:00	
850	HATCH END DATE & TIME:	8/25/21 10:00	
	DATE/TIME WATER ADDED:	8/27/21 13:58	
	DATE/TIME ANIMALS ADDED:	8/27/21 13:58	
	ANIMAL AGE WINDOW:	17h 0m	TAC Max. 24 h
	MAX AGE AT TEST START:	3d	TAC Max. 14 d
	TEST SET UP BY:	CPV	
AWSL2109-FILT PH3	PEER REVIEW BY (INITIALS/DATE):	PB	8/30/21 14:17

P. promelas APP-TIE PH 3 FILTRATION

	TRTMNT	Day 0 Initial	Day 1	Day 2 Final	SUMMARY WATER QUALITY DATA MEAN	S.D.	MIN.	MAX.
pH (S.U.)	C	7.60	7.90	7.78	7.76	0.15	7.60	7.90
	1	7.73	7.86	7.74	7.78	0.07	7.73	7.86
	2	7.88	7.87	7.70	7.82	0.10	7.70	7.88
	3	8.10	7.87	7.75	7.91	0.18	7.75	8.10
	4	8.15	8.15	7.92	8.07	0.13	7.92	8.15
Temp. (o C)	C	25	25	25	25	0.0	25	25
	1	25	25	25	25	0.0	25	25
	2	25	25	25	25	0.0	25	25
	3	25	25	25	25	0.0	25	25
	4	25	25	25	25	0.0	25	25
Diss. Oxygen (mg/l)	C	8.2	8.0	8.1	8.1	0.1	8.0	8.2
	1	8.2	8.0	7.9	8.0	0.2	7.9	8.2
	2	8.2	8.0	7.7	8.0	0.3	7.7	8.2
	3	8.2	7.9	7.5	7.9	0.4	7.5	8.2
	4	8.2	8.0	7.2	7.8	0.5	7.2	8.2
Cond. (uS/cm)	C	550		548	549	1.4	548	550
	1	650			650		650	650
	2	735			735		735	735
	3	855			855		855	855
	4	1155		1157	1156	1.4	1155	1157
Replicate measured		Flask	Surrogate	B				
Initials		LT	LT	LT				
		TRC (mg/l) in highest conc. at end of test:		N/A				
Changes & Notes (Initials, date, specific change or notes)								

Test chamber:	30 ml plastic cup:	✓		
	Other:			
Test solution vol. (15 ml min):	15 ml:	✓		
	Other (ml):			
Illumination & photoperiod:	50-100 ft-c 16L:8D			
Number of replicates/treatment:	4			
Initial number animals/replicate:	5			
Test Aerated?	N/A	Date & Time Air Start:	N/A	

TEST ID	TRT ID:	1	2	3	4
AWSL2109-FILT PH3	CONC(%):	12.5	25	50.0	100

P. promelas APP-TIE PH 3 FILTRATION

PH 3 Filtration Test (also collect filtered sample for PH 3 SPE Column Test)	
1	Volumes based on 0.5x dilutions of 100, 50, 25 and 12.5%. Total effluent 200 ml, total SFW for blanks and dilutions 400 ml (2 reps @ 30 ml plus 25 ml water quality surrogate)
2	Connect a ca. 18” piece of Teflon tubing to the Cole-Parmer peristaltic pump
3	Place inlet end of the tube in a 1000 ml flask
4	Connect to the outlet end of the tubing a 47 mm in-line polycarbonate filter holder
5	Place a 47 mm 1 um mesh GFF filter into the holder, wetting with deionized water before screwing shut.
6	Turn on the pump and pour 500 ml of deionized water into the 1000 ml flask. Discard filtrate.
7	After all the deionized water is pumped out of the flask add 900 ml of dilution water AT PH3. Discard first 50 ml then collect 400 ml for the filtration blank/diluent and then 450 ml for the PH3 C18 SPE test. Volumes filtered are reduced if the C18 SPE is not run.
8	After all of the dilution water is pumped from the flask begin adding effluent AT PH3. A total of 450 ml will be needed. Collect 200 ml for the PH3 filtration test and retain the other 250 ml of filtered sample for use in the PH3 C18 SPE test
9	Record on biological sheet of this template: B number of base (1 N NaOH) stock and volumes used to adjust sample and SFW back to ambient pH for the FILT PH3 test.
10	Pour test, including filtration blank. 30 ml x 2 reps plus 20 ml for initial water quality. **Dilutions are prepared with the filtration blank water**.
11	Add animals.
12	Retain the filter for later chemical analysis if desired. Wrap in deionized water-rinsed foil and store at 4o C.

Acute Fish Test-48 Hr Survival

Start Date:		Test ID:	AWSL2109I	Sample ID:	PH 3 FILTRATION
End Date:		Lab ID:	CBI	Sample Type:	
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	PP-Pimephales promelas
Comments:	DATA ENTERED BY PB				

Conc-%	1	2
CONTROL	1.0000	1.0000
12.5	1.0000	0.8000
25	0.8000	0.6000
50	0.4000	0.4000
100	0.0000	0.2000

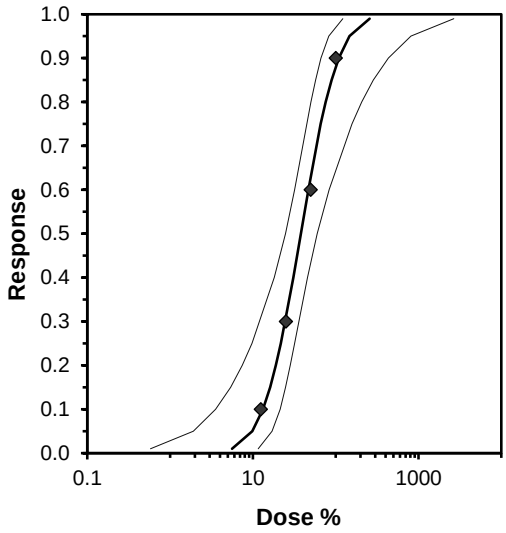
			Transform: Arcsin Square Root					Number	Total
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
CONTROL	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	2	0	10
12.5	0.9000	0.9000	1.2262	1.1071	1.3453	13.732	2	1	10
25	0.7000	0.7000	0.9966	0.8861	1.1071	15.685	2	3	10
50	0.4000	0.4000	0.6847	0.6847	0.6847	0.000	2	6	10
100	0.1000	0.1000	0.3446	0.2255	0.4636	48.867	2	9	10

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Normality of the data set cannot be confirmed				
Equality of variance cannot be confirmed				

Maximum Likelihood-Probit

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	2.80016	0.7705	1.28999	4.31033	0	0.09596	5.99148	0.95	1.57935	0.35712	3
Intercept	0.57756	1.22777	-1.82886	2.98398							
TSCR											

Point	Probits	%	95% Fiducial Limits	
EC01	2.674	5.60482	0.58038	11.5743
EC05	3.355	9.8161	1.90841	17.0976
EC10	3.718	13.2337	3.56411	21.2605
EC15	3.964	16.189	5.39097	24.8166
EC20	4.158	19.0016	7.43653	28.2653
EC25	4.326	21.8011	9.72508	31.8468
EC40	4.747	30.8232	18.0968	45.45
EC50	5.000			
EC60	5.253	46.7551	32.0261	83.1717
EC75	5.674	66.1042	44.9131	157.501
EC80	5.842	75.843	50.4155	206.741
EC85	6.036	89.0199	57.2505	286.04
EC90	6.282	108.899	66.6631	433.714
EC95	6.645	146.814	82.718	811.723
EC99	7.326	257.125	121.963	2674.14



P. promelas APP-TIE PH 3 SPE

TRTMNT (% Effl)	Rep	#Live Day 0	#Live Day 1	#Live Day 2	Final Mean % Live
C	A	5	5	5	100.0
Control	B	5	5	5	
#1	A	5	5	5	90.0
12.5	B	5	5	4	
# 2	A	5	5	5	100.0
25	B	5	5	5	
# 3	A	5	5	5	100.0
50.0	B	5	5	5	
# 4	A	5	5	5	100.0
100	B	5	5	5	
INITIALS:		CPV	LT	LT	% CONTROL SURVIVAL: 100.0
DATE & TIME:		8/27/21 15:35	8/28/21 8:20	8/29/21 15:05	TAC = 90%
CHANGES & NOTES (INITIALS, DATE, SPECIFIC CHANGE MADE					

Methanol A#	SPECIES:	Pimephales promelas	
90	ACCLIMATION WATER:	Mod. Hard Synthetic Freshwater	
SPE A#	FEEDING PRIOR TO TEST:	Artemia nauplii ad libitum	
NA	FEEDING DURING TEST:	None	
SPE CART VOL	SOURCE:	CBI Stock cultures	
6ml	ACCLIMATION TEMP (o C):	25	
ADJ BACK TO AMBIENT PH:	HATCH START DATE & TIME:	8/24/21 17:00	
Base stock B#:	HATCH END DATE & TIME:	8/25/21 10:00	
374	DATE/TIME WATER ADDED:	8/27/21 15:27	
ul base added 200 ml sample:	DATE/TIME ANIMALS ADDED:	8/27/21 15:35	
500	ANIMAL AGE WINDOW:	17h 0m	TAC Max. 24 h
ul base added 400 ml SFW:	MAX AGE AT TEST START:	3d	TAC Max. 14 d
600	TEST SET UP BY:	CPV	
AWSL2109-SPE PH3	PEER REVIEW BY (INITIALS/DATE):	PB	8/30/21 14:18

P. promelas APP-TIE PH 3 SPE

	TRTMNT	Day 0 Initial	Day 1	Day 2 Final	SUMMARY WATER QUALITY DATA MEAN	S.D.	MIN.	MAX.
pH (S.U.)	C	7.67	7.80	7.66	7.71	0.08	7.66	7.80
	1	7.60	7.74	7.62	7.65	0.08	7.60	7.74
	2	7.66	7.73	7.58	7.66	0.08	7.58	7.73
	3	7.69	7.70	7.55	7.65	0.08	7.55	7.70
	4	7.79	7.69	7.54	7.67	0.13	7.54	7.79
Temp. (o C)	C	25	25	25	25	0.0	25	25
	1	25	25	25	25	0.0	25	25
	2	25	25	25	25	0.0	25	25
	3	25	25	25	25	0.0	25	25
	4	25	25	25	25	0.0	25	25
Diss. Oxygen (mg/l)	C	8.2	8.3	8.2	8.2	0.1	8.2	8.3
	1	8.2	8.2	7.5	8.0	0.4	7.5	8.2
	2	8.2	8.1	6.8	7.7	0.8	6.8	8.2
	3	8.2	8.0	6.6	7.6	0.9	6.6	8.2
	4	8.2	7.8	6.6	7.5	0.8	6.6	8.2
Cond. (uS/cm)	C	586		507	547	55.9	507	586
	1	572			572		572	572
	2	628			628		628	628
	3	744			744		744	744
	4	1065		1020	1043	31.8	1020	1065
Replicate measured		Flask	Surrogate	A				
Initials		CPV	LT	LT				
		TRC (mg/l) in highest conc. at end of test:		N/A				
Changes & Notes (Initials, date, specific change or notes)								

Test chamber:	30 ml plastic cup:	✓			
	Other:				
Test solution vol. (15 ml min):	30 ml:	✓			
	Other (ml):				
Illumination & photoperiod:	50-100 ft-c 16L:8D		Template Number:	17	
Number of replicates/treatment:	4				
Initial number animals/replicate:	5				
Test Aerated?	N/A	Date & Time Air Start:	N/A		

TEST ID	TRT ID:	1	2	3	4
AWSL2109-SPE PH3	CONC(%):	12.5	25	50.0	100

P. promelas APP-TIE PH 3 SPE

	PH 3 C18 Solid Phase Extraction (SPE) Test
1	Volumes based on 0.5x dilutions of 100, 50, 25 and 12.5%. Total effluent 200 ml, total SFW for blanks and dilutions 400 ml (2 reps @ 30 ml plus 25 ml water quality surrogate)
2	Attach silicone tubing (ca. 15") to inlet side of G-R metering pump
3	Attach the outlet end of the tubing to the blue Luer-tubing adapter and then attach a small (4") length of glass tubing to the intake (latch) end of the tubing.
4	Place the glass tubing in a small (e.g. 250 ml) flask.
5	Pump DI water (50 ml) through the system
6	Attach a 6 ml (1 g) SPE tube to the Luer end of the adapter and position over an appropriate sized waste flask or beaker.
7	Add 12 ml of HPLC-grade methanol to the beaker and turn on pump. Pump should be set to provide a flow rate of 10 ml/min.
8	Allow the cartridge to fill with 1-2 ml of methanol before firmly attaching the adapter to the cartridge. Allow methanol to be pumped to waste. However, IF CONDUCTING THE SPE ELUATE TEST, COLLECT 3 ml OF METHANOL (Use clean scintillation vial) AFTER PASSAGE OF FIRST 5-6 ml. This will be used as the methanol blank in the eluate test. **Do not allow column to go dry.**
9	Add 50 ml deionized water just as the last of the methanol is pumped from the beaker. A small bubble in the line is O.K.; it will help you track the end of the methanol/beginning of the deionized water in the tube. However, the column must not go dry between the two.
10	DO NOT let column go dry after the addition of the deionized water (keep an eye on the column, a small volume of liquid should always lay on top of the column packing).
11	Add 450 ml of **filtered PH3** dilution water just as the last of the deionized water leaves the reservoir. A small bubble between the two in the pump tubing will enable you to tell when the dilution water is entering the column.
12	Collect 400 ml of PH3 dilution water after discarding the first 50 ml. This is tested as the SPE blank. DO NOT allow column to go dry.
13	Add 200 ml of **filtered PH3** sample just as the last of the dilution water is pumped from the reservoir. Collect the 200 ml eluate. THE COLUMN MAY GO DRY after the entire sample is collected.
14	Record on biological sheet of this template: B number of base (1 N NaOH) stock and volumes used to adjust sample and SFW back to ambient pH for the SPE PH3 test.
15	The filtered SPE sample is tested with appropriate dilutions, using SPE blank as the diluent
16	IF CONDUCTING THE SPE ELUATE TEST: Pass 1.8 ml of methanol over column and collect into a clean scintillation vial. OTHERWISE: Retain the column for later chemical analysis if desired. Wrap in acetone/deionized water-rinsed foil and store at 4o C.
17	Record A# of methanol and SPE column, and size (g) of column, on biological page.

P. promelas APP-TIE PH 11 ADJUSTMENT

TRTMNT (% Effl)	Rep	#Live Day 0	#Live Day 1	#Live Day 2	Final Mean % Live
C	A	5	5	5	100.0
Control	B	5	5	5	
#1	A	5	5	5	100.0
12.5	B	5	5	5	
# 2	A	5	5	2	70.0
25	B	5	5	5	
# 3	A	5	4	1	40.0
50.0	B	5	5	3	
# 4	A	5	1	0	0.0
100	B	5	0	0	
INITIALS:		CPV	LT	LT	% CONTROL SURVIVAL: 100.0
DATE & TIME:		8/27/21 15:08	8/28/21 8:16	8/29/21 15:08	TAC = 90%

CHANGES & NOTES (INITIALS, DATE, SPECIFIC CHANGE MADE			
ADJ TO PH 11:			
Base NaOH stock B#:	SPECIES:	Pimephales promelas	
374	ACCLIMATION WATER:	Mod. Hard Synthetic Freshwater	
ul base added 1L sample:	FEEDING PRIOR TO TEST:	Artemia nauplii ad libitum	
4800	FEEDING DURING TEST:	None	
ul base added 2 L SFW:	SOURCE:	CBI Stock cultures	
4500	ACCLIMATION TEMP (o C):	25	
ADJ BACK TO AMBIENT PH:	HATCH START DATE & TIME:	8/24/21 17:00	
Acid stock B#:	HATCH END DATE & TIME:	8/25/21 10:00	
373	DATE/TIME WATER ADDED:	8/27/21 14:30	
ul acid added 200 ml sample:	DATE/TIME ANIMALS ADDED:	8/27/21 15:08	
890	ANIMAL AGE WINDOW:	17h 0m	TAC Max. 24 h
ul acid added 400 ml SFW:	MAX AGE AT TEST START:	3d	TAC Max. 14 d
850	TEST SET UP BY:	CPV	
		SAMPLE USED	A
TEST ID:		TAC Max 36 h	
AWSL2109-11 ADJ	PEER REVIEW BY (INITIALS/DATE):	PB	8/30/21 14:07

P. promelas APP-TIE PH 11 ADJUSTMENT

	TRTMNT	Day 0 Initial	Day 1	Day 2 Final	SUMMARY WATER QUALITY DATA MEAN	S.D.	MIN.	MAX.
pH (S.U.)	C	8.20	7.91	7.74	7.95	0.23	7.74	8.20
	1	8.15	7.92	7.79	7.95	0.18	7.79	8.15
	2	8.10	7.98	7.82	7.97	0.14	7.82	8.10
	3	8.12	8.01	8.13	8.09	0.07	8.01	8.13
	4	8.17	8.51	8.25	8.31	0.18	8.17	8.51
Temp. (o C)	C	25	25	25	25	0.0	25	25
	1	25	25	25	25	0.0	25	25
	2	25	25	25	25	0.0	25	25
	3	25	25	25	25	0.0	25	25
	4	25	25	25	25	0.0	25	25
Diss. Oxygen (mg/l)	C	8.2	8.2	7.9	8.1	0.2	7.9	8.2
	1	8.2	8.2	7.9	8.1	0.2	7.9	8.2
	2	8.2	8.1	7.5	7.9	0.4	7.5	8.2
	3	8.2	8.0	7.5	7.9	0.4	7.5	8.2
	4	8.2	8.0	7.8	8.0	0.2	7.8	8.2
Cond. (uS/cm)	C	545		565	555	14.1	545	565
	1	571			571		571	571
	2	660			660		660	660
	3	850			850		850	850
	4	1150		1200	1175	35.4	1150	1200
Replicate measured		Flask	Surrogate	B				
Initials		CPV	LT	LT				
		TRC (mg/l) in highest conc. at end of test:		N/A				
Changes & Notes (Initials, date, specific change or notes)								

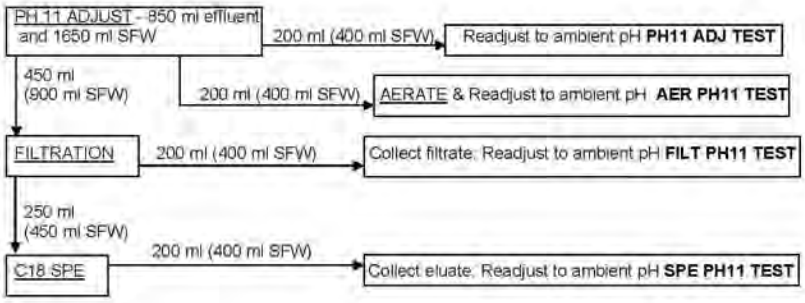
Test chamber:	30 ml plastic cup:	✓		
	Other:			
Test solution vol. (15 ml min):	30 ml:	✓		
	Other (ml):			
Illumination & photoperiod:	50-100 ft-c 16L:8D		Template Number:	6
Number of replicates/treatment:		4		
Initial number animals/replicate:		5		
Test Aerated?		N/A	Date & Time Air Start:	N/A

TEST ID	TRT ID:	1	2	3	4
AWSL2109-11 ADJ	CONC(%):	12.5	25	50.0	100

P. promelas APP-TIE PH 11 ADJUSTMENT

	pH 11 ADJ Test
1	Volumes based on 0.5x dilutions of 100, 50, 25 and 12.5% for each treatment (Total effluent 200 ml, total SFW for blanks and dilutions 400 ml (2 reps @ 30 ml plus 25 ml water quality surrogate))
2	Place 1000 ml of sample into a 1000 ml glass flask. Also add 2000 ml of dilution water into a separate 2000 ml flask. Add stir bars.
3	Adjust each to pH 11 using reagent grade NaOH stock (1N). Record B number of base stock and volumes used for adjustment biological bench sheet of this template.
4	Use 200 ml of sample and 400 ml of SFW for the pH 11 aeration test, and 450 ml of sample and 900 ml of SFW for pH 11 Filtration/SPE test. SEE FIGURE 1
4	Also a 200 ml volume of sample and 400 ml volume of sample is allowed to set while these other tests are set up. These are then adjusted back to ambient and tested as the pH 11 ADJ test. SEE FIGURE 1
5	Record on biological sheet of this template: B number of acid (1 N HCl) stock and volumes used to adjust sample and SFW back to ambient pH for the pH 11 ADJ test.
6	Pour concentrations with pH 3 sample and SFW adjusted back to ambient pH. Include this SFW blank as control. Four reps 15 ml each plus water quality cup.

