



Tennessee Valley Authority, Post Office Box 2000, Soddy Daisy, Tennessee 37384-2000

October 10, 2016

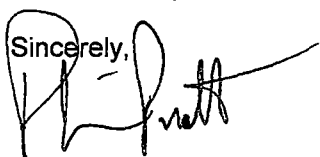
Ms. Angela Hall  
Tennessee Department of Environment  
and Conservation  
Division of Water Resources  
William R. Snodgrass Tennessee Tower  
312 Rosa L. Parks Avenue, 11th Floor  
Nashville, Tennessee 37243

Dear Ms. Hall:

TENNESSEE VALLEY AUTHORITY (TVA) - SEQUOYAH NUCLEAR PLANT (SQN) - NPDES  
PERMIT NO. TN0026450 - DISCHARGE MONITORING REPORT (DMR) FOR September 2016

Enclosed is the September 2016 Discharge Monitoring Report for Sequoyah Nuclear Plant. There were no exceedances during the reporting period. The Toxicity Report for sampling conducted July 31 - August 5 is enclosed. If you have any questions or need additional information, please contact Millicent Garland by email at [mrmoore@tva.gov](mailto:mrmoore@tva.gov) or by phone at (423) 843-6714.

*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.*

Sincerely,  


Preston P. Pratt  
(Acting) Site Vice President  
Sequoyah Nuclear Plant

Enclosures

cc (Enclosures):

Chattanooga Environmental Field Office  
Division of Water Pollution Control  
State Office Building, Suite 550  
540 McCallie Avenue  
Chattanooga, Tennessee 37402-2013

U.S. Nuclear Regulatory Commission  
Attn: Document Control Desk  
Washington, DC 20555

IE25  
NRR

PERMITTEE NAME/ADDRESS (Include Facility Name/Location if Different)

Name **TVA - SEQUOYAH NUCLEAR PLANT**  
 Address **P.O. BOX 2000**  
**(INTEROFFICE OPS-5N-SQN)**  
**SODDY - DAISY, TN 37384**  
 Facility **TVA - SEQUOYAH NUCLEAR PLANT**  
 Location **HAMILTON COUNTY**

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)  
 DISCHARGE MONITORING REPORT (DMR)

MAJOR  
 (SUBR 01)  
 F - FINAL  
 DIFFUSER DISCHARGE  
 EFFLUENT

Form Approved.  
 OMB No. 2040-0004

TN0026450 101 G  
 PERMIT NUMBER DISCHARGE NUMBER

MONITORING PERIOD  
 From 16 09 01 To 16 09 30

\*\*\* NO DISCHARGE ☐ \*\*\*

NOTE: Read instructions before completing this form.

PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
TEMPERATURE, WATER DEG. CENTIGRADE	SAMPLE MEASUREMENT	*****	*****	**	*****	*****	37.4	04	0	30 / 30	RCORDR
00010 1 0	PERMIT REQUIREMENT	*****	*****	***	*****	*****	Req. Mon. DAILY MAX	DEG. C.		CONTI NUOUS	CALCTD
EFFLUENT GROSS											
TEMPERATURE, WATER DEG. CENTIGRADE	SAMPLE MEASUREMENT	*****	*****	**	*****	*****	29.4	04	0	30 / 30	MODEL D
00010 Z 0	PERMIT REQUIREMENT	*****	*****	***	*****	*****	30.5 DAILY MX	DEG. C.		CONTI NUOUS	CALCTD
INSTREAM MONITORING											
TEMP. DIFF. BETWEEN SAMP. & UPSTRM DEG.C	SAMPLE MEASUREMENT	*****	*****	**	*****	*****	2.1	04	0	30 / 30	CALCTD
00016 1 S	PERMIT REQUIREMENT	*****	*****	***	*****	*****	3.0 DAILY MX	DEG. C.		CONTI NUOUS	CALCTD
EFFLUENT GROSS											
FLOW, IN CONDUIT OR THRU TREATMENT PLANT	SAMPLE MEASUREMENT	*****	1817	03	*****	*****	*****	**	0	30 / 30	RCORDR
50050 1 0	PERMIT REQUIREMENT	*****	Req. Mon. DAILY MAX	MGD	*****	*****	*****	***		CONTI NUOUS	RCORDR
EFFLUENT GROSS											
FLOW, IN CONDUIT OR THRU TREATMENT PLANT	SAMPLE MEASUREMENT	1807	*****	03	*****	*****	*****	03	0	30 / 30	CALCTD
50050 1 0	PERMIT REQUIREMENT	Req. Mon. MO AVG	*****	MGD	*****	*****	*****	MGD		CONTI NUOUS	CALCTD
EFFLUENT GROSS VALUE											
CHLORINE, TOTAL RESIDUAL	SAMPLE MEASUREMENT	*****	*****	**	*****	0.019	0.038	19	0	22 / 30	GRAB
50060 1 0	PERMIT REQUIREMENT	*****	*****	***	*****	0.1 MO AVG	0.1 DAILY MAX	MG/L		FIVE PER WEEK	CALCTD
EFFLUENT GROSS VALUE											
TEMPERATURE - C, RATE OF CHANGE	SAMPLE MEASUREMENT	*****	0.1	62	*****	*****	*****	**	0	30 / 30	CALCTD
82234 1 0	PERMIT REQUIREMENT	*****	2.0 DAILY MX	DEG C/HR	*****	*****	*****	***		CONTI NUOUS	CALCTD
EFFLUENT GROSS											

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER  Preston P. Pratt  (Acting) Site Vice President  TYPED OR PRINTED	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.	TELEPHONE		DATE		
		423	843-7001	16	10	05
		AREA CODE	NUMBER	YEAR	MO	DAY

(Acting) Site Vice President  
 SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)

No closed mode operation. The following injections occurred: Flogard MS 6236 (max calc. was 0.03 mg/L, limit was 0.20 mg/L), Spectrus BD 1500 (max calc. was 0.015 mg/L, limit was 2.0 mg/L).