Figure 1


PH 11 ADJUST - 850 ml effluent and 1650 ml SFW
200 ml (400 ml SFW)
Readjust to ambient pH PH11 ADJ TEST
450 ml (900 ml SFW)
200 ml (400 ml SFW)
AERATE & Readjust to ambient pH AER PH11 TEST
FILTRATION
200 ml (400 ml SFW)
Collect filtrate; Readjust to ambient pH FILT PH11 TEST
250 ml (450 ml SFW)
200 ml (400 ml SFW)
C18 SPE
Collect eluate; Readjust to ambient pH SPE PH11 TEST

Acute Fish Test-48 Hr Survival

Start Date:		Test ID:	AWSL2109L	Sample ID:	PH 11 ADJUSTED
End Date:		Lab ID:	CBI	Sample Type:	
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	PP-Pimephales promelas
Comments:	DATA ENTERED BY PB				

Conc-%	1	2
CONTROL	1.0000	1.0000
12.5	1.0000	1.0000
25	0.4000	1.0000
50	0.2000	0.6000
100	0.0000	0.0000

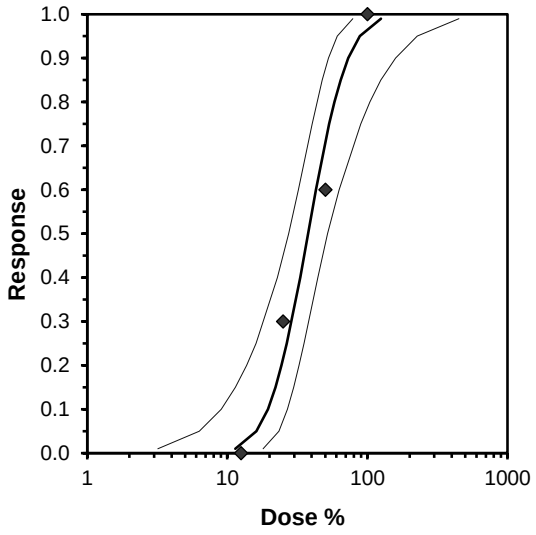
			Transform: Arcsin Square Root					Number	Total
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
CONTROL	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	2	0	10
12.5	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	2	0	10
25	0.7000	0.7000	1.0150	0.6847	1.3453	46.019	2	3	10
50	0.4000	0.4000	0.6749	0.4636	0.8861	44.261	2	6	10
100	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	2	10	10

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Normality of the data set cannot be confirmed				
Equality of variance cannot be confirmed				

Maximum Likelihood-Probit

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	4.46216	1.14445	2.21903	6.7053	0	1.48121	5.99148	0.48	1.57645	0.22411	6
Intercept	-2.03438	1.82248	-5.60643	1.53767							
TSCR											

Point	Probits	%	95% Fiducial Limits	
EC01	2.674	11.3527	3.18793	18.0094
EC05	3.355	16.1372	6.32069	23.2804
EC10	3.718	19.4646	9.03404	26.9015
EC15	3.964	22.0891	11.4332	29.82
EC20	4.158	24.4251	13.7216	32.5174
EC25	4.326	26.6252	15.9727	35.1873
EC40	4.747	33.0882	22.7649	44.1665
EC50	5.000			
EC60	5.253	42.9761	32.2459	62.7753
EC75	5.674	53.4081	40.3895	89.6581
EC80	5.842	58.2187	43.6822	104.423
EC85	6.036	64.3756	47.611	125.383
EC90	6.282	73.0557	52.7541	158.747
EC95	6.645	88.1195	60.9357	226.983
EC99	7.326	125.256	78.7413	450.207



P. promelas APP-TIE PH 11 AERATION

TRTMNT (% Effl)	Rep	#Live Day 0	#Live Day 1	#Live Day 2	Final Mean % Live
C	A	5	5	5	100.0
Control	B	5	5	5	
#1	A	5	5	5	100.0
12.5	B	5	5	5	
# 2	A	5	5	5	70.0
25	B	5	5	2	
# 3	A	5	5	0	10.0
50.0	B	5	4	1	
# 4	A	5	0	0	0.0
100	B	5	1	0	
INITIALS:		CPV	LT	LT	% CONTROL SURVIVAL: 100.0
DATE & TIME:		8/27/21 14:24	8/28/21 7:57	8/29/21 14:06	TAC = 90%
CHANGES & NOTES (INITIALS, DATE, SPECIFIC CHANGE MADE					

	SPECIES:	Pimephales promelas	
	ACCLIMATION WATER:	Mod. Hard Synthetic Freshwater	
	FEEDING PRIOR TO TEST:	Artemia nauplii ad libitum	
ADJ BACK TO AMBIENT PH:	FEEDING DURING TEST:	None	
Acid stock B#:	SOURCE:	CBI Stock cultures	
373	ACCLIMATION TEMP (o C):	25	
ul acid added 200 ml sample:	HATCH START DATE & TIME:	8/24/21 17:00	
450	HATCH END DATE & TIME:	8/25/21 10:00	
ul acid added 400 ml SFW:	DATE/TIME WATER ADDED:	8/27/21 14:24	
500	DATE/TIME ANIMALS ADDED:	8/27/21 14:24	
	ANIMAL AGE WINDOW:	17h 0m	TAC Max. 24 h
	MAX AGE AT TEST START:	3d	TAC Max. 14 d
	TEST SET UP BY:	CPV	
AWSL2109-AER PH11	PEER REVIEW BY (INITIALS/DATE):	PB	8/30/21 14:12

P. promelas APP-TIE PH 11 AERATION

	TRTMNT	Day 0 Initial	Day 1	Day 2 Final	SUMMARY WATER QUALITY DATA MEAN	S.D.	MIN.	MAX.
pH (S.U.)	C	7.78	8.20	7.80	7.93	0.24	7.78	8.20
	1	7.93	8.22	7.87	8.01	0.19	7.87	8.22
	2	8.07	8.28	7.95	8.10	0.17	7.95	8.28
	3	8.35	8.36	8.13	8.28	0.13	8.13	8.36
	4	8.57	8.66	8.55	8.59	0.06	8.55	8.66
Temp. (o C)	C	25	25	25	25	0.0	25	25
	1	25	25	25	25	0.0	25	25
	2	25	25	25	25	0.0	25	25
	3	25	25	25	25	0.0	25	25
	4	25	25	25	25	0.0	25	25
Diss. Oxygen (mg/l)	C	8.2	8.0	8.2	8.1	0.1	8.0	8.2
	1	8.2	8.0	7.9	8.0	0.2	7.9	8.2
	2	8.2	8.1	7.5	7.9	0.4	7.5	8.2
	3	8.2	8.2	7.3	7.9	0.5	7.3	8.2
	4	8.2	8.2	7.0	7.8	0.7	7.0	8.2
Cond. (uS/cm)	C	510		504	507	4.2	504	510
	1	600			600		600	600
	2	670			670		670	670
	3	790			790		790	790
	4	1088		1070	1079	12.7	1070	1088
Replicate measured		Flask	Surrogate	B				
Initials		LT	LT	LT				
		TRC (mg/l) in highest conc. at end of test:		N/A				
Changes & Notes (Initials, date, specific change or notes)								

Test chamber:	30 ml plastic cup:	✓		
	Other:			
Test solution vol. (15 ml min):	30 ml:	✓		
	Other (ml):			
Illumination & photoperiod:	50-100 ft-c 16L:8D		Template Number:	9
Number of replicates/treatment:		4		
Initial number animals/replicate:		5		
	Test Aerated?	N/A	Date & Time Air Start:	N/A

TEST ID	TRT ID:	1	2	3	4
AWSL2109-AER PH11	CONC(%):	12.5	25	50.0	100

P. promelas APP-TIE PH 11 AERATION

	pH 11 Aeration Test
1	Volumes based on 0.5x dilutions of 100, 50, 25 and 12.5%. Total effluent 200 ml, total SFW for blanks and dilutions 400 ml (2 reps @ 30 ml plus 25 ml water quality surrogate)
2	Place 200 ml of sample AT PH 11 into a 500 ml glass cylinder. Also add 400 ml of dilution water AT PH 11 into a separate cylinder.
3	Attach disposable glass Pasteur pipettes to new pieces of vinyl tubing. Use carbon-filtered air for aeration. Place pipettes in cylinders and aerate for 60 min.
4	After 60 min stop aeration.
5	Record on biological sheet of this template: B number of acid (1 N HCl) stock and volumes used to adjust sample and SFW back to ambient pH for the AER pH 11 test.
6	Pour concentrations with aerated sample using aerated SFW as the diluent. Include aeration blank as control. Four reps 15 ml each plus water quality cup.

Acute Fish Test-48 Hr Survival

Start Date:		Test ID:	AWSL2109K	Sample ID:	PH 11 AERATION
End Date:		Lab ID:	CBI	Sample Type:	
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	PP-Pimephales promelas
Comments:	DATA ENTERED BY PB				

Conc-%	1	2
CONTROL	1.0000	1.0000
12.5	1.0000	1.0000
25	1.0000	0.4000
50	0.0000	0.2000
100	0.0000	0.0000

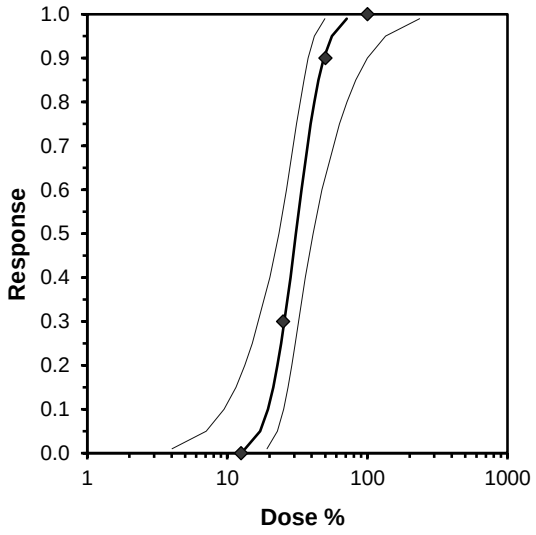
			Transform: Arcsin Square Root					Number	Total
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
CONTROL	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	2	0	10
12.5	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	2	0	10
25	0.7000	0.7000	1.0150	0.6847	1.3453	46.019	2	3	10
50	0.1000	0.1000	0.3446	0.2255	0.4636	48.867	2	9	10
100	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	2	10	10

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Normality of the data set cannot be confirmed				
Equality of variance cannot be confirmed				

Maximum Likelihood-Probit

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	6.41182	1.89253	2.70245	10.1212	0	0.10081	5.99148	0.95	1.48947	0.15596	4
Intercept	-4.55019	2.83872	-10.1141	1.0137							
TSCR											

Point	Probits	%	95% Fiducial Limits	
EC01	2.674	13.3858	4.0274	19.1737
EC05	3.355	17.0975	7.05924	22.8288
EC10	3.718	19.4802	9.45833	25.2206
EC15	3.964	21.2727	11.4681	27.1017
EC20	4.158	22.8143	13.3111	28.8146
EC25	4.326	24.2255	15.0654	30.493
EC40	4.747	28.1809	20.0688	36.0669
EC50	5.000			
EC60	5.253	33.805	26.3964	47.385
EC75	5.674	39.3244	31.243	63.0784
EC80	5.842	41.757	33.0687	71.3796
EC85	6.036	44.7829	35.164	82.8377
EC90	6.282	48.9036	37.7919	100.427
EC95	6.645	55.7189	41.7566	134.54
EC99	7.326	71.1688	49.7224	235.795



P. promelas APP-TIE PH 11 FILTRATION

TRTMNT (% Effl)	Rep	#Live Day 0	#Live Day 1	#Live Day 2	Final Mean % Live
C	A	5	5	5	100.0
Control	B	5	5	5	
#1	A	5	5	5	100.0
12.5	B	5	5	5	
# 2	A	5	5	5	100.0
25	B	5	5	5	
# 3	A	5	3	1	10.0
50.0	B	5	5	0	
# 4	A	5	0	0	0.0
100	B	5	0	0	
INITIALS:		CPV	LT	LT	% CONTROL SURVIVAL: 100.0
DATE & TIME:		8/27/21 14:23	8/28/21 7:49	8/29/21 14:47	TAC = 90%
CHANGES & NOTES (INITIALS, DATE, SPECIFIC CHANGE MADE					

	SPECIES:	Pimephales promelas	
ADJ BACK TO AMBIENT PH:	ACCLIMATION WATER:	Mod. Hard Synthetic Freshwater	
Acid stock B#:	FEEDING PRIOR TO TEST:	Artemia nauplii ad libitum	
273	FEEDING DURING TEST:	None	
ul acid added 200 ml sample:	SOURCE:	CBI Stock cultures	
840	ACCLIMATION TEMP (o C):	25	
ul acid added 400 ml SFW:	HATCH START DATE & TIME:	8/24/21 17:00	
820	HATCH END DATE & TIME:	8/25/21 10:00	
	DATE/TIME WATER ADDED:	8/27/21 14:17	
	DATE/TIME ANIMALS ADDED:	8/27/21 14:23	
	ANIMAL AGE WINDOW:	17h 0m	TAC Max. 24 h
	MAX AGE AT TEST START:	3d	TAC Max. 14 d
	TEST SET UP BY:	CPV	
AWSL2109-FILT PH11	PEER REVIEW BY (INITIALS/DATE):	PB	8/30/21 14:13

P. promelas APP-TIE PH 11 FILTRATION

	TRTMNT	Day 0 Initial	Day 1	Day 2 Final	SUMMARY WATER QUALITY DATA MEAN	S.D.	MIN.	MAX.
pH (S.U.)	C	7.81	7.71	7.71	7.74	0.06	7.71	7.81
	1	7.89	7.75	7.69	7.78	0.10	7.69	7.89
	2	8.03	7.85	7.75	7.88	0.14	7.75	8.03
	3	8.10	8.20	7.88	8.06	0.16	7.88	8.20
	4	8.31	8.46		8.39	0.11	8.31	8.46
Temp. (o C)	C	25	25	25	25	0.0	25	25
	1	25	25	25	25	0.0	25	25
	2	25	25	25	25	0.0	25	25
	3	25	25	25	25	0.0	25	25
	4	25	25		25	0.0	25	25
Diss. Oxygen (mg/l)	C	8.2	7.9	8.0	8.0	0.2	7.9	8.2
	1	8.2	7.9	8.0	8.0	0.2	7.9	8.2
	2	8.2	8.0	8.0	8.1	0.1	8.0	8.2
	3	8.2	8.1	7.5	7.9	0.4	7.5	8.2
	4	8.2	8.2		8.2	0.0	8.2	8.2
Cond. (uS/cm)	C	515		501	508	9.9	501	515
	1	583			583		583	583
	2	620			620		620	620
	3	823		820	822	2.1	820	823
	4	1111			1111		1111	1111
Replicate measured		Flask	Surrogate	A				
Initials		CPV	LT	LT				
		TRC (mg/l) in highest conc. at end of test:		N/A				
Changes & Notes (Initials, date, specific change or notes)								

Test chamber:	30 ml plastic cup:	✓			
	Other:				
Test solution vol. (15 ml min):	30 ml:	✓			
	Other (ml):				
Illumination & photoperiod:	50-100 ft-c 16L:8D		Template Number:	14	
Number of replicates/treatment:	4				
Initial number animals/replicate:	5				
Test Aerated?	N/A	Date & Time Air Start:	N/A		

TEST ID	TRT ID:	1	2	3	4
AWSL2109-FILT PH11	CONC(%):	12.5	25	50.0	100

P. promelas APP-TIE PH 11 FILTRATION

	PH 11 Filtration Test (also collect filtered sample for PH 11 SPE Column Test)
1	Volumes based on 0.5x dilutions of 100, 50, 25 and 12.5%. Total effluent 200 ml, total SFW for blanks and dilutions 400 ml (2 reps @ 30 ml plus 25 ml water quality surrogate)
2	Connect a ca. 18” piece of Teflon tubing to the Cole-Parmer peristaltic pump
3	Place inlet end of the tube in a 1000 ml flask
4	Connect to the outlet end of the tubing a 47 mm in-line polycarbonate filter holder
5	Place a 47 mm 1 um mesh GFF filter into the holder, wetting with deionized water before screwing shut.
6	Turn on the pump and pour 500 ml of deionized water into the 1000 ml flask. Discard filtrate.
7	After all the deionized water is pumped out of the flask add 900 ml of dilution water AT PH11. Discard first 50 ml then collect 400 ml for the filtration blank/diluent and then 450 ml for the PH11 C18 SPE test. Volumes filtered are reduced if the C18 SPE is not run.
8	After all of the dilution water is pumped from the flask begin adding effluent AT PH11. A total of 450 ml will be needed. Collect 200 ml for the PH11 filtration test and retain the other 250 ml of filtered sample for use in the PH11 C18 SPE test
9	Record on biological sheet of this template: B number of acid (1 N HCl) stock and volumes used to adjust sample and SFW back to ambient pH for the FILT pH 11 test.
10	Pour test, including filtration blank. 15 ml x 4 reps plus 20 ml for initial water quality. **Dilutions are prepared with the filtration blank water**.
11	Add animals.
12	Retain the filter for later chemical analysis if desired. Wrap in deionized water-rinsed foil and store at 4o C.

Acute Fish Test-48 Hr Survival

Start Date:		Test ID:	AWSL2109G	Sample ID:	PH 11 FILTRATION
End Date:		Lab ID:	CBI	Sample Type:	
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	PP-Pimephales promelas
Comments:	DATA ENTERED BY PB				

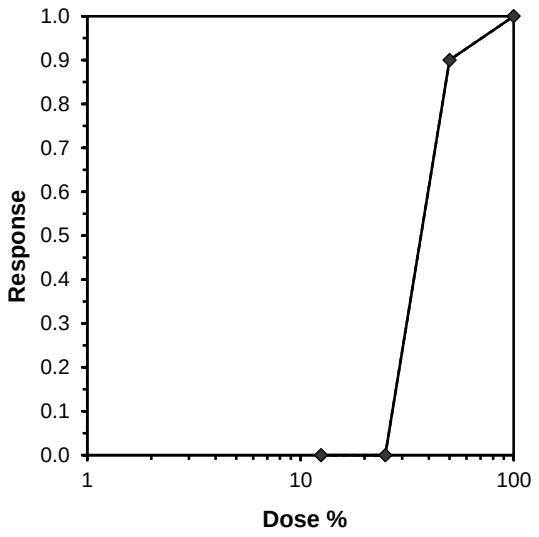
Conc-%	1	2
CONTROL	1.0000	1.0000
12.5	1.0000	1.0000
25	1.0000	1.0000
50	0.2000	0.0000
100	0.0000	0.0000

			Transform: Arcsin Square Root					Number	Total
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
CONTROL	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	2	0	10
12.5	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	2	0	10
25	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	2	0	10
50	0.1000	0.1000	0.3446	0.2255	0.4636	48.867	2	9	10
100	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	2	10	10

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Normality of the data set cannot be confirmed				
Equality of variance cannot be confirmed				

Trimmed Spearman-Karber

Trim Level	EC50	95% CL	
0.0%	37.893	33.223	43.219
5.0%	37.059	32.604	42.123
10.0%	36.743	33.878	39.851
20.0%	36.743	33.878	39.851
Auto-0.0%			



P. promelas APP-TIE PH 11 SPE

TRTMNT (% Effl)	Rep	#Live Day 0	#Live Day 1	#Live Day 2	Final Mean % Live
C	A	5	5	5	100.0
Control	B	5	5	5	
#1	A	5	5	5	100.0
12.5	B	5	5	5	
# 2	A	5	5	5	100.0
25	B	5	5	5	
# 3	A	5	5	5	100.0
50.0	B	5	5	5	
# 4	A	5	5	5	100.0
100	B	5	5	5	
INITIALS:		CPV	LT	LT	% CONTROL SURVIVAL: 100.0
DATE & TIME:		8/27/21 15:35	8/28/21 7:44	8/29/21 13:10	TAC = 90%
CHANGES & NOTES (INITIALS, DATE, SPECIFIC CHANGE MADE					

Methanol A#	SPECIES:	Pimephales promelas	
90	ACCLIMATION WATER:	Mod. Hard Synthetic Freshwater	
SPE A#	FEEDING PRIOR TO TEST:	Artemia nauplii ad libitum	
NA	FEEDING DURING TEST:	None	
SPE CART VOL	SOURCE:	CBI Stock cultures	
6ml	ACCLIMATION TEMP (o C):	25	
ADJ BACK TO AMBIENT PH:	HATCH START DATE & TIME:	8/25/21 17:00	
Acid stock B#:	HATCH END DATE & TIME:	8/26/21 10:00	
373	DATE/TIME WATER ADDED:	8/27/21 15:35	
ul acid added 200 ml sample:	DATE/TIME ANIMALS ADDED:	8/27/21 15:35	
920	ANIMAL AGE WINDOW:	17h 0m	TAC Max. 24 h
ul acid added 400 ml SFW:	MAX AGE AT TEST START:	2d	TAC Max. 14 d
800	TEST SET UP BY:	CPV	
		SAMPLE USED	A
TEST ID:		TAC Max 36 h	
AWSL2109-SPE PH11	PEER REVIEW BY (INITIALS/DATE):	PB	8/30/21 14:14

P. promelas APP-TIE PH 11 SPE

	TRTMNT	Day 0 Initial	Day 1	Day 2 Final	SUMMARY WATER QUALITY DATA MEAN	S.D.	MIN.	MAX.
pH (S.U.)	C	8.12	8.08	7.69	7.96	0.24	7.69	8.12
	1	8.13	8.11	7.67	7.97	0.26	7.67	8.13
	2	8.16	8.19	7.75	8.03	0.25	7.75	8.19
	3	8.18	8.27	7.70	8.05	0.31	7.70	8.27
	4	8.22	8.50	7.89	8.20	0.31	7.89	8.50
Temp. (o C)	C	25	25	25	25	0.0	25	25
	1	25	25	25	25	0.0	25	25
	2	25	25	25	25	0.0	25	25
	3	25	25	25	25	0.0	25	25
	4	25	25	25	25	0.0	25	25
Diss. Oxygen (mg/l)	C	8.2	8.0	8.1	8.1	0.1	8.0	8.2
	1	8.2	8.0	7.5	7.9	0.4	7.5	8.2
	2	8.2	7.9	6.8	7.6	0.7	6.8	8.2
	3	8.2	7.8	5.9	7.3	1.2	5.9	8.2
	4	8.2	7.4	5.0	6.9	1.7	5.0	8.2
Cond. (uS/cm)	C	500		489	495	7.8	489	500
	1	589			589		589	589
	2	670			670		670	670
	3	855			855		855	855
	4	1075		950	1013	88.4	950	1075
Replicate measured		Flask	Surrogate	B				
Initials		LT	LT	LT				
		TRC (mg/l) in highest conc. at end of test:		N/A				
Changes & Notes (Initials, date, specific change or notes)								

Test chamber:	30 ml plastic cup:	✓		
	Other:			
Test solution vol. (15 ml min):	30 ml:	✓		
	Other (ml):			
Illumination & photoperiod:	50-100 ft-c 16L:8D		Template Number:	4
Number of replicates/treatment:		4		
Initial number animals/replicate:		5		
	Test Aerated?	N/A	Date & Time Air Start:	N/A

TEST ID	TRT ID:	1	2	3	4
AWSL2109-SPE PH11	CONC(%):	12.5	25	50.0	100

P. promelas APP-TIE PH 11 SPE

	PH 11 C18 Solid Phase Extraction (SPE) Test
1	Volumes based on 0.5x dilutions of 100, 50, 25 and 12.5%. Total effluent 200 ml, total SFW for blanks and dilutions 400 ml (2 reps @ 30 ml plus 25 ml water quality surrogate)
2	Attach silicone tubing (ca. 15”) to inlet side of G-R metering pump
3	Attach the outlet end of the tubing to the blue Luer-tubing adapter and then attach a small (4”) length of glass tubing to the intake (latch) end of the tubing.
4	Place the glass tubing in a small (e.g. 250 ml) flask.
5	Pump DI water (50 ml) through the system
6	Attach a 6 ml (1 g) SPE tube to the Luer end of the adapter and position over an appropriate sized waste flask or beaker.
7	Add 12 ml of HPLC-grade methanol to the beaker and turn on pump. Pump should be set to provide a flow rate of 10 ml/min.
8	Allow the cartridge to fill with 1-2 ml of methanol before firmly attaching the adapter to the cartridge. Allow methanol to be pumped to waste. However, IF CONDUCTING THE SPE ELUATE TEST, COLLECT 3 ml OF METHANOL (Use clean scintillation vial) AFTER PASSAGE OF FIRST 5-6 ml. This will be used as the methanol blank in the eluate test. **Do not allow column to go dry.**
9	Add 50 ml deionized water just as the last of the methanol is pumped from the beaker. A small bubble in the line is O.K.; it will help you track the end of the methanol/beginning of the deionized water in the tube. However, the column must not go dry between the two.
10	DO NOT let column go dry after the addition of the deionized water (keep an eye on the column, a small volume of liquid should always lay on top of the column packing).
11	Add 450 ml of **filtered PH11** dilution water just as the last of the deionized water leaves the reservoir. A small bubble between the two in the pump tubing will enable you to tell when the dilution water is entering the column.
12	Collect 400 ml of PH11 dilution water after discarding the first 50 ml. This is tested as the SPE blank. DO NOT allow column to go dry.
13	Add 200 ml of **filtered PH11** sample just as the last of the dilution water is pumped from the reservoir. Collect the 200 ml eluate. THE COLUMN MAY GO DRY after the entire sample is collected.
14	Record on biological sheet of this template: B number of acid (1 N HCl) stock and volumes used to adjust sample and SFW back to ambient pH for the SPE pH 11 test.
15	The filtered SPE sample is tested with appropriate dilutions, using SPE blank as the diluent
16	IF CONDUCTING THE SPE ELUATE TEST: Pass 1.8 ml of methanol over column and collect into a clean scintillation vial. OTHERWISE: Retain the column for later chemical analysis if desired. Wrap in acetone/deionized water-rinsed foil and store at 4o C.
17	Record A# of methanol and SPE column, and size (g) of column, on biological page.