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 Facility **TVA - SEQUOYAH NUCLEAR PLANT**  
 Location **HAMILTON COUNTY**

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)  
 DISCHARGE MONITORING REPORT (DMR)

MAJOR  
 (SUBR 01)

Form Approved.  
 OMB No. 2040-0004

TN0026450 101 T  
 PERMIT NUMBER DISCHARGE NUMBER

F - FINAL  
 BIOMONITORING FOR OUTFALL 101

MONITORING PERIOD  
 YEAR MO DAY YEAR MO DAY  
 From 16 09 01 To 16 09 30

EFFLUENT

\*\*\* NO DISCHARGE ☐ \*\*\*

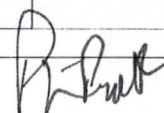
NOTE: Read instructions before completing this form.

ATTN:Millicent Garland

PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
IC25 STATRE 7DAY CHR CERIODAPHNIA	SAMPLE MEASUREMENT	*****	*****	**	Monitoring Not Required	*****	*****	23			
TRP3B 1 0	PERMIT REQUIREMENT	*****	*****	****	42.8 MINIMUM	*****	*****	PERCENT		SEMI ANNUAL	COMPOS
IC25 STATRE 7DAY CHR PIMEPHALES	SAMPLE MEASUREMENT	*****	*****	**	Monitoring Not Required	*****	*****	23			
TRP6C 1 0	PERMIT REQUIREMENT	*****	*****	****	42.8 MINIMUM	*****	*****	PERCENT		SEMI ANNUAL	COMPOS
EFFLUENT GROSS	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER

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(Acting) Site Vice President

SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE

DATE

423 843-7001 16 10 05  
 AREA CODE NUMBER YEAR MO DAY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)

Toxicity was not sampled in September 2016.



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NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)  
 DISCHARGE MONITORING REPORT (DMR)

MAJOR

(SUBR 01)

F - FINAL

LOW VOL. WASTE TREATMENT POND

EFFLUENT

Form Approved.

OMB No. 2040-0004

TN0026450

103 G

PERMIT NUMBER

DISCHARGE NUMBER

MONITORING PERIOD

From 

YEAR	MO	DAY
16	09	01

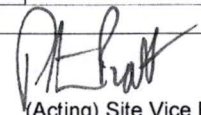
 To 

YEAR	MO	DAY
16	09	30

\*\*\* NO DISCHARGE ☐ \*\*\*

NOTE: Read instructions before completing this form.

PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
PH 00400 1 0 EFFLUENT GROSS	SAMPLE MEASUREMENT	*****	*****	**	7.7	*****	8.5	12	0	5 / 30	GRAB
	PERMIT REQUIREMENT	*****	*****	**	6.0 MINIMUM	*****	9.0 MAXIMUM	SU		ONCE/ WEEK	GRAB
SOLIDS, TOTAL SUSPENDED 00530 1 0 EFFLUENT GROSS	SAMPLE MEASUREMENT	*****	*****	**	*****	5.9	5.9	19	0	1 / 30	GRAB
	PERMIT REQUIREMENT	*****	*****	**	*****	30.0 MO AVG	100.0 DAILY MX	MG/L		ONCE/ MONTH	GRAB
OIL AND GREASE 00556 1 0 EFFLUENT GROSS	SAMPLE MEASUREMENT	*****	*****	**	*****	<5.0	<5.0	19	0	1 / 30	GRAB
	PERMIT REQUIREMENT	*****	*****	**	*****	15.0 MO AVG	20.0 DAILY MX	MG/L		ONCE/ MONTH	GRAB
FLOW, IN CONDUIT OR THRU TREATMENT PLANT 50050 1 0 EFFLUENT GROSS	SAMPLE MEASUREMENT	1.280	1.306	03	*****	*****	*****	**	0	5 / 30	INSTAN
	PERMIT REQUIREMENT	Req. Mon. MO AVG	Req. Mon DAILY MX	MGD	*****	*****	*****	**		ONCE/ WEEK	INSTAN
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER  Preston P. Pratt  (Acting) Site Vice President  TYPED OR PRINTED	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.	 (Acting) Site Vice President SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT	TELEPHONE		DATE		
			423	843-7001	16	10	05
			AREA CODE	NUMBER	YEAR	MO	DAY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)



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NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)  
 DISCHARGE MONITORING REPORT (DMR)

MAJOR

(SUBR 01)

F - FINAL

RECYCLED COOLING WATER

EFFLUENT

Form Approved.

OMB No. 2040-0004

**TN0026450**

**110 G**

PERMIT NUMBER

DISCHARGE NUMBER

MONITORING PERIOD

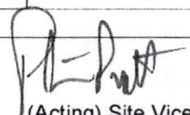
From **16 09 01** To **16 09 30**

\*\*\* NO DISCHARGE ☒ \*\*\*

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ATTN:Millicent Garland

PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
<b>TEMPERATURE, WATER DEG. CENTIGRADE</b>	SAMPLE MEASUREMENT	*****	*****	**	*****	*****		04			
00010 1 0	PERMIT REQUIREMENT	*****	*****	**	*****	*****	<b>REPORT DAILY MX</b>	DEG C		CONTINUOUS	CALCTD
<b>TEMPERATURE, WATER DEG. CENTIGRADE</b>	SAMPLE MEASUREMENT	*****	*****	**	*****	*****		04			
00010 Z 0	PERMIT REQUIREMENT	*****	*****	**	*****	*****	<b>30.5 DAILY MX</b>	DEG C		CONTINUOUS	CALCTD
<b>TEMP. DIFF. BETWEEN SAMP. &amp; UPSTRM DEG.C</b>	SAMPLE MEASUREMENT	*****	*****	**	*****	*****		04			
00016 1 0	PERMIT REQUIREMENT	*****	*****	**	*****	*****	<b>5 DAILY MX</b>	DEG C		CONTINUOUS	CALCTD
<b>FLOW, IN CONDUIT OR THRU TREATMENT PLANT</b>	SAMPLE MEASUREMENT	*****		03	*****	*****	*****	**			
50050 1 0	PERMIT REQUIREMENT	*****	<b>Req. Mon. DAILY MX</b>	MGD	*****	*****	*****	**		CONTINUOUS	RCORDR
<b>CHLORINE, TOTAL RESIDUAL</b>	SAMPLE MEASUREMENT	*****	*****	**	*****			19			
50060 1 0	PERMIT REQUIREMENT	*****	*****	**	*****	<b>0.1 MO AVG</b>	<b>0.1 DAILY MX</b>	MG/L		Five per Week	CALCTD
<b>TEMPERATURE - C, RATE OF CHANGE</b>	SAMPLE MEASUREMENT	*****		04	*****	*****	*****	**			
82234 1 0	PERMIT REQUIREMENT	*****	<b>2 DAILY MX</b>	DEG C	*****	*****	*****	**		CONTINUOUS	CALCTD
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

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Preston P. Pratt			423	843-7001	16	10	05
(Acting) Site Vice President			AREA CODE	NUMBER	YEAR	MO	DAY

TYPED OR PRINTED

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)

No Discharge this Period



PERMITTEE NAME/ADDRESS (Include Facility Name/Location if Different)

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NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)  
 DISCHARGE MONITORING REPORT (DMR)

MAJOR  
 (SUBR 01)

Form Approved.  
 OMB No. 2040-0004

**TN0026450** **110 T**  
**PERMIT NUMBER** **DISCHARGE NUMBER**

F - FINAL  
 RECYCLED COOLING WATER

EFFLUENT

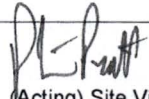
MONITORING PERIOD  
 YEAR MO DAY YEAR MO DAY  
 From **16 09 01** To **16 09 30**

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ATTN:Millicent Garland

PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
IC25 STATRE 7DAY CHR CERIODAPHNIA	SAMPLE MEASUREMENT	*****	*****	**		*****	*****	23			
TRP3B 1 0 0	PERMIT REQUIREMENT	*****	*****	****	42.8 MINIMUM	*****	*****	PERCENT		SEMI ANNUAL	COMPOS
IC25 STATRE 7DAY CHR PIMEPHALES	SAMPLE MEASUREMENT	*****	*****	**		*****	*****	23			
TRP6C 1 0 0	PERMIT REQUIREMENT	*****	*****	****	42.8 MINIMUM	*****	*****	PERCENT		SEMI ANNUAL	COMPOS
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
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	PERMIT REQUIREMENT										
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	PERMIT REQUIREMENT										

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			423	843-7001	16	10	05
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COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)

No Discharge this Period



PERMITTEE NAME/ADDRESS (Include Facility Name/Location if Different)

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NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)  
 DISCHARGE MONITORING REPORT (DMR)

MAJOR  
 (SUBR 01)

Form Approved.  
 OMB No. 2040-0004

**TN0026450** **118 G**  
 PERMIT NUMBER DISCHARGE NUMBER

F - FINAL  
 WASTEWATER & STORM WATER  
 EFFLUENT

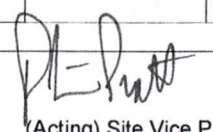
MONITORING PERIOD  
 YEAR MO DAY YEAR MO DAY  
 From **16 09 01** To **16 09 30**

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		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
OXYGEN, DISSOLVED (DO)  00300 1 0 EFFLUENT GROSS	SAMPLE MEASUREMENT	*****	*****	**		*****	*****	19			
	PERMIT REQUIREMENT	*****	*****	****	<b>2 MINIMUM</b>	*****	*****	MG/L		TWICE/ WEEK	GRAB
SOLIDS, TOTAL SUSPENDED  00530 1 0 EFFLUENT GROSS	SAMPLE MEASUREMENT	*****	*****	**	*****	*****		19			
	PERMIT REQUIREMENT	*****	*****	****	*****	*****	<b>100 DAILY MX</b>	MG/L		TWICE/ WEEK	GRAB
SOLIDS, SETTLEABLE  00545 1 0 EFFLUENT GROSS	SAMPLE MEASUREMENT	*****	*****	**	*****	*****		25			
	PERMIT REQUIREMENT	*****	*****	****	*****	*****	<b>1 DAILY MX</b>	ML/L		ONCE/ MONTH	GRAB
FLOW, IN CONDUIT OR THRU TREATMENT PLANT  50050 1 0 EFFLUENT GROSS	SAMPLE MEASUREMENT			03	*****	*****	*****	**			
	PERMIT REQUIREMENT	<b>Req. Mon. MO AVG</b>	<b>Req. Mon. DAILY MX</b>	MGD	*****	*****	*****	*		ONCE/ BATCH	ESTIMA
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

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			AREA CODE	NUMBER	YEAR	MO	DAY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)

During this reporting period, there has been no flow from the Dredge Pond other than that resulting from rainfall. No Discharge this Period