Effluent and Dilution Water Log (Freshwater Tests). FWEFFL061013

											SUMMARY WATER QUALITY DATA				
Initial sample charac-terization	Bottle(1):	A1									MEAN	S.D.	MIN.	MAX.	PARAMETER
	Arrival Temp. (oC, from CoC):	1									1		1	1	Arrival Temp.
	TRC (mg/l)(2):	<DL													
	TRC Corrected(2):														
	Hardness (mg/l):	98									98		98	98	Hardness (mg/l)
	Alkalinity (mg/l):	202									202		202	202	Alkalinity (mg/l)
	NH3-N (mg/l):	<1.0													
	Color/Appearance(3):	C													
	Obvious odor?	NO													
	Date & Time:	8/25/21 15:41													
	Initials:	LT													
Sample prep measure-ments	Test Day:	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7		MEAN	S.D.	MIN.	MAX.	
	Bottle(s):	A1-2													
	Prep. Temp. (oC):	25									25		25	25	Temp. (oC)
	D.O. (mg/l) After Warming:	9.2													
	Aeration Time (min):	2													
	Adjusted D.O. (mg/l):	8.2									8.2		8.2	8.2	D.O. (mg/l)
	Final pH (S.U.):	8.24									8.24		8.24	8.24	pH (S.U.)
	Conductivity (uS/cm)(4):	746									746		746	746	Cond. (uS/cm)
	Final TRC (mg/l)(5):	N.D.													
	Sample Filtered (60 um)?														
	Date & Time:	8/25/21 15:47													
	Initials:	CPV													
Dilution water	Test Day:	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7		MEAN	S.D.	MIN.	MAX.	
	Vat Number:	1													
	Temperature (oC):	25									25		25	25	Temp. (oC)
	Conductivity (uS/cm):	299									299		299	299	Cond. (uS/cm)
	D.O. (mg/l):	8.2									8.2		8.2	8.2	D.O. (mg/l)
	pH (S.U.):	7.69									7.69		7.69	7.69	pH (S.U.)
	Hardness (mg/l):	86									86		86	86	Hardness (mg/l)
	Alkalinity (mg/l):	61									61		61	61	Alkalinity (mg/l)
	Date & Time:	8/25/21 9:00													
	Initials:	CPV													
	Changes & Notes (Initials, date, specific change or notes)														
	Peer review Initial/Date:	PB	9/1/21 10:29	DILUTION WATER TYPE:	Mod. Hard Synthetic Freshwater (EPA)	ND=Not Determined/Measured, NA=Not Applicable. 1) Ninth character of lab sample ID on chain of custody AND bottle number in collection series. Together with Project ID constitutes entire sample bottle ID. 2) TRC MDL 0.02 mg/l; QL 0.22 mg/l. Corrected value if Mn, Cr potential positive interference. Corrected using KI and NaAsO2. 3) C-clear, O-opaque, T-turbid, S-solids (Sl-slight, M-moderate, H-heavy), Y-yellow, B-brown, Bl-black, G-green, P-pink, Gr-grey, Or-orange. 4) Measured on first use of sample only. 5) Final TRC measured only if chlorine present in initial characterization.												
PROJECT ID:	AWSL2109	ADDITIONAL EFFLUENT TREATMENT:													

Effluent and Dilution Water Log (Freshwater Tests). FWEFFL061013

											SUMMARY WATER QUALITY DATA				
Initial sample charac-terization	Bottle(1):	A1									MEAN	S.D.	MIN.	MAX.	PARAMETER
	Arrival Temp. (oC, from CoC):	1									1		1	1	Arrival Temp.
	TRC (mg/l)(2):	<DL													
	TRC Corrected(2):														
	Hardness (mg/l):	98									98		98	98	Hardness (mg/l)
	Alkalinity (mg/l):	202									202		202	202	Alkalinity (mg/l)
	NH3-N (mg/l):	<1.0													
	Color/Appearance(3):	C													
	Obvious odor?	NO													
	Date & Time:	8/25/21 15:41													
	Initials:	LT													
Sample prep measure-ments	Test Day:	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7		MEAN	S.D.	MIN.	MAX.	
	Bottle(s):	A1													
	Prep. Temp. (oC):	25									25		25	25	Temp. (oC)
	D.O. (mg/l) After Warming:	9.5													
	Aeration Time (min):	3													
	Adjusted D.O. (mg/l):	8.2									8.2		8.2	8.2	D.O. (mg/l)
	Final pH (S.U.):	8.35									8.35		8.35	8.35	pH (S.U.)
	Conductivity (uS/cm)(4):	698									698		698	698	Cond. (uS/cm)
	Final TRC (mg/l)(5):	N.D.													
	Sample Filtered (60 um)?														
	Date & Time:	8/27/21 9:53													
	Initials:	LT													
Dilution water	Test Day:	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7		MEAN	S.D.	MIN.	MAX.	
	Vat Number:	2													
	Temperature (oC):	25									25		25	25	Temp. (oC)
	Conductivity (uS/cm):	303									303		303	303	Cond. (uS/cm)
	D.O. (mg/l):	8.2									8.2		8.2	8.2	D.O. (mg/l)
	pH (S.U.):	7.80									7.80		7.80	7.80	pH (S.U.)
	Hardness (mg/l):	80									80		80	80	Hardness (mg/l)
	Alkalinity (mg/l):	62									62		62	62	Alkalinity (mg/l)
	Date & Time:	8/27/21 8:00													
	Initials:	LT													
	Changes & Notes (Initials, date, specific change or notes)														
	Peer review Initial/Date:	PB	9/1/21 10:30	DILUTION WATER TYPE:	Mod. Hard Synthetic Freshwater (EPA)	ND=Not Determined/Measured, NA=Not Applicable. 1) Ninth character of lab sample ID on chain of custody AND bottle number in collection series. Together with Project ID constitutes entire sample bottle ID. 2) TRC MDL 0.02 mg/l; QL 0.22 mg/l. Corrected value if Mn, Cr potential positive interference. Corrected using KI and NaAsO2. 3) C-clear, O-opaque, T-turbid, S-solids (Sl-slight, M-moderate, H-heavy), Y-yellow, B-brown, Bl-black, G-green, P-pink, Gr-grey, Or-orange. 4) Measured on first use of sample only. 5) Final TRC measured only if chlorine present in initial characterization.												
PROJECT ID:	AWSL2109 TIE PREP	ADDITIONAL EFFLUENT TREATMENT:													

ENTHALPY ANALYTICAL
formerly *Air, Water & Soil Laboratories*

Coastal Bioanalysts
6400 Enterprise Ct
Gloucester, VA 23061

1941 REYMET ROAD
RICHMOND, VIRGINIA 23237
(804) 358-8295 PHONE
(804)358-8297 FAX

Chain of Custody
Form #: D1331
Rev. 1.0
Effective: Feb 14, 2014

AWSL2109-A 21-1228

CHAIN OF CUSTODY

COMPANY NAME: Air, Water & Soil Labs, INC	INVOICE TO: AWS LABS	PROJECT NAME/Quote #: 21H1266
CONTACT: Katrina Cooke	INVOICE CONTACT: Katharine Clark	SITE NAME: 21H1266
ADDRESS:1941 Reymet Rd, Richmond, VA 23237	INVOICE ADDRESS:	PROJECT NUMBER: 21H1266
PHONE #: 804-358-8295	INVOICE PHONE #:	P.O. #:
FAX #:804-358-8297	EMAIL: support@awslabs.com	Pretreatment Program:
Is sample for compliance reporting? (YES) NO VA	Is sample from a chlorinated supply? YES NO	PWS I.D. #:
SAMPLER NAME (PRINT): Denise Vaughn	SAMPLER SIGNATURE:	Turn Around Time: 21 Days

Matrix Codes: WW=Waste Water/Storm Water GW=Ground Water DW=Drinking Water S=Soil/Solids OR=Organic A=Air WP=Wipe OT=Other_____

CLIENT SAMPLE I.D.	Grab	Composite	Field Filtered (Dissolved Metals)	Composite Start Date	Composite Start Time	Grab Date or Composite Stop Date	Grab Time or Composite Stop Time	Time Preserved	Matrix (See Codes)	Number of Containers	ANALYSIS / (PRESERVATIVE) Acute Toxicity - Ceriodaphnia Dubia	Acute Toxicity - Pimephales Promelas							COMMENTS
1) 21H1266-01 029 Annual Acute - CD & PP		X		08/24/21	0.00	08/24/21	23.59		WW	2	X	X							
2)																			
3)																			
4)																			
5)																			
6)																			
7)																			
8)																			
9)																			
10)																			

Preservative Codes: N=Nitric Acid C=Hydrochloric Acid S=Sulfuric Acid H=Sodium Hydroxide A=Ascorbic Acid Z=Zinc Acetate T=Sodium Thiosulfate M=Methanol

PLEASE NOTE PRESERVATIVE(S), INTERFERENCE CHECKS or PUMP RATE (L/min)

21H1266-01 A Due: 09/01/2021 18:00
Non-Potable Water-Cubitainer
BAE Systems, I
Collected: 08/24/2021 23:59
029 Annual Acute - CD & PP

Order #: 1G23015
Project: VPDES Weekly
Sample ID: 029 WC
Matrix: NPW Container: Cubitainer Pour Up
Pres: Cool < 6 °C
AcuteToxicity Sub
Date: 8.24.21
Time: 2359
Taken By: DV
8.25.21

RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME
Sarah Endsley	8/25/21 1400	[illegible]	
RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME
		L. Thomas @CBI	8/25/21 1540
RELINQUISHED:	DATE / TIME	RECEIVED: °C	DATE / TIME TV-LT

QC Data Package
Level I ☐
Level II ☐
Level III ☐
Level IV ☐

LAB USE ONLY COOLER TEMP 1 °C

21H1266 Coastal Bioanalysts - BAE.xls

1941 Reymet Road ● Richmond, Virginia 23237 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Laboratory Order ID 21L1059

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford, VA 24141	Date Received:	November 17, 2021 15:22
		Date Issued:	December 21, 2021 9:37
		Project Number:	[none]
Submitted To:	Sheree Andrews	Purchase Order:	RFAC-032621-01-RLL
Client Site I.D.:	029 4th Quarter Toxicity		

Enclosed are the results of analyses for samples received by the laboratory on 11/17/2021 15:22. If you have any questions concerning this report, please feel free to contact the laboratory.

Sincerely,

Ted Soyars

Technical Director

End Notes:

The test results listed in this report relate only to the samples submitted to the laboratory and as received by the Laboratory.

Unless otherwise noted, the test results for solid materials are calculated on a wet weight basis. Analyses for pH, dissolved oxygen, temperature, residual chlorine and sulfite that are performed in the laboratory do not meet NELAC requirements due to extremely short holding times. These analyses should be performed in the field. The results of field analyses performed by the Sampler included in the Certificate of Analysis are done so at the client's request and are not included in the laboratory's fields of certification nor have they been audited for adherence to a reference method or procedure.

The signature on the final report certifies that these results conform to all applicable NELAC standards unless otherwise specified. For a complete list of the Laboratory's NELAC certified parameters please contact customer service.

This report shall not be reproduced except in full without the expressed and written approval of an authorized representative of Air Water & Soil Laboratories, Inc.

TNI Accredited
VELAP ID 460021

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued:	December 21, 2021 9:37
		Project Number:	[none]
		Purchase Order:	RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	029 4th Quarter Toxicity		

ANALYTICAL REPORT FOR SAMPLES

Laboratory Order ID 21L1059

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
029 Quarterly TOX-Cd	21L1059-01	Waste Water	11/16/2021 00:00 to 11/16/2021 23:59	11/17/2021 15:22

Analysis for Toxicity was subcontracted to Coastal Bioanalysts, Inc. The subcontracted results are attached at the end of this Certificate of Analysis.

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued:	December 21, 2021 9:37
		Project Number:	[none]
		Purchase Order:	RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	029 4th Quarter Toxicity		

Laboratory Order ID: 21L1059

Analytical Results

Sample I.D. 029 Quarterly TOX-Cd **Laboratory Sample ID:** 21L1059-01

Composite Start-End Date/Time: 11/16/2021 00:00 - 11/16/2021 23:59

Field Residual Cl: **Field pH:**

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Subcontracted Analysis									
Acute Toxicity CD	01	EPA	Attached		--	1	12/21/21 06:50	12/21/21 06:50	N/A

Analytical Summary

Sample ID	Preparation Factors Initial / Final	Method	Batch ID	Sequence ID	Calibration ID
Subcontracted Analysis		**Preparation Method:**	***** DEFAULT PREP *****		
21L1059-01	1.00 mL / 1.00 mL	EPA	BEL0832		

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued:	December 21, 2021 9:37
		Project Number:	[none]
		Purchase Order:	RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	029 4th Quarter Toxicity		

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued:	December 21, 2021 9:37
		Project Number:	[none]
		Purchase Order:	RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	029 4th Quarter Toxicity		

Certified Analyses included in this Report

Analyte **Certifications**

Code	Description	Laboratory ID	Expires
MADEP	Massachusetts DEP	M-VA913	06/30/2022
MdDOE	Maryland DE Drinking Water	341	12/31/2021
NC	North Carolina DENR	495	12/31/2021
NCDEQ	North Carolina DEQ	495	12/31/2021
NCDOH	North Carolina Department of Health	51714	07/31/2022
NHDES	NELAP-New Hampshire Certificate #224221	2242	02/25/2022
NJDEP	NELAP-New Jersey DEP	VA015	06/30/2022
NYDOH	New York DOH Drinking Water	12096	04/01/2022
PADEP	NELAP-Pennsylvania Certificate #007	68-03503	10/31/2022
VELAP	NELAP-Virginia Certificate #11539	460021	06/14/2022
WVDEP	West Virginia DEP	350	12/31/2021

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued:	December 21, 2021 9:37
		Project Number:	[none]
		Purchase Order:	RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	029 4th Quarter Toxicity		

Summary of Data Qualifiers

Attached	Attached
RPD	Relative Percent Difference
Qual	Qualifers
-RE	Denotes sample was re-analyzed
D.F.	Dilution Factor. Please also see the Preparation Factor in the Analysis Summary section.
TIC	Tentatively Identified Compounds are compounds that are identified by comparing the analyte mass spectral pattern with the NIST spectral library. A TIC spectral match is reported when the pattern is at least 75% consistent with the published pattern. Compound concentrations are estimated and are calculated using an internal standard response factor of 1.
PCBs, Total	Total PCBs are defined as the sum of detected Aroclors 1016, 1221, 1232, 1248, 1254, 1260, 1262, and 1268.

ENTHALPY
formerly Air, Water & Soil Laboratories

1941 REYMET ROAD
RICHMOND, VIRGINIA 23237
(804) 358-8295 PHONE
(804)358-8297 FAX

Chain of Custody
Effective: Nov 15, 2018

CHAIN OF CUSTODY

PAGE 1 OF 1

COMPANY NAME: BAE Systems, Inc. - RFAAP	INVOICE TO: Accounts Payable	PROJECT NAME: 029 4th Quarter Toxicity
CONTACT: Sheree Andrews	INVOICE CONTACT:	SITE NAME:
ADDRESS: Route 114 Radford, Va 24141	INVOICE ADDRESS:	PROJECT NUMBER:
PHONE #: 1-540-717-4092	INVOICE PHONE #:	P.O. #:
FAX #: / EMAIL: Sheree.andrews@baesystems.com		Pretreatment Program:
Is sample for compliance reporting? YES	Regulatory State: Va / Is sample from a chlorinated supply? YES NO	PWS I.D. #:
SAMPLER NAME (PRINT): Matt Alberts	SAMPLER SIGNATURE: Matt Alberts	Turn Around Time: Circle 10 5 Days or _Day(s)

Matrix Codes: WW=Waste Water/Storm Water GW=Ground Water DW=Drinking Water S=Soil/Solids OR=Organic A=Air WP=Wipe OT=Other WW

CLIENT SAMPLE I.D.	Grab	Composite	Field Filtered (Dissolved Metals)	Composite Start Date	Composite Start Time	Grab Date or Composite Stop Date	Grab Time or Composite Stop Time	Time Preserved	Matrix (See Codes)	Number of Containers	ANALYSIS / (PRESERVATIVE): Acute Toxicity - Ceriodaphnia dubia								COMMENTS: Preservative Codes: N=Nitric Acid C=Hydrochloric Acid S=Sulfuric Acid H=Sodium Hydroxide A=Ascorbic Acid Z=Zinc Acetate T=Sodium Thiosulfate M=Methanol; PLEASE NOTE PRESERVATIVE(S), INTERFERENCE CHECKS or PUMP RATE (L/min)
1) 029 Quarterly Tox-cd		X		11.16.21	0000	11.16.21	2359		WW		x								
2)																			
3)																			
4)																			
5)																			
6)																			
7)																			
8)																			
9)																			
10)																			

RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME
Matt Alberts	11-17-21/0000	AWS Courier	
RELINQUISHED: Courier	DATE / TIME	RECEIVED: 17 NOV 2021 1337	DATE / TIME
RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME

QC Data Package
Level III ☐
Level IV ☐

LAB USE ONLY Therm ID: 271
Custody Seals used and intact? (Y / N)
COOLER TEMP 0.3 °C
Received on ice? (Y / N)

BAE Systems, Inc. 21L1059
Toxicity
Recd: 11/17/2021 Due: 12/20/2021

v130325002 11.16.21

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued:	December 21, 2021 9:37
		Project Number:	[none]
		Purchase Order:	RFAC-032621-01-RLL
Submitted To:	Sheree Andrews		
Client Site I.D.:	029 4th Quarter Toxicity		

Sample Conditions Checklist

Samples Received at:	**0.30°C**
How were samples received?	AWS Courier
Were Custody Seals used? If so, were they received intact?	No
Are the custody papers filled out completely and correctly?	Yes
Do all bottle labels agree with custody papers?	Yes
Is the temperature blank or representative sample within acceptable limits or received on ice, and recently taken?	Yes
Are all samples within holding time for requested laboratory tests?	Yes
Is a sufficient amount of sample provided to perform the tests included?	Yes
Are all samples in appropriate containers for the analyses requested?	Yes
Were volatile organic containers received?	No
Are all volatile organic and TOX containers free of headspace?	NA
Is a trip blank provided for each VOC sample set? VOC sample sets include EPA8011, EPA504, EPA8260, EPA624, EPA8015 GRO, EPA8021, EPA524, and RSK-175.	NA
Are all samples received appropriately preserved? Note that metals containers do not require field preservation but lab preservation may delay analysis.	Yes

Work Order Comments

Work order logged on standard 21 Day TAT. THM 17 Nov 2021/20.05
Per Sheree Andrews: work order to be re-logged and reanalyzed for toxicity as part of a broader toxicity investigation. JPV 12/19/21 15:26

Client: Enthalpy Analytical/Air, Water and Soil Laboratories
Project ID: AWSL2113BL
Client Sample ID: BAE-Radford Army Ammunition Plant 21K1076-01
Permit No.: VA0000248 Outfall 029
Sample Period: 11/16/21

Coastal Bioanalysts, Inc.

Report of Analysis: Whole Effluent Toxicity (WET) – Retest of 11/16/21 Sample

Submitted To:	**Prepared By:**
JP Verheul Business Development Manager / Senior Chemist Enthalpy Analytical/Air, Water and Soil Laboratories 1941 Reymet Road, Richmond, VA 23237	Coastal Bioanalysts, Inc. 6400 Enterprise Court Gloucester, VA 23061 (804) 694-8285 www.coastalbio.com Contact: Peter F. De Lisle, Technical Director

Acute Test Results*				
Species-Test Method	**Test Period**	**NOAEC**	**48-h LC50**	**T.U.$_{Ac}$**
C. dubia EPA 2002.0 initial	11/18/21-11/20/21	N/A	4.17	**23.98**
C. dubia EPA 2002.0 BL	12/2/21-12/4/21	N/A	1.43	**69.93**
P. promelas EPA 2000.0 BL	12/2/21-12/4/21	N/A	30.3	**3.30**

Details regarding test conduct and data analysis provided in attached bench sheets and printouts as applicable.
For each test method record the T.U.$_{Ac}$ value (bold) on the DMR.

Acute Test QA/QC Reference Toxicant: KCl Units: mg/l Test Organism Source: CBI Stock Cultures					
Species-Method (Ref. Test Date)	**Data Source**	**% Control Survival**	**48-h LC50**	**95% C.L./A.L. For LC50**	**RTT in Control?**
C. dubia 2002.0	RTT	100	434	410-459	Yes
(11/2/21-11/4/21)	CC	100	539	475-602	
P. promelas 2000.0	RTT	100	1000	907-1103	Yes
(11/2/21-11/4/21)	CC	100	1003	845-1160	

Note: RTT = Reference Toxicant Test, CC = Control Chart.

The results of analysis contained within this report relate only to the sample as received in the laboratory. This report shall not be reproduced except in full without written approval from the laboratory. Unless noted below, these test results meet all requirements of NELAP.