**TENNESSEE VALLEY AUTHORITY  
TOXICITY TEST REPORT**

**INTRODUCTION / EXECUTIVE SUMMARY**

Report Date: August 26, 2016

1. Facility / Discharger: Sequoyah Nuclear Plant / TVA
2. County / State: Hamilton / Tennessee
3. NPDES Permit #: TN0026450
4. Type of Facility: Nuclear-Fueled Electric Generating Plant
5. Design Flow (MGD): 1,579
6. Receiving Stream: Tennessee River (TRM 483.6)
7. 1Q10: 3,491
8. Outfall Tested: 101
9. Dates Sampled: July 31 – August 05, 2016
10. Average Flow on Days Sampled (MGD): 1791, 1797, 1793
11. Pertinent Site Conditions: Production / operation data will be provided upon request.
12. Test Dates: August 02 – 09, 2016
13. Test Type: Short-term Chronic Definitive
14. Test Species: Fathead Minnows (*Pimephales promelas*)  
Daphnids (*Ceriodaphnia dubia*)
15. Concentrations Tested (%):  
*Pimephales promelas*: UV treated Outfall 101: 10.7, 21.4, 42.8, 85.6, 100  
UV treated Intake: 100  
*Ceriodaphnia dubia*: Non-treated Outfall 101: 10.7, 21.4, 42.8, 85.6, 100  
Non-treated Intake: 100
16. Permit Limit Endpoint (%): Outfall 101: IC<sub>25</sub> = 42.8%
17. Test Results: Outfall 101: *Pimephales promelas*: IC<sub>25</sub> > 100%  
*Ceriodaphnia dubia*: IC<sub>25</sub> > 100%



18. Facility Contact: Millicent Garland Phone #: (423) 843-6714
19. Consulting / Testing Lab: Environmental Testing Solutions, Inc.
20. Lab Contact: Jim Sumner Phone #: (828) 350-9364
21. TVA Contact: Donald W. Snodgrass Phone #: (256) 386-2787
22. Notes: Exposures to samples collected July 31 – August 05, 2016 from Outfall 101 resulted in no toxic effects to fathead minnows or daphnids. The resulting IC25 values, for both species, were > 100 percent. Exposure of minnows and daphnids to intake samples resulted in no significant difference from the controls during this study period.

## METHODS SUMMARY

### Samples:

1. Sampling Point: Outfall 101, Intake
2. Sample Type: Composite
3. Sample Information:

Sample ID	Date (MM-DD-YY) Time (ET) Collected	Date (MM-DD-YY) Time (ET) Received	Arrival Temp. (°C)	Initial TRC* (mg/L)	Date (MM-DD-YY) Time (ET) Last Used By
101	07-31-16 0705 to 08-01-16 0605	08-01-16 1307	1.2, 0.8 <sup>†</sup>	<0.10	08-02-16 0927 08-03-16 0857
Intake	07-31-16 0720 to 08-01-16 0620	08-01-16 1307	0.2	<0.10	08-02-16 0927 08-03-16 0857
101	08-02-16 0705 to 08-03-16 0605	08-03-16 1220	1.2, 1.4 <sup>†</sup>	<0.10	08-04-16 0906 08-05-16 0907
Intake	08-02-16 0715 to 08-03-16 0615	08-03-16 1220	1.4	<0.10	08-04-16 0906 08-05-16 0907
101	08-04-16 0710 to 08-05-16 0610	08-05-16 1235	0.5, 0.7 <sup>†</sup>	<0.10	08-06-16 0939 08-07-16 0935 08-08-16 0853
Intake	08-04-16 0725 to 08-05-16 0625	08-05-16 1235	0.6	<0.10	08-06-16 0939 08-07-16 0935 08-08-16 0853

\*TRC = Total Residual Chlorine

<sup>†</sup>Samples were collected in two 2.5 gallon cubitainers. Temperature was measured in each cubitainer upon arrival.

4. Sample Manipulation: Samples from Outfall 101 and intake were warmed to test temperature (25.0 ± 1.0°C) in a warm water bath.

Aliquots of Outfall 101 and Intake samples were UV-treated through a 40-watt Smart® UV Sterilizer (manufactured by Emperor Aquatics, Inc.) for 2 minutes.



*Pimephales promelas*

*Ceriodaphnia dubia*

Test Organisms:

- |            |                          |                          |
|------------|--------------------------|--------------------------|
| 1. Source: | <u>In-house Cultures</u> | <u>In-house Cultures</u> |
| 2. Age:    | <u>&lt; 24-hours old</u> | <u>&lt; 24-hours old</u> |

Test Method Summary:

- |                                      |   |  |
|--------------------------------------|---|--|
| 1. Test Conditions:                  | <u>Static, Renewal</u>  | <u>Static, Renewal</u>                                     |
| 2. Test Duration:                    | <u>7 days</u>   | <u>Until at least 60% of control females have 3 broods</u> |
| 3. Control / Dilution Water:         | <u>Moderately Hard Synthetic</u>  | <u>Moderately Hard Synthetic</u>                           |
| 4. Number of Replicates:             | <u>4</u>  | <u>10</u>  |
| 5. Organisms per Replicate:          | <u>10</u>   | <u>1</u>   |
| 6. Test Initiation: (Date/Time):     | <u>08-02-16 0855 ET</u>   | <u>08-02-16 0927 ET</u>                                    |
| 7. Test Termination: (Date/Time):    | <u>08-09-16 0848 ET</u>   | <u>08-09-16 0831 ET</u>                                    |
| 8. Test Temperature: Outfall 101:    | <u>Mean = 24.7°C</u><br><u>(24.2 – 25.1°C)</u>  | <u>Mean = 24.8°C</u><br><u>(24.6 – 25.2°C)</u>             |
| 9. Physical / Chemical Measurements: | <u>Alkalinity, hardness, total residual chlorine, and conductivity were measured at the laboratory in each 100% sample. Daily temperatures were measured in one replicate for each test concentration. Pre- and post-exposure test solutions were analyzed daily for pH and dissolved oxygen.</u> |  |
| 10. Statistics:                      | <u>Statistics were performed according to methods prescribed by EPA using ToxCalc version 5.0 statistical software (Tidepool Scientific Software, McKinneyville, CA).</u>   |  |

**TOXICITY TEST RESULTS** (see Appendix C for Bench Sheets)

1. Results of a *Pimephales promelas* Chronic/ 7-day Toxicity Test.  
(Genus species) (Type / Duration)

Conducted August 02 – 09, 2016 using effluent from Outfall 101.

Test Solutions (% Effluent)	Percent Surviving (time interval used – days)						
	1	2	3	4	5	6	7
Control, UV-treated	100	100	100	100	100	100	100
10.7%	100	100	100	100	100	100	100
21.4%	100	100	100	100	100	100	100
42.8%	100	100	100	100	100	100	100
85.6%	100	100	100	98	98	98	98
100.0%	100	100	100	98	98	98	98
Intake	100	100	100	100	100	100	98
Control, Non-treated	100	100	100	100	100	100	100

Test Solutions (% Effluent)	Mean Dry Weight (mg) (replicate number)				
	1	2	3	4	Mean
Control, UV-treated	0.565	0.482	0.548	0.478	0.518
10.7%	0.488	0.461	0.516	0.549	0.504
21.4%	0.527	0.465	0.430	0.449	0.468
42.8%	0.481	0.509	0.537	0.528	0.514
85.6%	0.470	0.499	0.431	0.449	0.462
100.0%	0.466	0.502	0.534	0.501	0.501
Intake	0.479	0.511	0.495	0.460	0.486
Control, Non-treated	0.587	0.555	0.525	0.423	0.523

IC<sub>25</sub> Value: > 100%  
Permit Limit: 42.8%

95% Confidence Limits:  
Upper Limit: NA  
Lower Limit: NA

Calculated TU Estimates: < 1.0 TUc\*

Permit Limit: 2.3 TUc

\*TUa = 100/LC<sub>50</sub>; TUc = 100/ IC<sub>25</sub>



TOXICITY TEST RESULTS (see Appendix C for Bench Sheets)

2. Results of a *Ceriodaphnia dubia* Chronic/ 7-day Toxicity Test.  
(Genus species) (Type / Duration)

Conducted August 02 – 09, 2016 using effluent from Outfall 101.

Test Solutions (% Effluent)	Percent Surviving (time interval used – days)						
	1	2	3	4	5	6	7
Control	100	100	100	100	100	100	100
10.7%	100	100	100	100	100	100	100
21.4%	100	100	100	100	100	100	100
42.8%	100	100	100	100	100	100	100
85.6%	100	100	100	100	100	100	100
100.0%	100	100	100	100	100	100	100

Test Solutions (% Effluent)	Reproduction (#young/female/7 days) Data (replicate number)										
	1	2	3	4	5	6	7	8	9	10	Mean
Control	31	31	31	34	32	30	31	28	29	29	30.6
10.7%	31	32	32	35	30	33	35	29	33	32	32.2
21.4%	31	32	32	34	32	36	30	31	34	31	32.3
42.8%	34	35	35	31	33	34	32	32	37	30	33.3
85.6%	32	32	34	36	34	36	30	34	30	33	33.1
100.0%	37	35	36	31	36	35	38	37	33	36	35.4
IC <sub>25</sub> Value: <u>&gt; 100%</u> Permit Limit: <u>42.8%</u>  95% Confidence Limits: Upper Limit: <u>NA</u> Lower Limit: <u>NA</u>						Calculated TU Estimates: <u>&lt; 1.0 TUc*</u>  Permit Limit: <u>2.3 TUc</u>					

\*TUa = 100/LC<sub>50</sub>; TUc = 100/ IC<sub>25</sub>

**TOXICITY TEST RESULTS** (see Appendix C for Bench Sheets)

2. Results of a *Ceriodaphnia dubia* Chronic/ 7-day Toxicity Test.  
(Genus species) (Type / Duration)

Conducted August 02 – 09, 2016 using water from Intake

Test Solutions (% Effluent)	Percent Surviving (time interval used – days)						
	1	2	3	4	5	6	7
Control	100	100	100	100	100	100	100
Intake	100	100	100	100	100	100	100

Test Solutions (% Effluent)	Reproduction (#young/female/7 days) Data (replicate number)										
	1	2	3	4	5	6	7	8	9	10	Mean
Control	29	33	31	29	31	28	32	31	31	30	30.5
Intake	35	33	35	32	37	38	32	36	33	34	34.5
IC <sub>25</sub> Value: <u>&gt; 100%</u> Permit Limit: <u>N/A</u>  95% Confidence Limits: Upper Limit: <u>NA</u> Lower Limit: <u>NA</u>						Calculated TU Estimates: <u>&lt; 1.0 TUc*</u>  Permit Limit: <u>N/A</u>					

\*TUa = 100/LC<sub>50</sub>; TUc = 100/ IC<sub>25</sub>

**REFERENCE TOXICANT TEST RESULTS** (see Appendix A and D)

Species	Date	Time	Duration	Toxicant	Results (IC <sub>25</sub> )
<i>Pimephales promelas</i>	August 02 – 09, 2016	0830	7-days	KCl	0.79 g/L
<i>Ceriodaphnia dubia</i>	August 02 – 09, 2016	0915	7-days	NaCl	1.07 g/L



**PHYSICAL/CHEMICAL SUMMARY**

Water Chemistry Mean Values and Ranges for UV-treated *Pimephales promelas* and Non-treated *Ceriodaphnia dubia*, Sequoyah Nuclear Plant (SQN), Effluent Outfall 101 and Intake performed August 02-09, 2016.