APPROVED: Peter F. De Lisle

Digitally signed by Peter F. De Lisle
DN: cn=Peter F. De Lisle, o=Coastal Bioanalysts, Inc., ou=Toxicology, email=pfd@coastalbio.com, c=US
Date: 2021.12.06 15:39:02 -05'00'

Peter F. De Lisle, Ph.D.
Technical Director

Deviations from, additions to, or exclusions from the test method, non-standard conditions or data qualifiers and, as appropriate, a statement of compliance/non-compliance: **NONE**

Please leave feedback regarding our services at: http://coastalbio.com/survey

VELAP# 460030
EPA# VA01116

NELAP ACCREDITED LABORATORY

GLOSSARY OF TERMS AND ABBREVIATIONS

A.L. (Acceptance Limits): The results of a given reference toxicant test are compared to the control chart mean value ± 2 standard deviations. These limits approximate the 95% probability limits for the "true" reference toxicant value.

Chronic Value (ChrV): The geometric mean of the NOEC and LOEC. Units are same as test concentration units.

C.L. (Confidence Limits): These are the probability limits, based on the data set and statistical model employed, that the "true value" lies within the limits specified. Typically limits are based on 95% or 99% probabilities.

Control chart: A cumulative summary chart of results from QC tests with reference toxicants. The results of a given reference toxicant test are compared to the control chart mean value and 95% Acceptance Limits (A.L.) (mean ± 2 standard deviations).

IC25: The concentration of sample or chemical, calculated from the data set using statistical models, causing a 25% reduction in test organism growth, reproduction, etc. The lower the IC25, the more toxic the chemical or sample. Units are same as test concentration units.

LC50: The concentration of sample or chemical, calculated from the data set using statistical models, causing a 50% reduction in test organism survival. The lower the LC50, the more toxic the chemical or sample. Units are same as test concentration units. Note: The LC50 value must always be associated with the duration of exposure. Thus 48-h LC50, 96-h LC50, etc. are calculated.

LOEC: Lowest-observable-effect-concentration. The lowest concentration of sample or chemical in a chronic test dilution series in which the test organisms exhibit a statistically significant reduction in any of the test end points (e.g. growth, survival, reproduction) compared to control organisms. Units are same as test concentration units.

PMSD: Percent Minimum Significant Difference: The minimum difference which can exist between a test treatment and the controls in a particular test and be statistically significant; a measure of test sensitivity. The lower the PMSD the more sensitive the test.

N/A: Not applicable.

N/D: Not determined or measured.

NOAEC: No-observable-acute-effect-concentration. The highest concentration of sample or chemical in an acute test dilution series in which the test organisms exhibit no statistically significant reduction in the test end point (e.g. survival) compared to control organisms. Units are same as test concentration units.

NOEC: No-observable-effect-concentration. The highest concentration of sample or chemical in a chronic test dilution series in which the test organisms exhibit no statistically significant reduction in any of the test end points (e.g. growth, survival, reproduction) compared to control organisms. Some regulatory definitions also require that the NOEC be less than the LOEC. Units are same as test concentration units.

Q.L.: Quantitation Limit. Level, concentration, or quantity of a target variable (analyte) that can be reported at a specified degree of confidence.

T.U.: Toxic units. Expresses the relative toxicity of an effluent in such a manner that the larger the toxic unit value the more toxic the effluent. $T.U._{Ac} = 100/LC50$. $T.U._{Chr} = 100/NOEC$. A dimensionless unit.

VELAP# 460030
EPA# VA01116

C. dubia daily biological measurements (EPA 2002.0) Template version ACD-STAT-5trt-061113

TRTMNT (% Effl)	Rep	#Live Day 0	#Live Day 1	#Live Day 2	Final Mean % Live		
C	A	5	5	5	100.0		
	B	5	5	5			
Lab	C	5	5	5			
Control	D	5	5	5			
#1	A	5	5	2	25.0		
6.25	B	5	4	0			
% Effl	C	5	0	0			
	D	5	5	3			
# 2	A	5	0	0	0.0		
12.5	B	5	1	0			
% Effl	C	5	0	0			
	D	5	1	0			
# 3	A	5	0	0	0.0		
25.0	B	5	0	0			
% Effl	C	5	0	0			
	D	5	0	0			
# 4	A	5	0	0	0.0		
50.0	B	5	0	0			
% Effl	C	5	1	0			
	D	5	0	0			
# 5	A	5	0	0	0.0		
100	B	5	2	0			
% Effl	C	5	0	0		Test Duration:	48h 14m
	D	5	1	0			TAC 48+/-0.5h
INITIALS:		AK	LT	CPV	% CONTROL SURVIVAL:		100.0
DATE & TIME:		11/18/21 10:45	11/19/21 7:42	11/20/21 11:00			TAC = 90%
CHANGES & NOTES (INITIALS, DATE, SPECIFIC CHANGE MADE							

SPECIES:	Ceriodaphnia dubia		
ACCLIMATION WATER:	Mod. Hard Synthetic Freshwater		
FEEDING PRIOR TO TEST:	YCT + Selenastrum capricornutum		
FEEDING DURING TEST:	None -YCT + Selenastrum 2+ h before test		
SOURCE:	CBI Stock cultures		
ACCLIMATION TEMP (o C):	25		
BROOD RELEASE START DATE & TIME:	11/17/21 22:00		
BROOD RELEASE END DATE & TIME:	11/18/21 6:00		
DATE/TIME WATER ADDED:	11/18/21 10:40		
DATE/TIME ANIMALS ADDED:	11/18/21 10:45		
ANIMAL AGE WINDOW:	8h 0m		
MAX AGE AT TEST START:	12h 46m		TAC Max. 24 h
TEST SET UP BY:		AK	
SAMPLE COLLECTION DATE &TIME:	11/16/21 23:59	SAMPLE USED	A
SAMPLE AGE AT TEST START:	34h 47m	TAC Max 36 h	
PEER REVIEW BY (INITIALS/DATE):		CPV,PB	11/24/21 12:20

TEST ID: AWSL2113ACD

Ceriodaphnia daily water quality bench sheet (EPA METHOD 2002.0) Template version ACD-STAT-5trt-061113

	TRTMNT	Day 0 Initial	Day 1	Day 2 Final	SUMMARY WATER QUALITY DATA MEAN	S.D.	MIN.	MAX.
pH (S.U.)	C	8.07	7.96	7.84	7.96	0.12	7.84	8.07
	1	8.06	8.03	7.97	8.02	0.05	7.97	8.06
	2	8.11	8.08	8.09	8.09	0.02	8.08	8.11
	3	8.17	8.08		8.13	0.06	8.08	8.17
	4	8.22	8.17	8.28	8.22	0.06	8.17	8.28
	5	8.36	8.35	8.40	8.37	0.03	8.35	8.40
Temp. (o C)	C	25	25	25	25	0.0	25	25
	1	25	25	25	25	0.0	25	25
	2	25	25	25	25	0.0	25	25
	3	25	25		25	0.0	25	25
	4	25	25	25	25	0.0	25	25
	5	25	25	25	25	0.0	25	25
Diss. Oxygen (mg/l)	C	8.2	8.1	8.0	8.1	0.1	8.0	8.2
	1	8.2	8.1	8.0	8.1	0.1	8.0	8.2
	2	8.2	8.2	7.9	8.1	0.2	7.9	8.2
	3	8.2	8.2		8.2	0.0	8.2	8.2
	4	8.2	8.2	7.9	8.1	0.2	7.9	8.2
	5	8.2	8.3	8.1	8.2	0.1	8.1	8.3
Cond. (uS/cm)	C	296		327	312	21.9	296	327
	1	328			328		328	328
	2	346			346		346	346
	3	408			408		408	408
	4	515			515		515	515
	5	705		669	687	25.5	669	705
Replicate measured		Flask	Surrogate	B				
Initials		AK	LT	CPV				
		TRC (mg/l) in highest conc. at end of test:		N/A				
Changes & Notes (Initials, date, specific change or notes)								

Test chamber:	30 ml plastic cup:	✓			
	Other:				
Test solution vol. (15 ml min):	15 ml:	✓			
	Other (ml):				
Illumination & photoperiod:	50-100 ft-c 16L:8D		Template Number:	11	
Number of replicates/treatment:	4				
Initial number animals/replicate:	5				
Test Aerated?	N/A	Date & Time Air Start:	N/A		

TEST ID	TRT ID:	1	2	3	4	5
AWSL2113ACD	CONC(%):	6.25	12.5	25.0	50.0	100

Acute Ceriodaphnia Test-48 Hr Survival

Start Date:		Test ID:	AWSL2113	Sample ID:	
End Date:		Lab ID:	CBI	Sample Type:	
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	CD-Ceriodaphnia dubia
Comments:	DATA ENTERED BY PB				

Conc-%	1	2	3	4
CONTROL	1.0000	1.0000	1.0000	1.0000
6.25	0.4000	0.0000	0.0000	0.6000
12.5	0.0000	0.0000	0.0000	0.0000
25	0.0000	0.0000	0.0000	0.0000
50	0.0000	0.0000	0.0000	0.0000
100	0.0000	0.0000	0.0000	0.0000

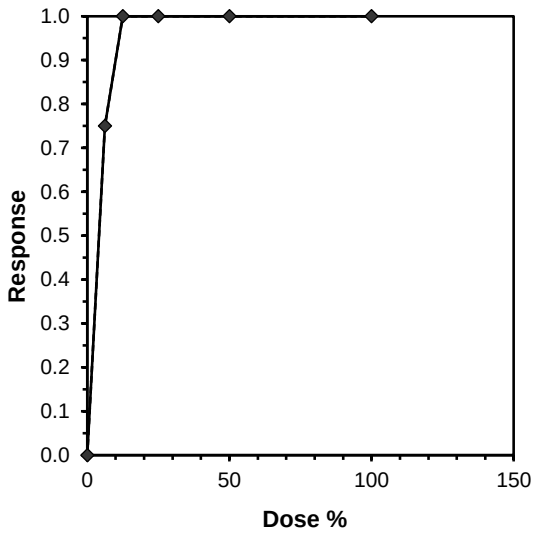
			Transform: Arcsin Square Root					Isotonic	
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Mean	N-Mean
CONTROL	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	1.0000	1.0000
6.25	0.2500	0.2500	0.5055	0.2255	0.8861	65.988	4	0.2500	0.2500
12.5	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4	0.0000	0.0000
25	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4	0.0000	0.0000
50	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4	0.0000	0.0000
100	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 normal distribution (p > 0.01)	0.8902	0.749	0.31151	0.27399
Equality of variance cannot be confirmed				

Linear Interpolation (200 Resamples)

Point	%	SD	95% CL(Exp)		Skew
IC05*	0.4167	0.0828	0.2500	0.7528	1.4336
IC10*	0.8333	0.1655	0.5000	1.5056	1.4336
IC15*	1.2500	0.2483	0.7500	2.2583	1.4336
IC20*	1.6667	0.3311	1.0000	3.0111	1.4336
IC25*	2.0833	0.4138	1.2500	3.7639	1.4336
IC40*	3.3333	0.6621	2.0000	6.0222	1.4336
IC50*		0.8007	2.5000	7.5227	1.2096

*



PD

C. dubia daily biological measurements (EPA 2002.0) Template version ACD-STAT-11trt-061113

TRTMNT (% Effl)	Rep	#Live Day 0	#Live Day 1	#Live Day 2	Final Mean % Live		
C	A	5	5	5	100.0		
	B	5	5	5			
Lab	C	5	5	5			
Control	D	5	5	5			
#1	A	5	5	3	80.0		
0.6	B	5	5	5			
% Effl	C	5	3	3			
	D	5	5	5			
# 2	A	5	5	3	70.0		
1.0	B	5	5	4			
% Effl	C	5	3	2			
	D	5	5	5			
# 3	A	5	2	2	65.0		
1.7	B	5	4	3			
% Effl	C	5	5	3			
	D	5	5	5			
# 4	A	5	3	0	0.0		
2.8	B	5	5	0			
% Effl	C	5	3	0			
	D	5	1	0			
# 5	A	5	1	0	10.0		
4.7	B	5	5	1			
% Effl	C	5	3	0			
	D	5	5	1			
# 6	A	5	4	0	0.0		
7.8	B	5	0	0			
% Effl	C	5	3	0			
	D	5	0	0			
# 7	A	5	0	0	0.0		
13	B	5	3	0			
% Effl	C	5	0	0			
	D	5	0	0			
# 8	A	5	4	0	0.0		
22	B	5	0	0			
% Effl	C	5	0	0			
	D	5	0	0			
# 9	A	5	5	0	0.0		
36	B	5	3	0			
% Effl	C	5	0	0			
	D	5	0	0			
# 10	A	5	3	0	0.0		
60	B	5	1	0			
% Effl	C	5	2	0			
	D	5	4	0			
# 11	A	5	1	0	0.0		
100	B	5	0	0			
% Effl	C	5	0	0		Test Duration:	48h 16m
	D	5	0	0			TAC 48+/-0.5h
INITIALS:		CPV	LT	LT	% CONTROL SURVIVAL:		100.0
DATE & TIME:		12/2/21 14:47	12/3/21 7:57	12/4/21 15:03			TAC = 90%
CHANGES & NOTES (INITIALS, DATE, SPECIFIC CHANGE MADE							

SPECIES:	Ceriodaphnia dubia		
ACCLIMATION WATER:	Mod. Hard Synthetic Freshwater		
FEEDING PRIOR TO TEST:	YCT + Selenastrum capricornutum		
FEEDING DURING TEST:	None -YCT + Selenastrum 2+ h before test		
SOURCE:	CBI Stock cultures		
ACCLIMATION TEMP (o C):	25		
BROOD RELEASE START DATE & TIME:	12/1/21 16:30		
BROOD RELEASE END DATE & TIME:	12/2/21 8:30		
DATE/TIME WATER ADDED:	12/2/21 14:12		
DATE/TIME ANIMALS ADDED:	12/2/21 14:47		
ANIMAL AGE WINDOW:	16h 0m		
MAX AGE AT TEST START:	22h 17m	TAC Max. 24 h	
TEST SET UP BY:		CPV	
SAMPLE COLLECTION DATE &TIME:	11/16/21 23:59	SAMPLE USED	A
SAMPLE AGE AT TEST START:	374h 48m	TAC Max 36 h	
PEER REVIEW BY (INITIALS/DATE):		PB	12/6/21 10:41

TEST ID: AWSL2113ACDBL

Ceriodaphnia daily water quality bench sheet (EPA METHOD 2002.0) Template version ACD-STAT-11trt-061113

	TRTMNT	Day 0 Initial	Day 1	Day 2 Final	SUMMARY WATER QUALITY DATA MEAN	S.D.	MIN.	MAX.
pH (S.U.)	C	8.19	7.89	7.84	7.97	0.19	7.84	8.19
	1	8.15	7.88	7.84	7.96	0.17	7.84	8.15
	2	8.14	7.89	7.86	7.96	0.15	7.86	8.14
	3	8.17	7.91	7.86	7.98	0.17	7.86	8.17
	4	8.16	7.91	7.87	7.98	0.16	7.87	8.16
	5	8.16	7.93	7.9	8.00	0.14	7.90	8.16
	6	8.19	7.93	7.92	8.01	0.15	7.92	8.19
	7	8.21	7.95	7.92	8.03	0.16	7.92	8.21
	8	8.25	7.99	7.93	8.06	0.17	7.93	8.25
	9	8.30	8.08	7.99	8.12	0.16	7.99	8.30
	10	8.36	8.32	8.29	8.32	0.04	8.29	8.36
	11	8.41	8.33	8.35	8.36	0.04	8.33	8.41
Temp. (o C)	C	25	25	25	25	0	25	25
	1	25	25	25	25	0	25	25
	2	25	25	25	25	0	25	25
	3	25	25	25	25	0	25	25
	4	25	25	25	25	0	25	25
	5	25	25	25	25	0	25	25
	6	25	25	25	25	0	25	25
	7	25	25	25	25	0	25	25
	8	25	25	25	25	0	25	25
	9	25	25	25	25	0	25	25
	10	25	25	25	25	0	25	25
	11	25	25	25	25	0	25	25
Diss. Oxygen (mg/l)	C	8.2	8.0	8.2	8.1	0.1	8.0	8.2
	1	8.2	8.0	8.2	8.1	0.1	8.0	8.2
	2	8.2	8.0	8.2	8.1	0.1	8.0	8.2
	3	8.2	8.0	8.2	8.1	0.1	8.0	8.2
	4	8.2	8.1	8.2	8.2	0.1	8.1	8.2
	5	8.2	8.2	8.2	8.2	0.0	8.2	8.2
	6	8.2	8.2	8.2	8.2	0.0	8.2	8.2
	7	8.2	8.2	8.2	8.2	0.0	8.2	8.2
	8	8.2	8.3	8.2	8.2	0.1	8.2	8.3
	9	8.2	8.1	8.2	8.2	0.1	8.1	8.2
	10	8.2	8.2	8.2	8.2	0.0	8.2	8.2
	11	8.2	8.2	8.2	8.2	0.0	8.2	8.2
Cond. (uS/cm)	C	302		330	316	19.8	302	330
	1	306			306		306	306
	2	308			308		308	308
	3	314			314		314	314
	4	327			327		327	327
	5	338			338		338	338
	6	349			349		349	349
	7	369			369		369	369
	8	406			406		406	406
	9	462			462		462	462
	10	565			565		565	565
	11	721		742	732	14.8	721	742
Replicate measured			S	B				
Initials		CPV	LT	LT				
		TRC (mg/l) in highest conc. at end of test:		N/A				
Changes & Notes (Initials, date, specific change or notes)								

Test chamber:	30 ml plastic cup:	☑	
	Other:		
Test solution vol. (15 ml min):	15 ml:	☑	
	Other (ml):		
Illumination & photoperiod:	50-100 ft-c 16L:8D	Template Number:	
Number of replicates/treatment:		4	
Initial number animals/replicate:		5	
Test Aerated?		N/A	Date & Time Air Start: N/A

TEST ID	TRT ID:	1	2	3	4	5	6	7	8	9	10
AWSL2113ACDBL	CONC(%):	0.6	1.0	1.7	2.8	4.7	7.8	13	22	36	60

Acute Ceriodaphnia Test-48 Hr Survival

Start Date:		Test ID:	AWSL2113A	Sample ID:	
End Date:		Lab ID:	CBI	Sample Type:	
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	CD-Ceriodaphnia dubia
Comments:	DATA ENTERED BY PB				

Conc-%	1	2	3	4
CONTROL	1.0000	1.0000	1.0000	1.0000
0.6	0.6000	1.0000	0.6000	1.0000
1	0.6000	0.8000	0.4000	1.0000
1.7	0.4000	0.6000	0.6000	1.0000
2.8	0.0000	0.0000	0.0000	0.0000
4.7	0.0000	0.2000	0.0000	0.2000
7.8	0.0000	0.0000	0.0000	0.0000
13	0.0000	0.0000	0.0000	0.0000
22	0.0000	0.0000	0.0000	0.0000
36	0.0000	0.0000	0.0000	0.0000
60	0.0000	0.0000	0.0000	0.0000
100	0.0000	0.0000	0.0000	0.0000

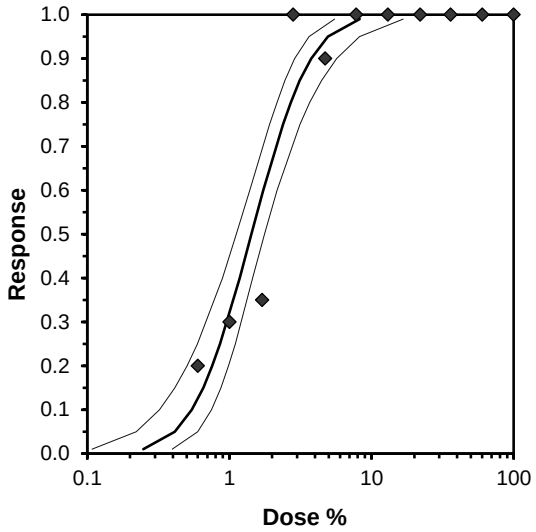
			Transform: Arcsin Square Root						
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Number Resp	Total Number
CONTROL	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	0	20
0.6	0.8000	0.8000	1.1157	0.8861	1.3453	23.763	4	4	20
1	0.7000	0.7000	1.0058	0.6847	1.3453	28.293	4	6	20
1.7	0.6500	0.6500	0.9505	0.6847	1.3453	29.432	4	7	20
2.8	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4	20	20
4.7	0.1000	0.1000	0.3446	0.2255	0.4636	39.900	4	18	20
7.8	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4	20	20
13	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4	20	20
22	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4	20	20
36	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4	20	20
60	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4	20	20
100	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 > 0.01)	0.9658	0.868	0.3578	-0.46661
Equality of variance cannot be confirmed				

Maximum Likelihood-Probit

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	3.05522	0.4552	2.16302	3.94741	0	11.2268	16.919	0.26	0.15518	0.32731	3
Intercept	4.52589	0.17553	4.18185	4.86992							
TSCR											

Point	Probits	%	95% Fiducial Limits	
EC01	2.674	0.2476	0.10828	0.39644
EC05	3.355	0.41381	0.2208	0.59762
EC10	3.718	0.54415	0.32155	0.74675
EC15	3.964	0.65456	0.41325	0.87021
EC20	4.158	0.75807	0.50328	0.98501
EC25	4.326	0.85983	0.59467	1.09795
EC40	4.747	1.18102	0.89276	1.46391
EC50	5.000			
EC60	5.253	1.73023	1.39142	2.16474
EC75	5.674	2.37656	1.9172	3.14475
EC80	5.842	2.69558	2.15542	3.68407
EC85	6.036	3.12188	2.45811	4.45324
EC90	6.282	3.7553	2.88358	5.68542
EC95	6.645	4.93807	3.62553	8.22849
EC99	7.326	8.25309	5.4974	16.6818



P. promelas daily biological measurements (EPA 2000.0) Template version APP-STAT-48h-11trt-061113

TRTMNT (%Effl)	Rep	#Live Day 0	#Live Day 1	#Live Day 2	Final Mean % Live		
C	A	10	10	10	100.0		
Lab Control	B	10	10	10			
#1	A	10	10	10	100.0		
0.6	B	10	10	10			
# 2	A	10	10	10	100.0		
1.0	B	10	10	10			
# 3	A	10	10	10	100.0		
1.7	B	10	10	10			
# 4	A	10	10	10	100.0		
2.8	B	10	10	10			
# 5	A	10	10	10	100.0		
4.7	B	10	10	10			
# 6	A	10	10	10	100.0		
7.8	B	10	10	10			
# 7	A	10	10	10	100.0		
13	B	10	10	10			
# 8	A	10	10	10	100.0		
22	B	10	10	10			
# 9	A	10	9	2	15.0		
36	B	10	8	1			
# 10	A	10	0	0	0.0		
60	B	10	3	0			
# 11	A	10	0	0	0.0	Test Duration:	48h 23m
100	B	10	1	0			TAC 48+/-0.5h
	INITIALS:	CPV	LT	LT	% CONTROL SURVIVAL:		100.0
	DATE & TIME:	12/2/21 14:34	12/3/21 8:01	12/4/21 14:57			TAC = 90%
CHANGES & NOTES (INITIALS, DATE, SPECIFIC CHANGE MADE							