Test	Sample ID	Temperature (°C)		Dissolved Oxygen (mg/L)		pH (S.U.)		Conductance (µmhos/cm)	Alkalinity (mg/L CaCO <sub>3</sub> )	Hardness (mg/L CaCO <sub>3</sub> )	*Total Residual Chlorine (mg/L)
		Initial	Final	Initial	Final	Initial	Final				
<i>Pimephales promelas</i>	Control, Non-treated	24.7 24.6 - 24.8	24.5 24.3 - 25.0	7.8 7.7 - 7.8	7.6 6.4 - 7.9	7.89 7.73 - 8.09	7.81 7.51 - 8.06	319 308 - 330	60 59 - 62	91 88 - 96	- - -
	Control, UV-treated	24.7 24.6 - 24.8	24.5 24.4 - 24.7	7.8 7.8 - 8.0	7.4 5.5 - 7.9	7.93 7.82 - 8.02	7.78 7.48 - 7.89	312 301 - 322	59 58 - 59	89 88 - 90	- - -
	10.7%	24.8 24.7 - 24.9	24.5 24.2 - 24.7	7.8 7.8 - 7.9	7.4 5.5 - 7.9	7.94 7.83 - 8.04	7.75 7.49 - 7.86	304 294 - 311	- - -	- - -	- - -
	21.4%	24.8 24.7 - 25.0	24.5 24.2 - 24.7	7.8 7.8 - 8.0	7.4 5.4 - 7.9	7.95 7.84 - 8.04	7.76 7.50 - 7.85	293 285 - 300	- - -	- - -	- - -
	42.8%	24.8 24.7 - 25.0	24.5 24.3 - 24.7	8.0 7.9 - 8.2	7.4 5.5 - 7.9	7.95 7.85 - 8.03	7.76 7.51 - 7.86	271 265 - 277	- - -	- - -	- - -
	85.6%	24.8 24.7 - 25.0	24.5 24.4 - 24.7	8.0 7.9 - 8.2	7.5 5.5 - 8.0	7.97 7.86 - 8.04	7.77 7.52 - 7.89	226 223 - 233	- - -	- - -	- - -
	100%	24.9 24.8 - 25.1	24.4 24.2 - 24.7	8.0 7.9 - 8.2	7.5 5.5 - 8.0	7.99 7.88 - 8.08	7.77 7.54 - 7.89	209 205 - 215	76 74 - 78	83 82 - 86	<0.10 <0.10 - <0.10
	Intake	24.8 24.7 - 25.0	24.5 24.4 - 24.6	8.0 8.0 - 8.2	7.6 6.3 - 8.0	7.99 7.89 - 8.07	7.81 7.65 - 7.91	205 199 - 209	73 72 - 74	78 73 - 82	<0.10 <0.10 - <0.10
	Control, Non-treated	24.7 24.7 - 24.8	24.9 24.6 - 25.0	7.8 7.7 - 7.8	7.9 7.8 - 8.0	7.89 7.73 - 8.09	7.94 7.86 - 8.03	319 308 - 330	60 59 - 62	91 88 - 96	- - -
	10.7%	24.8 24.7 - 24.9	24.8 24.6 - 25.0	7.9 7.8 - 7.9	7.9 7.8 - 8.0	8.01 7.91 - 8.12	7.92 7.85 - 8.02	305 295 - 313	- - -	- - -	- - -
<i>Ceriodaphnia dubia</i>	21.4%	24.8 24.7 - 24.9	24.8 24.6 - 24.9	7.9 7.8 - 8.0	7.9 7.8 - 8.0	7.99 7.90 - 8.10	7.92 7.85 - 8.01	294 283 - 304	- - -	- - -	- - -
	42.8%	24.8 24.7 - 24.9	24.8 24.6 - 25.1	7.9 7.8 - 8.0	7.9 7.8 - 8.0	7.99 7.90 - 8.09	7.93 7.86 - 8.03	270 257 - 277	- - -	- - -	- - -
	85.6%	24.8 24.7 - 24.9	24.8 24.7 - 24.9	7.9 7.8 - 8.0	7.9 7.8 - 8.0	7.99 7.91 - 8.09	7.95 7.89 - 8.04	225 216 - 235	- - -	- - -	- - -
	100%	24.9 24.8 - 25.0	24.9 24.7 - 25.2	8.0 7.8 - 8.1	8.0 7.9 - 8.1	8.01 7.92 - 8.11	7.96 7.90 - 8.05	205 197 - 215	78 76 - 80	83 82 - 86	<0.10 <0.10 - <0.10
	Intake	24.9 24.8 - 25.0	24.9 24.6 - 25.2	8.1 8.0 - 8.2	8.0 7.9 - 8.2	8.00 7.93 - 8.10	7.98 7.92 - 8.08	205 197 - 211	73 72 - 74	78 73 - 82	<0.10 <0.10 - <0.10
	Control, Non-treated	24.7 24.7 - 24.8	24.9 24.6 - 25.0	7.8 7.7 - 7.8	7.9 7.8 - 8.0	7.89 7.73 - 8.09	7.94 7.86 - 8.03	319 308 - 330	60 59 - 62	91 88 - 96	- - -
	10.7%	24.8 24.7 - 24.9	24.8 24.6 - 25.0	7.9 7.8 - 7.9	7.9 7.8 - 8.0	8.01 7.91 - 8.12	7.92 7.85 - 8.02	305 295 - 313	- - -	- - -	- - -
	21.4%	24.8 24.7 - 24.9	24.8 24.6 - 24.9	7.9 7.8 - 8.0	7.9 7.8 - 8.0	7.99 7.90 - 8.10	7.92 7.85 - 8.01	294 283 - 304	- - -	- - -	- - -

\*Note: Total residual chlorine was performed on non-treated Outfall 101 and Intake samples.

Overall temperature (°C)	Average	Minimum	Maximum
<i>Pimephales promelas</i>	24.7	24.2	25.1
<i>Ceriodaphnia dubia</i>	24.8	24.6	25.2

## **SUMMARY / CONCLUSIONS**

Exposures to samples collected July 31 – August 05, 2016 from Outfall 101 resulted in no toxic effects to fathead minnows or daphnids. The resulting IC25 values, for both species, were > 100 percent. Exposure of minnows and daphnids to intake samples resulted in no significant difference from the controls during this study period.