	SPECIES:	Pimephales promelas	
	ACCLIMATION WATER:	Mod. Hard Synthetic Freshwater	
	FEEDING PRIOR TO TEST:	Artemia nauplii ad libitum	
	FEEDING DURING TEST:	None	
	SOURCE:	CBI Stock cultures	
	ACCLIMATION TEMP (o C):	25	
	HATCH START DATE & TIME:	11/28/21 17:00	
	HATCH END DATE & TIME:	11/29/21 10:00	
	DATE/TIME WATER ADDED:	12/2/21 14:13	
	DATE/TIME ANIMALS ADDED:	12/2/21 14:34	
	ANIMAL AGE WINDOW:	17h 0m	TAC Max. 24 h
	MAX AGE AT TEST START:	4d	TAC Max. 14 d
	TEST SET UP BY:	CPV	
	SAMPLE COLLECTION DATE & TIME:	11/16/21 23:59 SAMPLE USED	A
TEST ID:	SAMPLE AGE AT TEST START:	374h 36m TAC MAX 36 h	
AWSL2113APPBL	PEER REVIEW BY (INITIALS/DATE):	PB	12/6/21 10:48

P. promelas daily water quality bench sheet (EPA METHOD 2002.0) Template version APP-STAT-48h-11trt-06113

	TRTMNT	Day 0 Initial	Day 1	Day 2 Final	SUMMARY WATER QUALITY DATA MEAN	S.D.	MIN.	MAX.
pH (S.U.)	C	8.19	7.78	7.88	7.95	0.21	7.78	8.19
	1	8.15	7.75	7.88	7.93	0.20	7.75	8.15
	2	8.14	7.78	7.86	7.93	0.19	7.78	8.14
	3	8.17	7.78	7.86	7.94	0.21	7.78	8.17
	4	8.16	7.78	7.86	7.93	0.20	7.78	8.16
	5	8.16	7.78	7.86	7.93	0.20	7.78	8.16
	6	8.19	7.83	7.88	7.97	0.20	7.83	8.19
	7	8.21	7.83	7.93	7.99	0.20	7.83	8.21
	8	8.25	7.96	7.95	8.05	0.17	7.95	8.25
	9	8.30	8.00	8.07	8.12	0.16	8.00	8.30
	10	8.36	8.16	8.13	8.22	0.13	8.13	8.36
	11	8.41	8.28	8.30	8.33	0.07	8.28	8.41
Temp. (o C)	C	25	25	25	25	0	25	25
	1	25	25	25	25	0	25	25
	2	25	25	25	25	0	25	25
	3	25	25	25	25	0	25	25
	4	25	25	25	25	0	25	25
	5	25	25	25	25	0	25	25
	6	25	25	25	25	0	25	25
	7	25	25	25	25	0	25	25
	8	25	25	25	25	0	25	25
	9	25	25	25	25	0	25	25
	10	25	25	25	25	0	25	25
	11	25	25	25	25	0	25	25
Diss. Oxygen (mg/l)	C	8.2	8.0	7.9	8.0	0.2	7.9	8.2
	1	8.2	8.0	7.9	8.0	0.2	7.9	8.2
	2	8.2	8.0	7.9	8.0	0.2	7.9	8.2
	3	8.2	7.9	7.9	8.0	0.2	7.9	8.2
	4	8.2	7.9	8.0	8.0	0.2	7.9	8.2
	5	8.2	8.0	7.9	8.0	0.2	7.9	8.2
	6	8.2	8.0	7.8	8.0	0.2	7.8	8.2
	7	8.2	8.0	7.6	7.9	0.3	7.6	8.2
	8	8.2	8.0	7.6	7.9	0.3	7.6	8.2
	9	8.2	8.1	7.9	8.1	0.2	7.9	8.2
	10	8.2	8.2	8.0	8.1	0.1	8.0	8.2
	11	8.2	8.2	8.0	8.1	0.1	8.0	8.2
Cond. (uS/cm)	C	302		337	320	24.7	302	337
	1	306			306		306	306
	2	308			308		308	308
	3	314			314		314	314
	4	327			327		327	327
	5	338			338		338	338
	6	349			349		349	349
	7	369			369		369	369
	8	406			406		406	406
	9	462			462		462	462
	10	565			565		565	565
	11	721		721	721	0.0	721	721
Replicate measured		B	A	B				
Initials		CPV	LT	LT				
		TRC (mg/l) in highest conc. at end of test:		N/A				
Changes & Notes (Initials, date, specific change or notes)								

Test chamber:	500 ml plastic:	☑	
	Other:		
Test solution vol. (200 ml min):	400 ml:	☑	
	Other (ml):		
Illumination & photoperiod:	50-100 ft-c 16L:8D		
Number of replicates/treatment:	2	Date & Time Air Start:	
Initial number animals/replicate:	10	D.O. Highest conc. @ aeration:	
Test Aerated?	No	Total live highest conc.@ aeration	

TEST ID	TRT ID:	1	2	3	4	5	6	7	8	9	10
AWSL2113APPBL	CONC (%):	0.6	1.0	1.7	2.8	4.7	7.8	13	22	36	60

Acute Fish Test-48 Hr Survival

Start Date:		Test ID:	AWSL2113B	Sample ID:	
End Date:		Lab ID:	CBI	Sample Type:	
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	PP-Pimephales promelas
Comments:	DATA ENTERED BY PB				

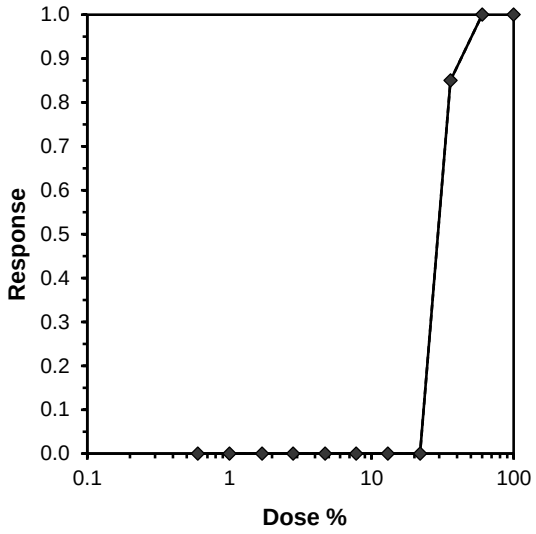
Conc-%	1	2
CONTROL	1.0000	1.0000
0.6	1.0000	1.0000
1	1.0000	1.0000
1.7	1.0000	1.0000
2.8	1.0000	1.0000
4.7	1.0000	1.0000
7.8	1.0000	1.0000
13	1.0000	1.0000
22	1.0000	1.0000
36	0.2000	0.1000
60	0.0000	0.0000
100	0.0000	0.0000

			Transform: Arcsin Square Root						
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Number Resp	Total Number
CONTROL	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	2	0	20
0.6	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	2	0	20
1	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	2	0	20
1.7	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	2	0	20
2.8	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	2	0	20
4.7	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	2	0	20
7.8	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	2	0	20
13	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	2	0	20
22	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	2	0	20
36	0.1500	0.1500	0.3927	0.3218	0.4636	25.550	2	17	20
60	0.0000	0.0000	0.1588	0.1588	0.1588	0.000	2	20	20
100	0.0000	0.0000	0.1588	0.1588	0.1588	0.000	2	20	20

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Normality of the data set cannot be confirmed				
Equality of variance cannot be confirmed				

Trimmed Spearman-Karber

Trim Level	EC50	95% CL	
0.0%	30.342	28.006	32.872
5.0%	29.857	27.448	32.478
10.0%	29.522	27.303	31.922
20.0%	29.392	27.835	31.036
Auto-0.0%			



pd

Effluent and Dilution Water Log (Freshwater Tests). FWEFFL061013

											SUMMARY WATER QUALITY DATA				
Initial sample charac-terization	Bottle(1):	A1									MEAN	S.D.	MIN.	MAX.	PARAMETER
	Arrival Temp. (oC, from CoC):	1									1		1	1	Arrival Temp.
	TRC (mg/l)(2):	<DL													
	TRC Corrected(2):														
	Hardness (mg/l):	94									94		94	94	Hardness (mg/l)
	Alkalinity (mg/l):	220									220		220	220	Alkalinity (mg/l)
	NH3-N (mg/l):	<1.0													
	Color/Appearance(3):	C													
	Obvious odor?	NO													
	Date & Time:	11/18/21 9:30													
	Initials:	LT													
Sample prep measure-ments	Test Day:	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7		MEAN	S.D.	MIN.	MAX.	
	Bottle(s):	A1													
	Prep. Temp. (oC):	25									25		25	25	Temp. (oC)
	D.O. (mg/l) After Warming:	9.0													
	Aeration Time (min):	2													
	Adjusted D.O. (mg/l):	8.2									8.2		8.2	8.2	D.O. (mg/l)
	Final pH (S.U.):	8.33									8.33		8.33	8.33	pH (S.U.)
	Conductivity (uS/cm)(4):	698									698		698	698	Cond. (uS/cm)
	Final TRC (mg/l)(5):	N.D.													
	Sample Filtered (60 um)?														
	Date & Time:	11/18/21 10:35													
	Initials:	AK													
Dilution water	Test Day:	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7		MEAN	S.D.	MIN.	MAX.	
	Vat Number:	2													
	Temperature (oC):	25									25		25	25	Temp. (oC)
	Conductivity (uS/cm):	300									300		300	300	Cond. (uS/cm)
	D.O. (mg/l):	8.2									8.2		8.2	8.2	D.O. (mg/l)
	pH (S.U.):	7.70									7.70		7.70	7.70	pH (S.U.)
	Hardness (mg/l):	84									84		84	84	Hardness (mg/l)
	Alkalinity (mg/l):	58									58		58	58	Alkalinity (mg/l)
	Date & Time:	11/18/21 8:00													
	Initials:	LT													
	Changes & Notes (Initials, date, specific change or notes)														
	Peer review Initial/Date:	CPV,PB	11/24/21 12:21	DILUTION WATER TYPE:	Mod. Hard Synthetic Freshwater (EPA)	ND=Not Determined/Measured, NA=Not Applicable. 1) Ninth character of lab sample ID on chain of custody AND bottle number in collection series. Together with Project ID constitutes entire sample bottle ID. 2) TRC MDL 0.02 mg/l; QL 0.22 mg/l. Corrected value if Mn, Cr potential positive interference. Corrected using KI and NaAsO2. 3) C-clear, O-opaque, T-turbid, S-solids (Sl-slight, M-moderate, H-heavy), Y-yellow, B-brown, Bl-black, G-green, P-pink, Gr-grey, Or-orange. 4) Measured on first use of sample only. 5) Final TRC measured only if chlorine present in initial characterization.												
PROJECT ID:	AWSL2113	ADDITIONAL EFFLUENT TREATMENT:													

Effluent and Dilution Water Log (Freshwater Tests). FWEFFL061013

											SUMMARY WATER QUALITY DATA				
Initial sample charac-terization	Bottle(1):	A1									MEAN	S.D.	MIN.	MAX.	PARAMETER
	Arrival Temp. (oC, from CoC):	1									1		1	1	Arrival Temp.
	TRC (mg/l)(2):	<DL													
	TRC Corrected(2):														
	Hardness (mg/l):	94									94		94	94	Hardness (mg/l)
	Alkalinity (mg/l):	220									220		220	220	Alkalinity (mg/l)
	NH3-N (mg/l):	<1.0													
	Color/Appearance(3):	C													
	Obvious odor?	NO													
	Date & Time:	11/18/21 9:30													
	Initials:	LT													
Sample prep measure-ments	Test Day:	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7		MEAN	S.D.	MIN.	MAX.	
	Bottle(s):	A1													
	Prep. Temp. (oC):	25									25		25	25	Temp. (oC)
	D.O. (mg/l) After Warming:	9.6													
	Aeration Time (min):	2													
	Adjusted D.O. (mg/l):	8.2									8.2		8.2	8.2	D.O. (mg/l)
	Final pH (S.U.):	8.38									8.38		8.38	8.38	pH (S.U.)
	Conductivity (uS/cm)(4):	695									695		695	695	Cond. (uS/cm)
	Final TRC (mg/l)(5):	N.D.													
	Sample Filtered (60 um)?														
	Date & Time:	12/2/21 13:53													
	Initials:	CPV													
Dilution water	Test Day:	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7		MEAN	S.D.	MIN.	MAX.	
	Vat Number:	1													
	Temperature (oC):	25									25		25	25	Temp. (oC)
	Conductivity (uS/cm):	306									306		306	306	Cond. (uS/cm)
	D.O. (mg/l):	8.2									8.2		8.2	8.2	D.O. (mg/l)
	pH (S.U.):	7.74									7.74		7.74	7.74	pH (S.U.)
	Hardness (mg/l):	88									88		88	88	Hardness (mg/l)
	Alkalinity (mg/l):	58									58		58	58	Alkalinity (mg/l)
	Date & Time:	12/2/21 8:00													
	Initials:	LT													
	Changes & Notes (Initials, date, specific change or notes)														
	Peer review Initial/Date:	PB	12/6/21 10:40	DILUTION WATER TYPE:	Mod. Hard Synthetic Freshwater (EPA)	ND=Not Determined/Measured, NA=Not Applicable. 1) Ninth character of lab sample ID on chain of custody AND bottle number in collection series. Together with Project ID constitutes entire sample bottle ID. 2) TRC MDL 0.02 mg/l; QL 0.22 mg/l. Corrected value if Mn, Cr potential positive interference. Corrected using KI and NaAsO2. 3) C-clear, O-opaque, T-turbid, S-solids (Sl-slight, M-moderate, H-heavy), Y-yellow, B-brown, Bl-black, G-green, P-pink, Gr-grey, Or-orange. 4) Measured on first use of sample only. 5) Final TRC measured only if chlorine present in initial characterization.												
PROJECT ID:	AWSL2113BL	ADDITIONAL EFFLUENT TREATMENT:													

AWSL2113-A
21-1808

ENTHALPY ANALYTICAL
formerly *Air, Water & Soil Laboratories*

Coastal Bioanalysts
6400 Enterprise Ct
Gloucester, VA 23061

1941 REYMET ROAD
RICHMOND, VIRGINIA 23237
(804) 358-8295 PHONE
(804)358-8297 FAX

Chain of Custody
Form #: D1331
Rev. 1.0
Effective: Feb 14, 2014

CHAIN OF CUSTODY

COMPANY NAME: Air, Water & Soil Labs, INC	INVOICE TO: AWS LABS	PROJECT NAME/Quote #: 21K1076
CONTACT: Katrina Cooke	INVOICE CONTACT: awsap@awslabs.com	SITE NAME: 21K1076
ADDRESS:1941 Reymet Rd, Richmond, VA 23237	INVOICE ADDRESS:	PROJECT NUMBER: 21K1076
PHONE #: 804-358-8295	INVOICE PHONE #:	P.O. #: PO.018803
FAX #:804-358-8297	EMAIL: support@awslabs.com	Pretreatment Program:

Is sample for compliance reporting? (YES) NO VA | Is sample from a chlorinated supply? YES NO | PWS I.D. #:

SAMPLER NAME (PRINT): Matt Alberts SAMPLER SIGNATURE: | **Turn Around Time: 21 Days**

Matrix Codes: WW=Waste Water/Storm Water GW=Ground Water DW=Drinking Water S=Soil/Solids OR=Organic A=Air WP=Wipe OT=Other_____

CLIENT SAMPLE I.D.	Grab	Composite	Field Filtered (Dissolved Metals)	Composite Start Date	Composite Start Time	Grab Date or Composite Stop Date	Grab Time or Composite Stop Time	Time Preserved	Matrix (See Codes)	Number of Containers	ANALYSIS / (PRESERVATIVE) Acute Toxicity - Ceriodaphnia Dubia								COMMENTS
1)		X		11/16/21	00.00	11/16/21	23.59		WW	1	X								
21K1076-01: 029 Quarterly TOX-Cd																			
3)																			
4)																			
5)																			
6)																			
7)																			
8)																			
9)																			
10)																			

Preservative Codes: N=Nitric Acid C=Hydrochloric Acid S=Sulfuric Acid H=Sodium Hydroxide A=Ascorbic Acid Z=Zinc Acetate T=Sodium Thiosulfate M=Methanol

PLEASE NOTE PRESERVATIVE(S), INTERFERENCE CHECKS or PUMP RATE (L/min)

RELINQUISHED:	DATE / TIME	RECEIVED: L. Thomas	DATE / TIME 11/18/21 0930
RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME
RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME

QC Data Package
Level I ☐
Level II ☐
Level III ☐
Level IV ☐

LAB USE ONLY **COOLER TEMP** 1 °C

TV-LT

21K1076 Coastal Bioanalysts - BAE.xls

SCREEN TOXICITY BIOASSAY REPORT

BAE SYSTEMS

PACE JOB #: 7360293

CLIENT SAMPLE ID: NITROGLYCERIN SCREENING

TEST ORGANISM: CERIODAPHNIA DUBIA

Pace Analytical received 5 samples on 02-12-21
for the analyses presented in the following report

SCREEN TOXICITY

BIOASSAY REPORT

Pace Job #: 7360293

Conducted For:

BAE Systems
Radford Army Ammunition Plant
P O Box 1
State Route 114
Radford, VA 24141

Conducted By:

Pace Analytical
225 Industrial Park Road
P. O. Box 286
Beaver, WV 25813

Pace Analytical
225 Industrial Park Road
P O Box 286
Beaver WV 25813
TEL: (304) 255-2500
Website: www.pacelabs.com

Executive Summary

BAE Systems submitted 5 samples for a toxicity screening test. The client sample ID was Nitroglycerin Screening and the Pace job number was 7360293. Pace Analytical had supplied Moderately Hard Synthetic Fresh Water to BAE to be spiked with various amounts of Nitroglycerin ("NG"); (0.5 ppm, 1.0 ppm, 2.5 ppm, 5.0 ppm and 10.0 ppm) in an effort to determine the toxic level of NG. The samples were spiked by BAE lab personnel on 02-11-21 and were delivered to the laboratory on 02-12-21. The screening toxicity tests were initiated on 02-12-21 and utilized *Ceriodaphnia dubia* as the test species. The tests were terminated after a 48-hour exposure period on 02-14-21. A Screening Toxicity test is a "PASS / FAIL" test which determines if there is significant difference in the survival of 100.0% effluent compared to the control.

The *Ceriodaphnia dubia* test results were as follows for the 0.5 ppm test: "PASS" All test organisms survived in the 100.0% effluent and in the control. In essence, this effluent was non-toxic with regards to the survival of the *Ceriodaphnia dubia*.

The *Ceriodaphnia dubia* test results were as follows for the 1.0 ppm test: "PASS" All test organisms survived in the 100.0% effluent and in the control. In essence, this effluent was non-toxic with regards to the survival of the *Ceriodaphnia dubia*.

The *Ceriodaphnia dubia* test results were as follows for the 2.5 ppm test: "PASS" All test organisms survived in the 100.0% effluent and in the control. In essence, this effluent was non-toxic with regards to the survival of the *Ceriodaphnia dubia*.

The *Ceriodaphnia dubia* test results were as follows for the 5.0 ppm test: "PASS" All test organisms survived in the 100.0% effluent and in the control. In essence, this effluent was non-toxic with regards to the survival of the *Ceriodaphnia dubia*.

The *Ceriodaphnia dubia* test results were as follows for the 10.0 ppm test: "PASS" One test organism died in the 100.0% effluent. All test organisms survived in the control. In essence, this effluent was non-toxic with regards to the survival of the *Ceriodaphnia dubia*.

Please feel free to contact myself, or Ed Kirk, Director-Biological Division, should you have any comments or questions, or if we can be of any further assistance. We truly appreciate your business!

Sincerely,

Michael Lester
Bioassay Lab Manager
Pace Analytical

PACE ANALYTICAL
SAMPLE INFORMATION

Client: BAE Systems
Radford Army Ammunition Plant

Address: Route 114
P.O. Box 1
Radford, VA 24143

Pace Job #: 7360293

Pace Sample ID #: 7360293-001-005

Client Sample ID #: Nitroglycerin Screening

NPDES Permit #: NA

Receiving Water Body Name: NA

Sample Type: Grab

Collected : **Date:** 02-11-21 **Time:** 1330

Bioassay Tests Performed: 48- Hr Static Screen Non-Renewal

Test Procedure: EPA Methods Manual 821-R-02-012; October 2002.
ENV-SOP-BEAV-TOX-ACUTE-REV.01

Test Method: *Ceriodaphnia dubia*: 2002.0

Measured Effect: Death or erratic behavior

Test Beginning: **Date:** 02-12-21 **Time:** 1315
Test Ending: **Date:** 02-14-21 **Time:** 1030

Test Organisms: *Ceriodaphnia dubia* **Age**: <24 Hrs

Dilution Water Use: Moderately Hard Synthetic Fresh Water

Last Reference Toxicant Test Date: 02-04-21

Reference Toxicant Used and Results: KCL-Potassium Chloride, acceptable results

PACE ANALYTICAL
TEST RESULTS

Pace Sample #: 7360293-001 Client Sample #: 0.50 ppm NG

Ceriodaphnia dubia

Statistical Test Method	Pass/Fail	Qualifier Data
None Needed	Pass	

All test organisms survived in the 100.0% effluent and in the control.

Qualifiers:
P - Initial pH falls outside the range of 6.0 - 9.0
H - 36 Hour Hold Time Exceeded
T - Initial Temperature exceeded 0 - 6º Range

DATE: 02-19-21

APPROVED: Michael Lester
Michael Lester
Bioassay Lab Manager

PACE ANALYTICAL
TEST RESULTS

Pace Sample #: 7360293-002 Client Sample #: 1.0 ppm NG

Ceriodaphnia dubia

Statistical Test Method	Pass/Fail	Qualifier Data
None Needed	Pass	

All test organisms survived in the 100.0% effluent and in the control.

Qualifiers:
P - Initial pH falls outside the range of 6.0 - 9.0
H - 36 Hour Hold Time Exceeded
T - Initial Temperature exceeded 0 - 6º Range

DATE: 02-19-21

APPROVED: Michael Lester
Michael Lester
Bioassay Lab Manager

PACE ANALYTICAL
TEST RESULTS

Pace Sample #: 7360293-003 Client Sample #: 2.5 ppm NG

Ceriodaphnia dubia

Statistical Test Method	Pass/Fail	Qualifier Data
None Needed	Pass	

All test organisms survived in the 100.0% effluent and in the control.

Qualifiers:
P - Initial pH falls outside the range of 6.0 - 9.0
H - 36 Hour Hold Time Exceeded
T - Initial Temperature exceeded 0 - 6º Range

DATE: 02-19-21

APPROVED: Michael Lester
Michael Lester
Bioassay Lab Manager

PACE ANALYTICAL
TEST RESULTS

Pace Sample #: 7360293-004 Client Sample #: 5.0 ppm NG

Ceriodaphnia dubia

Statistical Test Method	Pass/Fail	Qualifier Data
None Needed	Pass	

All test organisms survived in the 100.0% effluent and in the control.

Qualifiers:
P - Initial pH falls outside the range of 6.0 - 9.0
H - 36 Hour Hold Time Exceeded
T - Initial Temperature exceeded 0 - 6º Range

DATE: 02-19-21

APPROVED: Michael Lester
Michael Lester
Bioassay Lab Manager

PACE ANALYTICAL
TEST RESULTS

Pace Sample #: 7360293-005 Client Sample #: 10.0 ppm NG

Ceriodaphnia dubia

Statistical Test Method	Pass/Fail	Qualifier Data
None Needed	Pass	

One test organism died in the 100.0% effluent. All test organisms survived in the control.

Qualifiers:
P - Initial pH falls outside the range of 6.0 - 9.0
H - 36 Hour Hold Time Exceeded
T - Initial Temperature exceeded 0 - 6º Range

DATE: 02-19-21

APPROVED: Michael Lester
Michael Lester
Bioassay Lab Manager

PACE ANALYTICAL
TOXICITY TEST CONDITIONS

Pace Sample #: 7362093-001-005
Client Sample ID: Nitroglycerin Screening

Test Species: *Ceriodaphnia dubia*
Organism Source: In-house Cultures

Exposure Chamber
- Container Type: disp. cups
- Total vessel capacity: 50 ml
- Test solution volume: 30 ml
- Water depth: Constant X
  - Cyclic ___

Aeration During Test
- None: X
- Slow: ___
- Moderate: ___
- Vigorous: ___
- Time aeration began: ____

Feeding Schedule
- Not fed: ___
- Fed daily: ___
- Fed prior to test: X

Aeration Prior To Test Initiation
- Moderate: X
- Minutes: 0

Photoperiod
- 16Hr/8Hr: X
- Other (specify): _____

Place Test Conducted
- Environmental Chamber: X

Vessel type and volume used to deliver effluent and diluent to test chambers: None Needed

Material(s) used to place test organisms into test chambers: large-bore pipets

Condition of surviving organisms at end of test: Healthy

Comments: _____

Concentration (%)	Diluent (mls)	Effluent (mls)	Total (mls)
Control	250	0	250
100.0	0	250	250

PACE TOXICITY TEST DATA

Client: BAE Systems	**Test Beginning**:	**Date**: 02-12-21	**Time**: 1315
Client Sample ID: 0.50 ppm NG	**Test Ending**:	**Date**: 02-14-21	**Time**: 1030
Pace Sample ID: 7360293-001	**Dilution Water**: Moderately Hard Synthetic Fresh Water		
NPDES Permit #: NA	**Test Organism**: *Ceriodaphnia dubia*		**Age**: <24 Hrs
Bioassay Test: 48-Hr Static Screen Non-Renewal	**Isolation Date**: 02-11-21	**Time**: 1110	
Sample Collection Data	**# Replicates**: 4	**# Organisms/Rep**: 5	
Sample Volume: 1 Liter **Sample Type**: Grab	**Effluent**		**Dilution Water**
Collected From: **Date**: **Time**:	**Alkalinity** NA	**Chlorine** 0.00	**Alkalinity** 62.4 mg/L
Collected To: **Date**: 02-11-21-21 **Time**: 1330	**Hardness** NA	**Dechlorinated** NA	**Hardness** 88.1 mg/L

Test Concentration (%)	Number of Live Organisms			Dissolved Oxygen (mg/l)			pH (SU)			Conductivity (umhos)			Test Temperature (°C)		
	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs
Control A	5	5	5	7.0	7.2	7.8	8.17	8.10	8.02	365	370	360	26.2	24.1	23.4
Control B	5	5	5												
Control C	5	5	5												
Control D	5	5	5												
100.0 % A	5	5	5	8.0	7.6	7.8	7.42	7.94	8.03	331	362	354	22.2	24.3	24.1
100.0% B	5	5	5												
100.0% C	5	5	5												
100.0% D	5	5	5												
Initials	SO	SO	SO												
Time	1315	1100	1030												
Comments:															

PACE TOXICITY TEST DATA

Client: BAE Systems | **Test Beginning**: **Date**: 02-12-21 **Time**: 1315

Client Sample ID: 1.0 ppm NG | **Test Ending**: **Date**: 02-14-21 **Time**: 1030

Pace Sample ID: 7360293-002 | **Dilution Water**: Moderately Hard Synthetic Fresh Water

NPDES Permit #: NA | **Test Organism**: *Ceriodaphnia dubia* **Age**: <24 Hrs

Bioassay Test: 48-Hr Static Screen Non-Renewal | **Isolation Date**: 02-11-21 **Time**: 1110

Sample Collection Data | **# Replicates**: 4 **# Organisms/Rep**: 5

Sample Volume: 1 liter **Sample Type**: Grab | **Effluent** | **Dilution Water**

Collected From: **Date**: **Time**: | **Alkalinity** NA **Chlorine** 0.00 **Alkalinity** 62.4 mg/L

Collected To: **Date**: 02-11-21 **Time**: 1330 | **Hardness** NA **Dechlorinated** NA **Hardness** 88.1 mg/L

Test Concentration (%)	Number of Live Organisms			Dissolved Oxygen (mg/l)			pH (SU)			Conductivity (umhos)			Test Temperature (°C)		
	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs
Control A	5	5	5	7.0	7.2	7.8	8.17	8.10	8.02	365	370	360	26.2	24.1	23.4
Control B	5	5	5												
Control C	5	5	5												
Control D	5	5	5												
100.0 % A	5	5	5	8.4	7.6	7.6	7.37	8.01	8.05	347	372	364	20.8	23.8	24.2
100.0% B	5	5	5												
100.0% C	5	5	5												
100.0% D	5	5	5												
Initials	SO	SO	SO												
Time	1315	1100	1030												
Comments:															

PACE TOXICITY TEST DATA

Client: BAE Systems | **Test Beginning**: **Date**: 02-12-21 **Time**: 1315

Client Sample ID: 2.5 ppm NG | **Test Ending**: **Date**: 02-14-21 **Time**: 1030

Pace Sample ID: 7360293-003 | **Dilution Water**: Moderately Hard Synthetic Fresh Water

NPDES Permit #: NA | **Test Organism**: *Ceriodahnia dubia* **Age**: < 24 Hrs

Bioassay Test: 48-Hr Static Screen Non-Renewal | **Isolation Date**: 02-11-21 **Time**: 1110

Sample Collection Data | **# Replicates**: 4 **# Organisms/Rep**: 5

Sample Volume: 1 liter **Sample Type**: Grab | **Effluent** | **Dilution Water**

Collected From: **Date**: **Time**: | **Alkalinity** NA **Chlorine** 0.00 **Alkalinity** 62.4 mg/L

Collected To: **Date**: 02-11-21 **Time**: 1330 | **Hardness** NA **Dechlorinated** NA **Hardness** 88.1 mg/L

Test Concentration (%)	Number of Live Organisms			Dissolved Oxygen (mg/l)			pH (SU)			Conductivity (umhos)			Test Temperature (°C)		
	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs
Control A	5	5	5	7.0	7.2	7.8	8.17	8.10	8.02	365	370	360	26.2	24.1	23.4
Control B	5	5	5												
Control C	5	5	5												
Control D	5	5	5												
100.0 % A	5	5	5	8.5	7.6	7.6	7.36	7.98	8.07	333	362	352	20.4	24.2	24.2
100.0% B	5	5	5												
100.0% C	5	5	5												
100.0% D	5	5	5												
Initials	SO	SO	SO												
Time	1315	1100	1030												
Comments:															

PACE TOXICITY TEST DATA

Client: BAE Systems | **Test Beginning**: **Date**: 02-12-21 **Time**: 1315

Client Sample ID: 5.0 ppm NG | **Test Ending**: **Date**: 02-14-21 **Time**: 1030

Pace Sample ID: 7360293-004 | **Dilution Water**: Moderately Hard Synthetic Fresh Water

NPDES Permit #: NA | **Test Organism**: *Ceriodaphnia dubia* **Age**: < 24 Hrs

Bioassay Test: 48-Hr Static Screen Non-Renewal | **Isolation Date**: 02-11-21 **Time**: 1110

Sample Collection Data | **# Replicates**: 4 **# Organisms/Rep**: 5

Sample Volume: 1 liter **Sample Type**: Grab | **Effluent** | **Dilution Water**

Collected From: **Date**: **Time**: | **Alkalinity** NA **Chlorine** 0.00 **Alkalinity** 62.4 mg/L

Collected To: **Date**: 02-11-21 **Time**: 1330 | **Hardness** NA **Dechlorinated** NA **Hardness** 88.1 mg/L

Test Concentration (%)	Number of Live Organisms			Dissolved Oxygen (mg/l)			pH (SU)			Conductivity (umhos)			Test Temperature (°C)		
	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs
Control A	5	5	5	7.0	7.2	7.8	8.17	8.10	8.02	365	370	360	26.2	24.1	23.4
Control B	5	5	5												
Control C	5	5	5												
Control D	5	5	5												
100.0 % A	5	5	5	8.0	7.6	7.6	7.43	7.99	8.07	340	359	355	23.1	24.2	24.3
100.0% B	5	5	5												
100.0% C	5	5	5												
100.0% D	5	5	5												
Initials	SO	SO	SO												
Time	1315	1100	1030												
Comments:															

PACE TOXICITY TEST DATA

Client: BAE Systems	**Test Beginning**:	**Date**: 02-12-21	**Time**: 1315
Client Sample ID: 10.0 ppm NG	**Test Ending**:	**Date**: 02-14-21	**Time**: 1030
Pace Sample ID: 7360293-005	**Dilution Water**: Moderately Hard Synthetic Fresh Water		
NPDES Permit #: NA	**Test Organism**: *Ceriodaphnia dubia*		**Age**: < 24 Hrs
Bioassay Test: 48-Hr Static Screen Non-Renewal	**Isolation Date**: 02-11-21	**Time**: 1110	
Sample Collection Data	**# Replicates**: 4	**# Organisms/Rep**: 5	
Sample Volume: 1 liter **Sample Type**: Grab	**Effluent**		**Dilution Water**
Collected From: **Date**: **Time**:	**Alkalinity** NA	**Chlorine** 0.00	**Alkalinity** 62.4 mg/L
Collected To: **Date**: 02-11-21 **Time**: 1330	**Hardness** NA	**Dechlorinated** NA	**Hardness** 88.1 mg/L

Test Concentration (%)	Number of Live Organisms			Dissolved Oxygen (mg/l)			pH (SU)			Conductivity (umhos)			Test Temperature (°C)		
	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs	0Hrs	24Hrs	48Hrs
Control A	5	5	5	7.0	7.2	7.8	8.17	8.10	8.02	365	370	360	26.2	24.1	23.4
Control B	5	5	5												
Control C	5	5	5												
Control D	5	5	5												
100.0 % A	5	5	5	7.8	7.6	7.6	7.42	8.08	8.08	342	370	365	25.4	23.2	24.2
100.0% B	5	5	5												
100.0% C	5	5	4												
100.0% D	5	5	5												
Initials	SO	SO	SO												
Time	1315	1100	1030												
Comments:															

Pass / Fail-48 Hour

Start Date:	2/12/2021 13:15	Test ID:	7360293-05	Sample ID:	NG 10.0 ppm
End Date:	2/14/2021 10:30	Lab ID:	PACE-WV01040	Sample Type:	PT-Product Testing
Sample Date:	2/11/2021 13:30	Protocol:	EPAAW02-EPA/821/R-02-01	Test Species:	CD-Ceriodaphnia dubia
Comments:					

Conc-ppm	1	2	3	4
Hard Synthetic	1.0000	1.0000	1.0000	1.0000
100	1.0000	1.0000	0.8000	1.0000

			Transform: Arcsin Square Root					Rank	1-Tailed
Conc-ppm	Mean	N-Mean	Mean	Min	Max	CV%	N	Sum	Critical
Hard Synthetic	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4		
100	0.9500	0.9500	1.2857	1.1071	1.3453	9.261	4	16.00	11.00

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.05)	0.7064	0.818	-2.0367	4.9
Equality of variance cannot be confirmed				

Hypothesis Test (1-tail, 0.05)

Wilcoxon Two-Sample Test indicates no significant differences
Treatments vs MHSF-Moderately Hard Synthetic

CHAIN OF CUSTODY RECORD

REIC

Research Environmental & Industrial Consultants, Inc.

MAIN LABORATORY & CORPORATE HEADQUARTERS:

P.O. Box 286 * 225 Industrial Park Road, Beaver, WV 25813
800-999-0105 * 304-255-2500 * www.reiclabs.com

MID-OHIO VALLEY Service Center
101 17th Street
Ashland, KY 41101
606-393-5027

SHENANDOAH Service Center
1557 Commerce Rd, Ste. 201
Verona, VA 24482
540-248-0183

ROANOKE Service Center
3029-C Peters Creek Rd
Roanoke, VA 24019
540-777-1276

V5-1109

REIC use ONLY — Client ID: _____ Date: _____ Sheet: _____

Client Name: BAE Systems/ RFAAP — P.O. #: RFAC-071219-01-SJM

Contact Person: Sheree Andrews — Phone #: 540-639-7215

Email Address: sheree.andrews@baesystems.com — Cell Phone #: 540-717-4092

Address: Route 114, P.O. Box 1 — City: Radford — State: VA — Zip: 24143

Billing Address (If Different): _____

City: _____ State: _____ Zip: _____

Site ID & State: _____ Sampler: M. Albert

NPDES Permit #: VA 0000248 — Outfall #: _____

Receiving Stream: New River

From Where and How Sample was Collected: SMHW spiked NG Solutions

Rain Event: _____ Flow: _____

SAMPLE ID	NUMBER & TYPE OF CONTAINERS	COLLECTION DATE AND TIME FROM Date	FROM Time	TO Date	TO Time	SAMPLE COMP / GRAB	Test Type	Test Species
Nitroglycerin screening (see comments)	5 glass	2-11-2021	1330	2-11-2021	1330	Comp	◉ Acute	☐ Pimephales promelas (Fathead Minnow)
							○ Chronic	☒ Ceriodaphnia dubia
							○ Screen	☐ Daphnia magna
								☐ Daphnia pulex

All analytical requests are subject to REIC's Standard Terms and Conditions.

Field Readings	
Temperature:	—
pH:	—
Conductivity:	—
DO:	—
Chlorine: NA	
Is the Sample: ○ Chlorinated ○ Dechlorinated	
Dechlorination Method: NA	
Should REIC Dechlorinate Sample: ○ YES ◉ NO	
Date: Time:	
Sample Appearance:	
Sample Odor:	

Comments

Below are the dilutions to be tested:

0.5 ppm Nitroglycerin (NG) 0.8
1 ppm NG 1.5
2.5 ppm NG 3.0
5 ppm NG 2.0
10 ppm NG

REIC USE ONLY	
Temperature:	°C
pH:	SU
Conductivity:	µmhos/cm
DO:	mg/L
Chlorine:	mg/L
Sample Appearance:	
Sample Odor:	
Date Sample Received:	
Sample Storage During Shipment:	
Method of Shipment to REIC:	
Time: Initials:	

1

Relinquished By (Signature): M. Albert — Date / Time: 2-11-21 1410 hr

Received By (Signature): D Vaughn — Date / Time: 2.12.21 10730

2

Relinquished By (Signature): Denise Vaughn — Date / Time: 2.12.21 0900

Received By (Signature): [illegible] — Date / Time: 2.12.21 0900

2-12-21 1212

02-12-21 1243

TOXICITY TEST DATA SHEET

INITIAL READINGS

Pace Job # 7360293-001

Client Name BAE Systems

Client Sample ID 0.5 ppm / 0.49

Sample Type

Date Received 02-12-21

Sampling From		Sampling To	
Date 02-11-21	Time 1330	Date	Time

Dissolved Oxygen 7.8

pH 7.31

Conductivity 356

Temperature 2.8

Chlorine HANNA HI 96781 Reagent Lot # U09A 0.00

Chlorine HACH Model CN66/66F/66T Reagent Lot #

Appearance Clear

Odor

Shipment Method Pace Courier

Sample Storage During Shipment On Ice in Cooler

Sample Storage Upon Arrival Bio Lab

Date 02-12-21 Time 1250 Initials d

TOXICITY TEST DATA SHEET

INITIAL READINGS

Pace Job # 7360293-002

Client Name BAE Systems

Client Sample ID 1.0 ppm / 0.98

Sample Type

Date Received 02-12-21

Sampling From		Sampling To	
Date	Time	Date 021221	Time 1330

Dissolved Oxygen 7.7

pH 7.29

Conductivity 349

Temperature 0.8

Chlorine HANNA HI 96781 Reagent Lot # L09A 000

Chlorine HACH Model CN66/66F/66T Reagent Lot # ——

Appearance Clear

Odor None

Shipment Method Pace Courier

Sample Storage During Shipment on Ice Cooler

Sample Storage Upon Arrival Bio lab 2

Date 02-12-21 Time 1250 Initials d

TOXICITY TEST DATA SHEET

INITIAL READINGS

Pace Job # 7360293-003

Client Name BAE Systems

Client Sample ID 2.5 ppm / 2.47

Sample Type

Date Received 021221

Sampling From		Sampling To	
Date	Time	Date 021121	Time 1330

Dissolved Oxygen 8.5

pH 7.30

Conductivity 343

Temperature 1.5

Chlorine HANNA HI 96781 Reagent Lot # 4094 000

Chlorine HACH Model CN66/66F/66T Reagent Lot #

Appearance Clear

Odor None

Shipment Method Pace Courier

Sample Storage During Shipment On Ice Cooler

Sample Storage Upon Arrival Bio wx 2

Date 021221 Time 1252 Initials d

TOXICITY TEST DATA SHEET

INITIAL READINGS

Pace Job # 7360293-004

Client Name BAE Systems ~~5.0 ppm~~ 021221d

Client Sample ID 5.0 ppm / 5.0 mg/L

Sample Type

Date Received 02.12.21

Sampling From		Sampling To	
Date	Time	Date 02.11.21	Time 1330

Dissolved Oxygen 8.2

pH 7.28

Conductivity 338

Temperature 3.1

Chlorine HANNA HI 96781 Reagent Lot # 409A 000

Chlorine HACH Model CN66/66F/66T Reagent Lot #

Appearance Clear

Odor None

Shipment Method Pace Courier

Sample Storage During Shipment On The Cooler

Sample Storage Upon Arrival Bio WC2

Date 02.12.21 Time 1254 Initials d

TOXICITY TEST DATA SHEET

INITIAL READINGS

Pace Job # 7360293-005

Client Name BAE Spokane

Client Sample ID 10.0 ppm / 10.01

Sample Type

Date Received 02.12.21

Sampling From		Sampling To	
Date	Time	Date 02.11.21	Time 1330

Dissolved Oxygen 9.0

pH 7.28

Conductivity 341

Temperature 26

Chlorine HANNA HI 96781 Reagent Lot # 409A 000

Chlorine HACH Model CN66/66F/66T Reagent Lot # ——

Appearance Clear

Odor None

Shipment Method Pace Courier

Sample Storage During Shipment On Ice In Cooler

Sample Storage Upon Arrival B.O WC 2

Date 02.12.21 Time 1254 Initials dl

BIOLOGICAL MONITORING, INC
1800 KRAFT DRIVE SUITE 104 BLACKSBURG VIRGINIA 24060
PH:540-953-2821 EMAIL:BMI@BIOMON.COM WWW.BIOMON.COM
TNI ACCREDITED LAB# 460015

BAE Systems
Toxicity Testing Summary
22OCT21

Introduction

BAE Systems retained the professional services of Biological Monitoring, Inc. (BMI) to perform toxicity studies relating to the potential contribution to aquatic toxicity of an industrial chemical (Methyl Centralite). Previous toxicity evaluations have reportedly implicated methyl centralite as an agent responsible for observed acute toxicity in BAE's final effluent. This study utilized 48-hour Acute Toxicity Tests with *Pimephales promelas* and / or *Ceriodaphnia dubia*. The samples tested were Sweetie Barrel Discharge, Methyl Centralite Water Accommodated Fraction (WAF), Methyl Centralite WAF with 0.2% Strong Alcohol, Strong Alcohol, Filtered Water, and Water Dry Discharge.

Samples Tested

1. Sweetie Barrel Discharge

   This sample is reportedly methyl centralite dissolved in strong alcohol. The liquid phase (apparently soluble portion) was used in testing. The sample was treated as a compound and the results were expressed as mg/L (w/v).

2. Methyl Centralite WAF

   Methyl centralite was received as a dry compound. This compound was not soluble in water. Therefore, the WAF method to prepare the compound for testing was used. The WAF was prepared by adding 1000 mg of methyl centralite to 1000 ml BMI lab water. This mixture was placed on a magnetic stirrer for 24h. The mixture was then allowed to settle, and the resultant supernatant was used in testing. Results for this test were expressed as mg/L WAF (w/v).

3. Methyl Centralite WAF with 0.2% Strong Alcohol

   This sample was prepared as in number 2 above with the addition of 0.2% strong alcohol (w/v). Results were expressed as mg/L (w/v).

4. Strong Alcohol

   Strong alcohol was tested as a compound. This test was used to evaluate the role of strong alcohol in preparing samples above. Results were expressed in mg/L (w/v).

5. Filtered Water

   Filtered water was tested to ensure that makeup water was not responsible for observed acute toxicity.

6. Water Dry Discharge

   Water Dry Discharge was received as a liquid sample. This sample was treated as an "effluent". As such, results were expressed in percent (v/v). This sample was challenged with only a Ceriodaphnid test.

Results

1. Sweetie Barrel Discharge

   Table 1 presents a summary of the toxicity testing results. Testing with this sample resulted in a 48h LC50 of 4910 mg/L using fathead minnows and 2608 mg/L using Ceriodaphnids.