## Appendix A

### ADDITIONAL TOXICITY TEST INFORMATION

#### SUMMARY OF METHODS

1. *Pimephales promelas*

Tests were conducted according to EPA-821-R-02-013 (October 2002) using four replicates, each containing ten test organisms, per treatment. Test vessels consisted of 500-mL plastic disposable cups, each containing 250-mL of test solution.

2. *Ceriodaphnia dubia*

Tests were conducted according to EPA-821-R-02-013 (October 2002) using ten replicates, each containing one test organism, per treatment. Test vessels consisted of 30-mL polypropylene cups, each containing 15-mL of test solution.

#### DEVIATIONS / MODIFICATIONS TO TEST PROTOCOL

1. *Pimephales promelas*

Samples used in the fathead minnow test were exposed to UV light for two minutes prior to introduction of test organisms. UV treatment is used to control interference of fish pathogens. This treatment method was approved on November 23, 2015 by the State of Tennessee in a letter from Jessica Murphy to Terry Cheek, Senior Manager of TVA Water Permits, Compliance, and Monitoring.

2. *Ceriodaphnia dubia*

None

#### DEVIATIONS / MODIFICATIONS TO PRETEST CULTURE OR HOLDING OF TEST ORGANISMS

1. *Pimephales promelas*

None

2. *Ceriodaphnia dubia*

None

## **PHYSICAL AND CHEMICAL METHODS**

1. Reagents, Titrants, Buffers, etc.: All chemicals were certified products used before expiration dates (where applicable).
2. Instruments: All identification, service, and calibration information pertaining to laboratory instruments is recorded in calibration and maintenance logbooks.
3. Temperature was measured by SM 2550 B-2000.
4. Dissolved oxygen was measured by SM 4500-O G-2001.
5. The pH was measured by SM 4500-H+ B-2000.
6. Conductance was measured by SM 2510 B-1997.
7. Alkalinity was measured by SM 2320 B-1997.
8. Total hardness was measured by SM 2340 C-1997.
9. Total residual chlorine was measured by ORION 97-70-1977.

## **QUALITY ASSURANCE**

Toxicity Test Methods: All phases of the study including, but not limited to, sample collection, handling and storage, glassware preparation, test organism culturing/acquisition and acclimation, test organism handling during test, and maintaining appropriate test conditions were conducted according to the protocol as described in this report and EPA-821-R-02-013. Any known deviations were noted during the study and are reported herein.

## **REFERENCE TOXICANT TESTS** (See Appendix D for control chart information)

1. Test Type: 7-day chronic tests with results expressed as IC<sub>25</sub> values in g/L KCl or NaCl.
2. Standard Toxicant: Potassium Chloride (KCl crystalline) for *Pimephales promelas*.  
Sodium Chloride (NaCl crystalline) for *Ceriodaphnia dubia*.
3. Dilution Water Used: Moderately hard synthetic water.
4. Statistics: ToxCalc software Version 5.0 was used for statistical analyses.

## REFERENCES

1. NPDES Permit No. TN0026450.
2. USEPA. Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, EPA-821-R-02-013 (October 2002).
3. Standard Methods for the Examination of Water and Wastewater, 22<sup>nd</sup> Edition, 2012.
4. Quality Assurance Program: Standard Operating Procedures, Environmental Testing Solutions, Inc (most current version).



Sequoyah Nuclear Plant Biomonitoring  
August 02 – 09, 2016

Appendix B

Diffuser Discharge Concentrations of Total Residual Chlorine,  
Diffuser Discharge Concentrations of Chemicals Used to  
Control Microbiologically Induced Corrosion and Mollusks  
During Toxicity Test Sampling

Table B-1. Sequoyah Nuclear Plant Outfall 101  
Diffuser Discharge Concentrations of Chemicals Used to Control Microbiologically  
Induced Corrosion and Mollusks, During Toxicity Test Sampling,  
February 6, 2005 – August 5, 2016

Date	Sodium Hypochlorite mg/L TRC	Towerbrom mg/L TRC	PCL-222 mg/L Phosphate	PCL-401 mg/L Copolymer	CL-363 mg/L DMAD	Cuprostat-PF mg/L Azole	H-130M mg/L Quat	Nalco 73551 mg/L EO/PO	H-150M mg/L Quat
02/06/2005	-	<0.0042	0.028	0.010	-	-	-	-	-
02/07/2005	-	<0.0116	0.028	0.010	-	-	-	0.007	-
02/08/2005	-	<0.0080	0.028	0.010	-	-	-	-	-
02/09/2005	-	0.0199	0.028	0.010	-	-	-	-	-
02/10/2005	-	<0.0042	0.028	0.010	-	-	-	-	-
02/11/2005	-	0.0155	0.028	0.010	-	-	-	0.007	-
06/05/2005	-	0.0063	-	-	-	-	-	-	-
06/06/2005	-	0.0043	-	-	-	-	-	-	0.037
06/07/2005	-	0.0103	-	-	-	-	-	-	0.037
06/08/2005	-	0.0295	-	-	-	-	-	-	0.037
06/09/2005	-	0.0129	-	-	-	-	-	-	-
06/10/2005	-	0.0184	-	-	-	-	-	-	-
07/17/2005	-	0.0109	0.026	0.009	-	-	-	-	-
07/18/2005	-	0.0150	0.026	0.009	-	-	-	-	0.036
07/19/2005	-	0.0163	0.026	0.009	-	-	-	-	0.036
07/20/2005	-	0.0209	0.026	0.009	-	-	-	0.014	0.036
07/21/2005	-	0.0242	0.026	0.009	-	-	-	-	-
07/22/2005	-	0.0238	0.054	0.018	-	-	-	0.014	-
10/30/2005	-	0.0068	-	-	-	-	-	-	-
10/31/2005	-	0.0112	-	-	-	-	-	-	-
11/01/2005	-	0.0104	-	-	-	-	-	-	0.035
11/02/2005	-	0.0104	-	-	-	-	-	-	0.036
11/03/2005	-	0.0117	-	-	-	-	-	-	0.036
11/04/2005	-	0.0165	-	-	-	-	-	-	0.035
11/14/2005	-	0.0274	-	-	-	-	-	-	-
11/15/2005	-	0.0256	-	-	-	-	-	-	-
11/16/2005	-	0.0234	-	-	-	-	-	-	-
11/17/2005	-	0.0231	-	-	-	-	-	-	-
11/18/2005	-	0.0200	-	-	-	-	-	-	-
11/19/2005	-	0.0116	-	-	-	-	-	-	-