2. Methyl Centralite WAF

   Table 1 presents a summary of the toxicity testing results. Testing with this sample resulted in a 48h LC50 of 277 mg/L using fathead minnows and 297 mg/L using Ceriodaphnids.

3. Methyl Centralite WAF with 0.2% Strong Alcohol

   Table 1 presents a summary of the toxicity testing results. Testing with this sample resulted in a 48h LC50 of 218 mg/L using fathead minnows and 330 mg/L using Ceriodaphnids.

4. Strong Alcohol

   Table 1 presents a summary of the toxicity testing results. Testing with this sample resulted in a 48h LC50 of > 10000 mg/L using fathead minnows and Ceriodaphnids.

5. Filtered Water

   Table 1 presents a summary of the toxicity testing results. Filtered water was not toxic to Ceriodaphnids or fathead minnows (LC50 > 100%).

6. Water Dry Discharge

   Table 1 presents a summary of the toxicity testing results. Testing with this sample yielded an LC50 of 16.6 % using Ceriodaphnids.

Table 1: Summary of Toxicity Testing Results

Sample	Organism	LC50	Confidence Intervals
Sweetie Barrel Discharge	*Pimephales promelas*	4910 mg/L	4058-5941 mg/L
	Ceriodaphnia dubia	2608 mg/L	2106-3230 mg/L
Methyl Centralite WAF	*Pimephales promelas*	277 mg/L	236-324 mg/L
	Ceriodaphnia dubia	297 mg/L	254-348 mg/L
Methyl Centralite WAF with 0.2% Strong Alcohol	*Pimephales promelas*	218 mg/L	189-251 mg/L
	Ceriodaphnia dubia	330 mg/L	301-362 mg/L
Strong Alcohol	*Pimephales promelas*	>10000 mg/L	NA
	Ceriodaphnia dubia	>10000 mg/L	NA
Water Dry Discharge	*Ceriodaphnia dubia*	16.6%	14.5-19.0%

1941 Reymet Road ● Richmond, Virginia 23237 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Laboratory Order ID 21L0453

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford, VA 24141	Date Received:	December 8, 2021 13:41
		Date Issued:	March 10, 2022 18:04
		Project Number:	TIE 029 NG & NGDP STUDY
Submitted To:	Sheree Andrews	Purchase Order:	
Client Site I.D.:	Bioplant-NG/Degradation Products Study		

Enclosed are the results of analyses for samples received by the laboratory on 12/08/2021 13:41. If you have any questions concerning this report, please feel free to contact the laboratory.

Sincerely,

Ted Soyars

Technical Director

End Notes:

The test results listed in this report relate only to the samples submitted to the laboratory and as received by the Laboratory.

Unless otherwise noted, the test results for solid materials are calculated on a wet weight basis. Analyses for pH, dissolved oxygen, temperature, residual chlorine and sulfite that are performed in the laboratory do not meet NELAC requirements due to extremely short holding times. These analyses should be performed in the field. The results of field analyses performed by the Sampler included in the Certificate of Analysis are done so at the client's request and are not included in the laboratory's fields of certification nor have they been audited for adherence to a reference method or procedure.

The signature on the final report certifies that these results conform to all applicable NELAC standards unless otherwise specified. For a complete list of the Laboratory's NELAC certified parameters please contact customer service.

This report shall not be reproduced except in full without the expressed and written approval of an authorized representative of Air Water & Soil Laboratories, Inc.

TNI Accredited
VELAP ID 460021

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued: Project Number: Purchase Order:	March 10, 2022 18:04 TIE 029 NG & NGDP STUDY Phas
Submitted To:	Sheree Andrews		
Client Site I.D.:	Bioplant-NG/Degradation Products Study		

ANALYTICAL REPORT FOR SAMPLES

Laboratory Order ID 21L0453

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
CLE	21L0453-01	Non-Potable Water	12/07/2021 00:00 to 12/07/2021 23:59	12/08/2021 13:41

Analysis for Chronic Toxicity and NG/NGDP was subcontracted to Coastal Bioanalysts. The subcontracted results are attached at the end of this Certificate of Analysis.

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued:	March 10, 2022 18:04
		Project Number:	TIE 029 NG & NGDP STUDY Phas
		Purchase Order:	
Submitted To:	Sheree Andrews		
Client Site I.D.:	Bioplant-NG/Degradation Products Study		

Laboratory Order ID: 21L0453

Analytical Results

Sample I.D. CLE **Laboratory Sample ID:** 21L0453-01

Composite Start-End Date/Time: 12/07/2021 00:00 - 12/07/2021 23:59

Field Residual Cl: **Field pH:**

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
Wet Chemistry Analysis									
Dissolved Organic Carbon (DOC)	01	SM22 5310C-2011	**97.7 mg/L**		50.0	50	01/04/22 17:22	01/04/22 17:22	PMQ
Subcontracted Analysis									
Acute Toxicity CD	01	EPA	Attached		--	1	12/28/21 14:13	12/28/21 14:14	N/A

Analytical Summary

Administrative	**Preparation Method:**
21L0453-01	EA
21L0453-01	SW8330A

Sample ID	Preparation Factors Initial / Final	Method	Batch ID	Sequence ID	Calibration ID
Subcontracted Analysis		**Preparation Method:**	***** DEFAULT PREP *****		
21L0453-01	1.00 mL / 1.00 mL	EPA	BEL1066		

Sample ID	Preparation Factors Initial / Final	Method	Batch ID	Sequence ID	Calibration ID
Wet Chemistry Analysis		**Preparation Method:**	**No Prep Halides**		
21L0453-01	40.0 mL / 40.0 mL	SM22 5310C-2011	BEL1205	SEL1095	AI10078

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued:	March 10, 2022 18:04
		Project Number:	TIE 029 NG & NGDP STUDY Phas
		Purchase Order:	
Submitted To:	Sheree Andrews		
Client Site I.D.:	Bioplant-NG/Degradation Products Study		

Wet Chemistry Analysis - Quality Control

Enthalpy Analytical

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual
Batch BEL1205 - No Prep Halides										
Blank (BEL1205-BLK1)				Prepared & Analyzed: 01/04/2022						
Dissolved Organic Carbon (DOC)	<1.0 mg/L	1.0	mg/L							
LCS (BEL1205-BS1)				Prepared & Analyzed: 01/04/2022						
Dissolved Organic Carbon (DOC)	10.1 mg/L	1	mg/L	10.0 mg/L		101	80-120			
LCS Dup (BEL1205-BSD1)				Prepared & Analyzed: 01/04/2022						
Dissolved Organic Carbon (DOC)	10.1 mg/L	1	mg/L	10.0 mg/L		101	80-120	0.688	20	
Duplicate (BEL1205-DUP1)		**Source: 21L0453-01**		Prepared & Analyzed: 01/04/2022						
Dissolved Organic Carbon (DOC)	93.2 mg/L	50.0	mg/L		97.7 mg/L			4.77	20	
Matrix Spike (BEL1205-MS1)		**Source: 21L0453-01**		Prepared & Analyzed: 01/04/2022						
Dissolved Organic Carbon (DOC)	585 mg/L	50.0	mg/L	500	97.7 mg/L	97.5	80-120			

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued: Project Number: Purchase Order:	March 10, 2022 18:04 TIE 029 NG & NGDP STUDY Phas
Submitted To:	Sheree Andrews		
Client Site I.D.:	Bioplant-NG/Degradation Products Study		

Certified Analyses included in this Report

Analyte **Certifications**

Code	Description	Laboratory ID	Expires
MADEP	Massachusetts DEP	M-VA913	06/30/2022
MdDOE	Maryland DE Drinking Water	341	12/31/2022
NC	North Carolina DENR	495	07/31/2022
NCDEQ	North Carolina DEQ	495	12/31/2022
NCDOH	North Carolina Department of Health	51714	07/31/2022
NHDES	NELAP-New Hampshire Certificate #224221	2242	02/25/2022
NJDEP	NELAP-New Jersey DEP	VA015	06/30/2022
NYDOH	New York DOH Drinking Water	12096	04/01/2022
PADEP	NELAP-Pennsylvania Certificate #007	68-03503	10/31/2022
VELAP	NELAP-Virginia Certificate #11539	460021	06/14/2022
WVDEP	West Virginia DEP	350	02/28/2022

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued: Project Number: Purchase Order:	March 10, 2022 18:04 TIE 029 NG & NGDP STUDY Phas
Submitted To:	Sheree Andrews		
Client Site I.D.:	Bioplant-NG/Degradation Products Study		

Summary of Data Qualifiers

Attached	Attached
RPD	Relative Percent Difference
Qual	Qualifers
-RE	Denotes sample was re-analyzed
D.F.	Dilution Factor. Please also see the Preparation Factor in the Analysis Summary section.
TIC	Tentatively Identified Compounds are compounds that are identified by comparing the analyte mass spectral pattern with the NIST spectral library. A TIC spectral match is reported when the pattern is at least 75% consistent with the published pattern. Compound concentrations are estimated and are calculated using an internal standard response factor of 1.
PCBs, Total	Total PCBs are defined as the sum of detected Aroclors 1016, 1221, 1232, 1248, 1254, 1260, 1262, and 1268.

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued: Project Number: Purchase Order:	March 10, 2022 18:04 TIE 029 NG & NGDP STUDY Phas
Submitted To:	Sheree Andrews		
Client Site I.D.:	Bioplant-NG/Degradation Products Study		

1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	BAE Systems, Inc. - RFAAP Route 114 Radford VA, 24141	Date Issued: Project Number: Purchase Order:	March 10, 2022 18:04 TIE 029 NG & NGDP STUDY Phas
Submitted To:	Sheree Andrews		
Client Site I.D.:	Bioplant-NG/Degradation Products Study		

Sample Conditions Checklist

Samples Received at:	**1.20°C**
How were samples received?	AWS Courier
Were Custody Seals used? If so, were they received intact?	No
Are the custody papers filled out completely and correctly?	Yes
Do all bottle labels agree with custody papers?	Yes
Is the temperature blank or representative sample within acceptable limits or received on ice, and recently taken?	Yes
Are all samples within holding time for requested laboratory tests?	Yes
Is a sufficient amount of sample provided to perform the tests included?	Yes
Are all samples in appropriate containers for the analyses requested?	Yes
Were volatile organic containers received?	No
Are all volatile organic and TOX containers free of headspace?	NA
Is a trip blank provided for each VOC sample set? VOC sample sets include EPA8011, EPA504, EPA8260, EPA624, EPA8015 GRO, EPA8021, EPA524, and RSK-175.	NA
Are all samples received appropriately preserved? Note that metals containers do not require field preservation but lab preservation may delay analysis.	No

Per Sheree Andrews: Sample is part of an ongoing chronic toxicity evaluation; aliquot should be poured off and preserved with H3PO4 for subcontract evaluation of Nitroglyerin, Mono-nitroglycerin, and Di-nitroglycerin, as well as dissolved organic carbon (lab filtered). JPV 12/19/21 15:14

Client: Enthalpy Analytical/Air, Water and Soil Laboratories
Project ID: AWSL2115
Client Sample ID: BAE-Radford Army Ammunition Plant 21L0453-01A
Permit No.: VA0000248 CLE (029)
Sample Period: 12/7/21

Coastal Bioanalysts, Inc.

Report of Analysis: Whole Effluent Toxicity (WET)

Submitted To:	**Prepared By:**
JP Verheul Business Development Manager / Senior Chemist Enthalpy Analytical/Air, Water and Soil Laboratories 1941 Reymet Road, Richmond, VA 23237	Coastal Bioanalysts, Inc. 6400 Enterprise Court Gloucester, VA 23061 (804) 694-8285 www.coastalbio.com Contact: Peter F. De Lisle, Technical Director

Acute Test Results*				
Species-Test Method	**Test Period**	**NOAEC**	**48-h LC50**	**T.U.$_{Ac}$**
C. dubia EPA 2002.0	12/9/21-12/11/21	N/A	84.3	**1.19**
P. promelas EPA 2000.0	12/9/21-12/11/21	N/A	28.1	**3.56**

Details regarding test conduct and data analysis provided in attached bench sheets and printouts as applicable.
For each test method record the T.U.$_{Ac}$ value (bold) on the DMR.

Acute Test QA/QC	**Reference Toxicant: KCl**	**Units: mg/l**	**Test Organism Source: CBI Stock Cultures**		
Species-Method (Ref. Test Date)	**Data Source**	**% Control Survival**	**48-h LC50**	**95% C.L./A.L. For LC50**	**RTT in Control?**
C. dubia 2002.0	RTT	100	434	410-459	Yes
(11/2/21-11/4/21)	CC	100	539	475-602	
P. promelas 2000.0	RTT	100	1000	907-1103	Yes
(11/2/21-11/4/21)	CC	100	1003	845-1160	

Note: RTT = Reference Toxicant Test, CC = Control Chart.

The results of analysis contained within this report relate only to the sample as received in the laboratory. This report shall not be reproduced except in full without written approval from the laboratory. Unless noted below, these test results meet all requirements of NELAP.

APPROVED: Peter F. De Lisle

Digitally signed by Peter F. De Lisle
DN: cn=Peter F. De Lisle, o=Coastal Bioanalysts, Inc., ou=Toxicology, email=pfd@coastalbio.com, c=US
Date: 2021.12.15 12:18:45 -05'00'

Peter F. De Lisle, Ph.D.
Technical Director

Deviations from, additions to, or exclusions from the test method, non-standard conditions or data qualifiers and, as appropriate, a statement of compliance/non-compliance: **NONE**

Please leave feedback regarding our services at: http://coastalbio.com/survey

VELAP# 460030
EPA# VA01116

NELAP ACCREDITED LABORATORY

GLOSSARY OF TERMS AND ABBREVIATIONS

A.L. (Acceptance Limits): The results of a given reference toxicant test are compared to the control chart mean value ± 2 standard deviations. These limits approximate the 95% probability limits for the "true" reference toxicant value.

Chronic Value (ChrV): The geometric mean of the NOEC and LOEC. Units are same as test concentration units.

C.L. (Confidence Limits): These are the probability limits, based on the data set and statistical model employed, that the "true value" lies within the limits specified. Typically limits are based on 95% or 99% probabilities.

Control chart: A cumulative summary chart of results from QC tests with reference toxicants. The results of a given reference toxicant test are compared to the control chart mean value and 95% Acceptance Limits (A.L.) (mean ± 2 standard deviations).

IC25: The concentration of sample or chemical, calculated from the data set using statistical models, causing a 25% reduction in test organism growth, reproduction, etc. The lower the IC25, the more toxic the chemical or sample. Units are same as test concentration units.

LC50: The concentration of sample or chemical, calculated from the data set using statistical models, causing a 50% reduction in test organism survival. The lower the LC50, the more toxic the chemical or sample. Units are same as test concentration units. Note: The LC50 value must always be associated with the duration of exposure. Thus 48-h LC50, 96-h LC50, etc. are calculated.

LOEC: Lowest-observable-effect-concentration. The lowest concentration of sample or chemical in a chronic test dilution series in which the test organisms exhibit a statistically significant reduction in any of the test end points (e.g. growth, survival, reproduction) compared to control organisms. Units are same as test concentration units.

PMSD: Percent Minimum Significant Difference: The minimum difference which can exist between a test treatment and the controls in a particular test and be statistically significant; a measure of test sensitivity. The lower the PMSD the more sensitive the test.

N/A: Not applicable.

N/D: Not determined or measured.

NOAEC: No-observable-acute-effect-concentration. The highest concentration of sample or chemical in an acute test dilution series in which the test organisms exhibit no statistically significant reduction in the test end point (e.g. survival) compared to control organisms. Units are same as test concentration units.

NOEC: No-observable-effect-concentration. The highest concentration of sample or chemical in a chronic test dilution series in which the test organisms exhibit no statistically significant reduction in any of the test end points (e.g. growth, survival, reproduction) compared to control organisms. Some regulatory definitions also require that the NOEC be less than the LOEC. Units are same as test concentration units.

Q.L.: Quantitation Limit. Level, concentration, or quantity of a target variable (analyte) that can be reported at a specified degree of confidence.

T.U.: Toxic units. Expresses the relative toxicity of an effluent in such a manner that the larger the toxic unit value the more toxic the effluent. $T.U._{Ac} = 100/LC50$. $T.U._{Chr} = 100/NOEC$. A dimensionless unit.

C. dubia daily biological measurements (EPA 2002.0) Template version ACD-STAT-11trt-061113

TRTMNT (% Effl)	Rep	#Live Day 0	#Live Day 1	#Live Day 2	Final Mean % Live		
C	A	5	5	5	100.0		
	B	5	5	5			
Lab	C	5	5	5			
Control	D	5	5	5			
#1	A	5	5	5	100.0		
0.6	B	5	5	5			
% Effl	C	5	5	5			
	D	5	5	5			
# 2	A	5	5	5	100.0		
1.0	B	5	5	5			
% Effl	C	5	5	5			
	D	5	5	5			
# 3	A	5	5	5	100.0		
1.7	B	5	5	5			
% Effl	C	5	5	5			
	D	5	5	5			
# 4	A	5	5	5	100.0		
2.8	B	5	5	5			
% Effl	C	5	5	5			
	D	5	5	5			
# 5	A	5	5	5	100.0		
4.7	B	5	5	5			
% Effl	C	5	5	5			
	D	5	5	5			
# 6	A	5	5	5	100.0		
7.8	B	5	5	5			
% Effl	C	5	5	5			
	D	5	5	5			
# 7	A	5	5	5	100.0		
13	B	5	5	5			
% Effl	C	5	5	5			
	D	5	5	5			
# 8	A	5	5	5	100.0		
22	B	5	5	5			
% Effl	C	5	5	5			
	D	5	5	5			
# 9	A	5	5	5	100.0		
36	B	5	5	5			
% Effl	C	5	5	5			
	D	5	5	5			
# 10	A	5	5	5	100.0		
60	B	5	5	5			
% Effl	C	5	5	5			
	D	5	5	5			
# 11	A	5	4	1	25.0		
100	B	5	4	2			
% Effl	C	5	2	2		Test Duration:	48h 23m
	D	5	0	0			TAC 48+/-0.5h
INITIALS:		LT	LT	AK	% CONTROL SURVIVAL:		100.0
DATE & TIME:		12/9/21 11:53	12/10/21 7:59	12/11/21 12:16			TAC = 90%

CHANGES & NOTES (INITIALS, DATE, SPECIFIC CHANGE MADE	TOXCALC TO BE PERFORMED WITH PERMIT-SPECIFIC DILUTIONS

	SPECIES:	Ceriodaphnia dubia		
	ACCLIMATION WATER:	Mod. Hard Synthetic Freshwater		
	FEEDING PRIOR TO TEST:	YCT + Selenastrum capricornutum		
	FEEDING DURING TEST:	None -YCT + Selenastrum 2+ h before test		
	SOURCE:	CBI Stock cultures		
	ACCLIMATION TEMP (o C):	25		
	BROOD RELEASE START DATE & TIME:	12/8/21 12:30		
	BROOD RELEASE END DATE & TIME:	12/8/21 16:30		
	DATE/TIME WATER ADDED:	12/9/21 11:16		
	DATE/TIME ANIMALS ADDED:	12/9/21 11:53		
	ANIMAL AGE WINDOW:	4h 0m		
	MAX AGE AT TEST START:	23h 24m	TAC Max. 24 h	
	TEST SET UP BY:		LT	
	SAMPLE COLLECTION DATE &TIME:	12/7/21 23:59	SAMPLE USED	A
TEST ID:	SAMPLE AGE AT TEST START:	35h 55m	TAC Max 36 h	
AWSL2115ACD	PEER REVIEW BY (INITIALS/DATE):		PB	12/13/21 11:24

Ceriodaphnia daily water quality bench sheet (EPA METHOD 2002.0) Template version ACD-STAT-11trt-061113

	TRTMNT	Day 0 Initial	Day 1	Day 2 Final	SUMMARY WATER QUALITY DATA MEAN	S.D.	MIN.	MAX.
pH (S.U.)	C	8.00	7.94	7.99	7.98	0.03	7.94	8.00
	1	8.00	7.97	8.00	7.99	0.02	7.97	8.00
	2	8.02	7.97	8.00	8.00	0.03	7.97	8.02
	3	8.11	7.97	8.03	8.04	0.07	7.97	8.11
	4	8.15	7.97	8.05	8.06	0.09	7.97	8.15
	5	8.20	7.99	8.06	8.08	0.11	7.99	8.20
	6	8.20	8.00	8.08	8.09	0.10	8.00	8.20
	7	8.21	8.01	8.12	8.11	0.10	8.01	8.21
	8	8.24	8.01	8.14	8.13	0.12	8.01	8.24
	9	8.25	8.04	8.16	8.15	0.11	8.04	8.25
	10	8.25	8.08	8.22	8.18	0.09	8.08	8.25
	11	8.25	8.23	8.35	8.28	0.06	8.23	8.35
Temp. (o C)	C	25	25	25	25	0	25	25
	1	25	25	25	25	0	25	25
	2	25	25	25	25	0	25	25
	3	25	25	25	25	0	25	25
	4	25	25	25	25	0	25	25
	5	25	25	25	25	0	25	25
	6	25	25	25	25	0	25	25
	7	25	25	25	25	0	25	25
	8	25	25	25	25	0	25	25
	9	25	25	25	25	0	25	25
	10	25	25	25	25	0	25	25
	11	25	25	25	25	0	25	25
Diss. Oxygen (mg/l)	C	8.2	8.3	8.2	8.2	0.1	8.2	8.3
	1	8.2	8.3	8.3	8.3	0.1	8.2	8.3
	2	8.2	8.3	8.3	8.3	0.1	8.2	8.3
	3	8.2	8.4	8.3	8.3	0.1	8.2	8.4
	4	8.2	8.4	8.5	8.4	0.2	8.2	8.5
	5	8.2	8.4	8.6	8.4	0.2	8.2	8.6
	6	8.2	8.4	8.6	8.4	0.2	8.2	8.6
	7	8.2	8.4	8.6	8.4	0.2	8.2	8.6
	8	8.2	8.3	8.7	8.4	0.3	8.2	8.7
	9	8.2	8.3	8.7	8.4	0.3	8.2	8.7
	10	8.2	8.2	8.6	8.3	0.2	8.2	8.6
	11	8.2	8.3	8.7	8.4	0.3	8.2	8.7
Cond. (uS/cm)	C	300		314	307	9.9	300	314
	1	308			308		308	308
	2	309			309		309	309
	3	312			312		312	312
	4	315			315		315	315
	5	321			321		321	321
	6	333			333		333	333
	7	350			350		350	350
	8	384			384		384	384
	9	443			443		443	443
	10	530			530		530	530
	11	691		722	707	21.9	691	722
Replicate measured		Flask	S	D				
Initials		LT	LT	AK				
		TRC (mg/l) in highest conc. at end of test:		N/A				
Changes & Notes (Initials, date, specific change or notes)								

Test chamber:	30 ml plastic cup:	☑	
	Other:		
Test solution vol. (15 ml min):	15 ml:	☑	
	Other (ml):		
Illumination & photoperiod:	50-100 ft-c 16L:8D	Template Number:	15
Number of replicates/treatment:		4	
Initial number animals/replicate:		5	
Test Aerated?		N/A	Date & Time Air Start: N/A

TEST ID	TRT ID:	1	2	3	4	5	6	7	8	9	10
AWSL2115ACD	CONC(%):	0.6	1.0	1.7	2.8	4.7	7.8	13	22	36	60

Acute Ceriodaphnia Test-48 Hr Survival

Start Date:		Test ID:	AWSL2115CD	Sample ID:	
End Date:		Lab ID:	CBI	Sample Type:	
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	CD-Ceriodaphnia dubia
Comments:	DATA ENTERED BY PB				

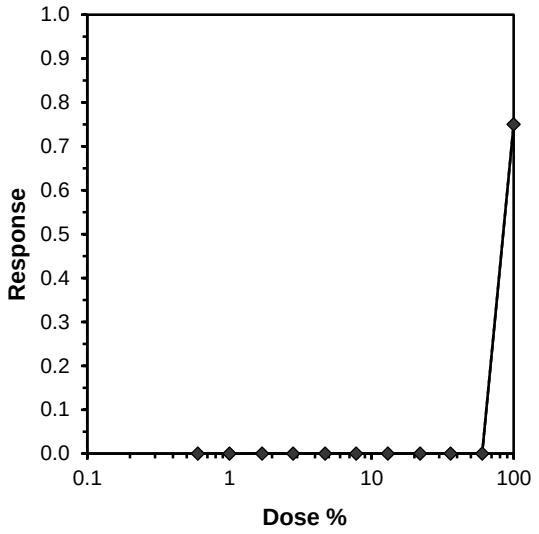
Conc-%	1	2	3	4
CONTROL	1.0000	1.0000	1.0000	1.0000
0.6	1.0000	1.0000	1.0000	1.0000
1	1.0000	1.0000	1.0000	1.0000
1.7	1.0000	1.0000	1.0000	1.0000
2.8	1.0000	1.0000	1.0000	1.0000
4.7	1.0000	1.0000	1.0000	1.0000
7.8	1.0000	1.0000	1.0000	1.0000
13	1.0000	1.0000	1.0000	1.0000
22	1.0000	1.0000	1.0000	1.0000
36	1.0000	1.0000	1.0000	1.0000
60	1.0000	1.0000	1.0000	1.0000
100	0.2000	0.4000	0.4000	0.0000

			Transform: Arcsin Square Root					Number	Total
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
CONTROL	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	0	20
0.6	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	0	20
1	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	0	20
1.7	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	0	20
2.8	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	0	20
4.7	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	0	20
7.8	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	0	20
13	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	0	20
22	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	0	20
36	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	0	20
60	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	0	20
100	0.2500	0.2500	0.5146	0.2255	0.6847	42.578	4	15	20

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.37224	0.929	-1.89291	19.1091
Equality of variance cannot be confirmed				

Trimmed Spearman-Karber

Trim Level	EC50	95% CL	
0.0%			
5.0%			
10.0%			
20.0%			
Auto-25.0%		77.244	92.095



P. promelas daily biological measurements (EPA 2000.0) Template version APP-STAT-48h-11trt-061113

TRTMNT (%Effl)	Rep	#Live Day 0	#Live Day 1	#Live Day 2	Final Mean % Live		
C	A	10	10	10	100.0		
Lab Control	B	10	10	10			
#1	A	10	10	10	100.0		
0.6	B	10	10	10			
# 2	A	10	10	10	100.0		
1.0	B	10	10	10			
# 3	A	10	10	10	100.0		
1.7	B	10	10	10			
# 4	A	10	10	10	100.0		
2.8	B	10	10	10			
# 5	A	10	10	10	100.0		
4.7	B	10	10	10			
# 6	A	10	10	10	100.0		
7.8	B	10	10	10			
# 7	A	10	10	10	100.0		
13	B	10	10	10			
# 8	A	10	10	10	85.0		
22	B	10	10	7			
# 9	A	10	10	1	15.0		
36	B	10	10	2			
# 10	A	10	1	0	0.0		
60	B	10	1	0			
# 11	A	10	0	0	0.0	Test Duration:	48h 27m
100	B	10	0	0			TAC 48+/-0.5h
	INITIALS:	LT	LT	AK	% CONTROL SURVIVAL:		100.0
	DATE & TIME:	12/9/21 11:46	12/10/21 7:55	12/11/21 12:13			TAC = 90%
CHANGES & NOTES (INITIALS, DATE, SPECIFIC CHANGE MADE		TOXCALC TO BE PERFORMED WITH PERMIT-SPECIFIC DILUTIONS					

	SPECIES:	Pimephales promelas	
	ACCLIMATION WATER:	Mod. Hard Synthetic Freshwater	
	FEEDING PRIOR TO TEST:	Artemia nauplii ad libitum	
	FEEDING DURING TEST:	None	
	SOURCE:	CBI Stock cultures	
	ACCLIMATION TEMP (o C):	25	
	HATCH START DATE & TIME:	12/2/21 17:00	
	HATCH END DATE & TIME:	12/3/21 10:00	
	DATE/TIME WATER ADDED:	12/9/21 11:17	
	DATE/TIME ANIMALS ADDED:	12/9/21 11:46	
	ANIMAL AGE WINDOW:	17h 0m	TAC Max. 24 h
	MAX AGE AT TEST START:	7d	TAC Max. 14 d
	TEST SET UP BY:	LT	
	SAMPLE COLLECTION DATE & TIME:	12/7/21 23:59 SAMPLE USED	A
TEST ID:	SAMPLE AGE AT TEST START:	35h 47m TAC MAX 36 h	
AWSL2115APP	PEER REVIEW BY (INITIALS/DATE):	PB	12/13/21 11:23

P. promelas daily water quality bench sheet (EPA METHOD 2002.0) Template version APP-STAT-48h-11trt-06113

	TRTMNT	Day 0 Initial	Day 1	Day 2 Final	SUMMARY WATER QUALITY DATA MEAN	S.D.	MIN.	MAX.
pH (S.U.)	C	8.00	7.60	8.08	7.89	0.26	7.60	8.08
	1	8.00	7.65	8.07	7.91	0.23	7.65	8.07
	2	8.02	7.65	8.06	7.91	0.23	7.65	8.06
	3	8.11	7.65	8.05	7.94	0.25	7.65	8.11
	4	8.15	7.65	8.03	7.94	0.26	7.65	8.15
	5	8.20	7.68	8.04	7.97	0.27	7.68	8.20
	6	8.20	7.77	8.06	8.01	0.22	7.77	8.20
	7	8.21	7.81	8.07	8.03	0.20	7.81	8.21
	8	8.24	7.79	8.09	8.04	0.23	7.79	8.24
	9	8.25	7.80	8.17	8.07	0.24	7.80	8.25
	10	8.25	7.85	8.32	8.14	0.25	7.85	8.32
	11	8.25	7.86		8.06	0.28	7.86	8.25
Temp. (o C)	C	25	25	25	25	0	25	25
	1	25	25	25	25	0	25	25
	2	25	25	25	25	0	25	25
	3	25	25	25	25	0	25	25
	4	25	25	25	25	0	25	25
	5	25	25	25	25	0	25	25
	6	25	25	25	25	0	25	25
	7	25	25	25	25	0	25	25
	8	25	25	25	25	0	25	25
	9	25	25	25	25	0	25	25
	10	25	25	25	25	0	25	25
	11	25	25		25	0	25	25
Diss. Oxygen (mg/l)	C	8.2	8.0	7.9	8.0	0.2	7.9	8.2
	1	8.2	8.0	7.9	8.0	0.2	7.9	8.2
	2	8.2	7.5	7.5	7.7	0.4	7.5	8.2
	3	8.2	7.2	7.5	7.6	0.5	7.2	8.2
	4	8.2	7.1	7.60	7.6	0.6	7.1	8.2
	5	8.2	7.1	7.50	7.6	0.6	7.1	8.2
	6	8.2	7.2	7.5	7.6	0.5	7.2	8.2
	7	8.2	7.2	6.7	7.4	0.8	6.7	8.2
	8	8.2	7.1	6.6	7.3	0.8	6.6	8.2
	9	8.2	6.5	5.4	6.7	1.4	5.4	8.2
	10	8.2	6.3	4.5	6.3	1.9	4.5	8.2
	11	8.2	4.8		6.5	2.4	4.8	8.2
Cond. (uS/cm)	C	300		345	323	31.8	300	345
	1	308			308		308	308
	2	309			309		309	309
	3	312			312		312	312
	4	315			315		315	315
	5	321			321		321	321
	6	333			333		333	333
	7	350			350		350	350
	8	384			384		384	384
	9	443			443		443	443
	10	530		543	537	9.2	530	543
	11	691			691		691	691
Replicate measured		B		A				
Initials		LT		AK				
		TRC (mg/l) in highest conc. at end of test:		N/A				
Changes & Notes (Initials, date, specific change or notes)								

Test chamber:	500 ml plastic:	✓	
	Other:		
Test solution vol. (200 ml min):	400 ml:	✓	
	Other (ml):		
Illumination & photoperiod:	50-100 ft-c 16L:8D		
Number of replicates/treatment:	2	Date & Time Air Start:	
Initial number animals/replicate:	10	D.O. Highest conc. @ aeration:	
Test Aerated?	No	Total live highest conc.@ aeration	

TEST ID	TRT ID:	1	2	3	4	5	6	7	8	9	10
AWSL2115APP	CONC (%):	0.6	1.0	1.7	2.8	4.7	7.8	13	22	36	60

Acute Fish Test-48 Hr Survival

Start Date:		Test ID:	AWSL2115PP	Sample ID:	
End Date:		Lab ID:	CBI	Sample Type:	
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	PP-Pimephales promelas
Comments:	DATA ENTERED BY PB				

Conc-%	1	2
CONTROL	1.0000	1.0000
0.6	1.0000	1.0000
1	1.0000	1.0000
1.7	1.0000	1.0000
2.8	1.0000	1.0000
4.7	1.0000	1.0000
7.8	1.0000	1.0000
13	1.0000	1.0000
22	1.0000	0.7000
36	0.1000	0.2000
60	0.0000	0.0000
100	0.0000	0.0000

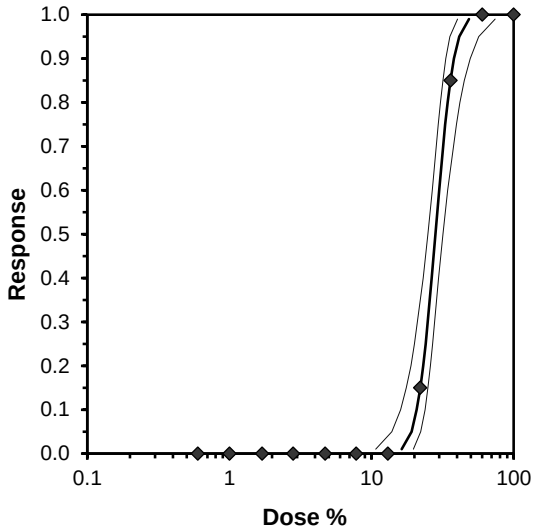
			Transform: Arcsin Square Root					Number	Total
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
CONTROL	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	2	0	20
0.6	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	2	0	20
1	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	2	0	20
1.7	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	2	0	20
2.8	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	2	0	20
4.7	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	2	0	20
7.8	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	2	0	20
13	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	2	0	20
22	0.8500	0.8500	1.2016	0.9912	1.4120	24.767	2	3	20
36	0.1500	0.1500	0.3927	0.3218	0.4636	25.550	2	17	20
60	0.0000	0.0000	0.1588	0.1588	0.1588	0.000	2	20	20
100	0.0000	0.0000	0.1588	0.1588	0.1588	0.000	2	20	20

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Normality of the data set cannot be confirmed				
Equality of variance cannot be confirmed				

Maximum Likelihood-Probit

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	9.82533	2.11669	5.67662	13.974	0	0.02569	16.919	1	1.44931	0.10178	3
Intercept	-9.23998	3.07823	-15.2733	-3.20665							
TSCR											

Point	Probits	%	95% Fiducial Limits	
EC01	2.674	16.3133	10.6678	19.6817
EC05	3.355	19.1383	13.9363	22.2233
EC10	3.718	20.8391	16.0229	23.78
EC15	3.964	22.0713	17.5689	24.942
EC20	4.158	23.1023	18.8711	25.9501
EC25	4.326	24.0251	20.0326	26.8906
EC40	4.747	26.5172	23.0668	29.6945
EC50	5.000		24.8916	31.7959
EC60	5.253	29.8606	26.6602	34.302
EC75	5.674	32.9581	29.4502	39.484
EC80	5.842	34.2746	30.5205	41.9103
EC85	6.036	35.8756	31.7567	45.0128
EC90	6.282	37.9968	33.311	49.352
EC95	6.645	41.3736	35.6471	56.737
EC99	7.326	48.5382	40.2534	74.1157



Effluent and Dilution Water Log (Freshwater Tests). FWEFFL061013

											SUMMARY WATER QUALITY DATA				
Initial sample charac-terization	Bottle(1):	A1									MEAN	S.D.	MIN.	MAX.	PARAMETER
	Arrival Temp. (oC, from CoC):	1									1		1	1	Arrival Temp.
	TRC (mg/l)(2):	<DL													
	TRC Corrected(2):														
	Hardness (mg/l):	128									128		128	128	Hardness (mg/l)
	Alkalinity (mg/l):	245									245		245	245	Alkalinity (mg/l)
	NH3-N (mg/l):	<1.0													
	Color/Appearance(3):	C													
	Obvious odor?	NO													
	Date & Time:	12/9/21 10:45													
	Initials:	LT													
Sample prep measure-ments	Test Day:	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7		MEAN	S.D.	MIN.	MAX.	
	Bottle(s):	A1-1													
	Prep. Temp. (oC):	25									25		25	25	Temp. (oC)
	D.O. (mg/l) After Warming:	8.2													
	Aeration Time (min):	0													
	Adjusted D.O. (mg/l):	8.2									8.2		8.2	8.2	D.O. (mg/l)
	Final pH (S.U.):	7.84									7.84		7.84	7.84	pH (S.U.)
	Conductivity (uS/cm)(4):	690									690		690	690	Cond. (uS/cm)
	Final TRC (mg/l)(5):	N.D.													
	Sample Filtered (60 um)?														
	Date & Time:	12/9/21 11:12													
	Initials:	LT													
Dilution water	Test Day:	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7		MEAN	S.D.	MIN.	MAX.	
	Vat Number:	2													
	Temperature (oC):	25									25		25	25	Temp. (oC)
	Conductivity (uS/cm):	304									304		304	304	Cond. (uS/cm)
	D.O. (mg/l):	8.2									8.2		8.2	8.2	D.O. (mg/l)
	pH (S.U.):	7.70									7.70		7.70	7.70	pH (S.U.)
	Hardness (mg/l):	86									86		86	86	Hardness (mg/l)
	Alkalinity (mg/l):	61									61		61	61	Alkalinity (mg/l)
	Date & Time:	12/9/21 8:00													
	Initials:	LT													
	Changes & Notes (Initials, date, specific change or notes)														
	Peer review Initial/Date:	PB	12/15/21 9:33	DILUTION WATER TYPE:	Mod. Hard Synthetic Freshwater (EPA)	ND=Not Determined/Measured, NA=Not Applicable. 1) Ninth character of lab sample ID on chain of custody AND bottle number in collection series. Together with Project ID constitutes entire sample bottle ID. 2) TRC MDL 0.02 mg/l; QL 0.22 mg/l. Corrected value if Mn, Cr potential positive interference. Corrected using KI and NaAsO2. 3) C-clear, O-opaque, T-turbid, S-solids (Sl-slight, M-moderate, H-heavy), Y-yellow, B-brown, Bl-black, G-green, P-pink, Gr-grey, Or-orange. 4) Measured on first use of sample only. 5) Final TRC measured only if chlorine present in initial characterization.												
PROJECT ID:	AWSL2115	ADDITIONAL EFFLUENT TREATMENT:													

ENTHALPY ANALYTICAL
formerly *Air, Water & Soil Laboratories*

Coastal Bioanalysts
6400 Enterprise Ct
Gloucester, VA 23061

AWSL 21IS-A
21-1931

1941 REYMET ROAD
RICHMOND, VIRGINIA 23237
(804) 358-8295 PHONE
(804)358-8297 FAX

Chain of Custody
Form #: D1331
Rev. 1.0
Effective: Feb 14, 2014

CHAIN OF CUSTODY

COMPANY NAME: Air, Water & Soil Labs, INC	INVOICE TO: AWS LABS	PROJECT NAME/Quote #: 21L0453
CONTACT: Sarah Endsley	INVOICE CONTACT: RIC-env@enthalpy.com	SITE NAME: 21L0453
ADDRESS:1941 Reymet Rd, Richmond, VA 23237	INVOICE ADDRESS:	PROJECT NUMBER: 21L0453
PHONE #: 804-358-8295	INVOICE PHONE #:	P.O. #:
FAX #:804-358-8297	EMAIL: support@awslabs.com	Pretreatment Program:
Is sample for compliance reporting? YES NO	Is sample from a chlorinated supply? YES NO	PWS I.D. #:
SAMPLER NAME (PRINT):	SAMPLER SIGNATURE:	**Turn Around Time: TBD Days**

Matrix Codes: WW=Waste Water/Storm Water GW=Ground Water DW=Drinking Water S=Soil/Solids OR=Organic A=Air WP=Wipe OT=Other_____

CLIENT SAMPLE I.D.	Grab	Composite	Field Filtered (Dissolved Metals)	Composite Start Date	Composite Start Time	Grab Date or Composite Stop Date	Grab Time or Composite Stop Time	Time Preserved	Matrix (See Codes)	Number of Containers	ANALYSIS / (PRESERVATIVE): Contact JPUBERNUL							
1) 21L0453-01: CLE		X		12.7.21	00.00	12.7.21	2359		WW	1	X							
2)																		
3)																		
4)																		
5)																		
6)																		
7)																		
8)																		
9)																		
10)																		

21L0453-01 A Due: 01/21/2022 18:00
Non-Potable Water-Cubitainer
BAE Systems, Collected: 12/07/2021 23:59
CLE

COMMENTS

Preservative Codes: N=Nitric Acid C=Hydrochloric Acid S=Sulfuric Acid H=Sodium Hydroxide A=Ascorbic Acid Z=Zinc Acetate T=Sodium Thiosulfate M=Methanol

FOR NG/NCDP TOXICITY INVESTIGATION SEE PETE DELISLE

PLEASE NOTE PRESERVATIVE(S), INTERFERENCE CHECKS or PUMP RATE (L/min)

RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME
[signature]	12/8/21 1450	[signature]	12/8/21 1423
RELINQUISHED:	DATE / TIME	RECEIVED: L. Thomas	DATE / TIME 12/9/21 0840
RELINQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME

QC Data Package
Level I ☐
Level II ☐
Level III ☐
Level IV ☐

LAB USE ONLY TV-LT

COOLER TEMP ____ °C

10 of 10

Coastal Bioanalysts - BAE

Client: Enthalpy Analytical/Air, Water and Soil Laboratories
Project ID: AWSL2115
Client Sample ID: BAE-Radford Army Ammunition Plant 21L0453-01A
Permit No.: VA0000248 CLE (029)
Sample Period: 12/7/21

Coastal Bioanalysts, Inc.

Report of Analysis: Nitroglycerin and nitroglycerin degradation products (subcontracted)

Submitted To:	**Prepared By:**
JP Verheul Business Development Manager / Senior Chemist Enthalpy Analytical/Air, Water and Soil Laboratories 1941 Reymet Road, Richmond, VA 23237	Coastal Bioanalysts, Inc. 6400 Enterprise Court Gloucester, VA 23061 (804) 694-8285 www.coastalbio.com Contact: Peter F. De Lisle, Technical Director

Please see attached results from National Institute for Scientific Research (INRS), Quebec, Canada.

The results of analysis contained within this report relate only to the sample as received in the laboratory. This report shall not be reproduced except in full without written approval from the laboratory. These test results do not meet requirements of NELAP.

APPROVED: Peter F. De Lisle

Digitally signed by Peter F. De Lisle
DN: cn=Peter F. De Lisle, o=Coastal Bioanalysts, Inc., ou=Toxicology, email=pfd@coastalbio.com, c=US
Date: 2022.03.10 11:06:34 -05'00'

Peter F. De Lisle, Ph.D.
Technical Director

Please leave feedback regarding our services at: http://coastalbio.com/survey

VELAP# 460030
EPA# VA01116

Reception Date		Tuesday, December 21, 2021
Analysis date	Mononitroglyerin	Wednesday, December 22, 2021
	Dinitro- and Nitroglycerin	Thursday, December 23, 2021

Results for aqueous analysis of Nitroglycerin and degradations products

Target analyte	Units	21L0453-01 B	21L0453-01 C	21L0453-01 D
1-Mononitroglycerin	mg/L	0.98	0.98	0.99
2-Mononitroglycerin	mg/L	1.15	1.15	1.16
1,2-Dinitroglycerin	mg/L	7.4	7.4	7.4
1,3-Dinitroglycerin	mg/L	3.8	3.8	3.8
Nitroglycerin	mg/L	22	22	22

Type of QC	Analyte	Value	Units
Blank	1-Mononitroglycerin	< 0.04	mg/L
	2-Mononitroglycerin	< 0.04	mg/L
	1,2-Dinitroglycerin	< 0.09	mg/L
	1,3-Dinitroglycerin	< 0.09	mg/L
	Nitroglycerin	< 0.8	mg/L
Spiked Blank	1-Mononitroglycerin	98	Recovery %
	2-Mononitroglycerin	103	Recovery %
	1,2-Dinitroglycerin	100	Recovery %
	1,3-Dinitroglycerin	100	Recovery %
	Nitroglycerin	104	Recovery %
Spiked sample (21L0453-01 B)	1-Mononitroglycerin	97	Recovery %
	2-Mononitroglycerin	97	Recovery %
	1,2-Dinitroglycerin	107	Recovery %
	1,3-Dinitroglycerin	105	Recovery %
	Nitroglycerin	97	Recovery %