Table B-1. Sequoyah Nuclear Plant Outfall 101  
Diffuser Discharge Concentrations of Chemicals Used to Control Microbiologically  
Induced Corrosion and Mollusks, During Toxicity Test Sampling,  
February 6, 2005 – August 5, 2016

Date	Sodium Hypochlorite mg/L TRC	Towerbrom mg/L TRC	PCL-222 mg/L Phosphate	PCL-401 mg/L Copolymer	CL-363 mg/L DMAD	Cuprostat-PF mg/L Azole	H-130M mg/L Quat	Nalco 73551 mg/L EO/PO	H-150M mg/L Quat	MSW 101 mg/L Phosphate
11/12/2006	-	0.0055	-	-	-	-	-	-	-	-
11/13/2006	-	0.0068	-	-	-	-	-	-	0.037	-
11/14/2006	-	0.0143	-	-	-	-	-	-	0.037	-
11/15/2006	-	0.0068	-	-	-	-	-	-	0.037	-
11/16/2006	-	0.0267	-	-	-	-	-	-	0.037	-
11/17/2006	-	0.0222	-	-	-	-	-	-	-	-
11/26/2006	-	0.0188	-	-	-	-	-	-	-	-
11/27/2006	-	0.0138	-	-	-	-	-	-	-	-
11/28/2006	-	0.0120	-	-	-	-	-	-	-	-
11/29/2006	-	0.0288	-	-	-	-	-	-	-	-
11/30/2006	-	0.0376	-	-	-	-	-	-	-	-
12/01/2006	-	0.0187	-	-	-	-	-	-	-	-
05/28/07	-	-	-	-	-	-	-	-	-	0.015
05/29/07	-	-	-	-	-	-	-	-	0.036	0.015
05/30/07	-	0.0084	-	-	-	-	-	0.017	0.036	0.015
05/31/07	-	0.0103	-	-	-	-	-	-	0.036	0.015
06/01/07	-	0.0164	-	-	-	-	-	0.017	0.036	0.015
06/02/07	-	0.0305	-	-	-	-	-	-	-	0.015
12/02/07	-	0.0241	-	-	-	-	-	-	-	-
12/03/07	-	0.0128	-	-	-	-	-	-	-	-
12/04/07	-	0.0238	-	-	-	-	-	-	-	-
12/05/07	-	0.0158	-	-	-	-	-	-	-	-
12/06/07	-	0.0162	-	-	-	-	-	-	-	-
12/07/07	-	0.0175	-	-	-	-	-	-	-	-
04/13/08	-	0.0039	-	-	-	-	-	-	-	-
04/14/08	-	0.0124	-	-	-	-	-	-	-	-
04/15/08	-	0.0229	-	-	-	-	-	-	-	-
04/16/08	-	0.0143	-	-	-	-	-	-	-	-
04/17/08	-	0.0120	-	-	-	-	-	-	-	-
04/18/08	-	0.0149	-	-	-	-	-	-	-	-
10/26/08	-	0.0260	-	-	-	-	-	-	-	-
10/27/08	-	0.0151	-	-	-	-	-	0.017	-	-
10/28/08	-	0.0172	-	-	-	-	-	-	0.041	-
10/29/08	-	0.0154	-	-	-	-	-	-	0.041	0.030
10/30/08	-	-	-	-	-	-	-	0.018	0.041	0.030
10/31/08	-	0.0086	-	-	-	-	-	-	0.041	0.030



Table B-1. Sequoyah Nuclear Plant Outfall 101  
Diffuser Discharge Concentrations of Chemicals Used to Control Microbiologically  
Induced Corrosion and Mollusks, During Toxicity Test Sampling,  
February 6, 2005 – August 5, 2016

Date	Sodium Hypochlorite mg/L TRC	Towerbrom mg/L TRC	PCL- 222 mg/L Phosph ate	PCL-401 mg/L Copolymer	CL-363 mg/L DMAD	Cuprostat -PF mg/L Azole	H-130M mg/L Quat	Nalco 73551 mg/L EO/PO	Spectrus CT1300 mg/L Quat	H-150M mg/L Quat	MSW 101 mg/L Phosphate
02/08/09	-	0.0197	-	-	-	-	-	0.017	-	-	-
02/09/09	-	0.0237	-	-	-	-	-	0.017	-	-	-
02/10/09	-	0.0104	-	-	-	-	-	0.021	-	-	-
02/11/09	-	0.0155	-	-	-	-	-	0.017	-	-	-
02/12/09	-	0.0106	-	-	-	-	-	0.017	-	-	-
02/13/09	-	-	-	-	-	-	-	-	-	-	-
05/10/09	-	0.0129	-	-	-	-	-	-	-	-	-
05/11/09	-	0.0415	-	-	-	-	-	-	-	0.0446	-
05/12/09	-	0.0053	-	-	-	-	-	-	-	0.0396	-
05/13/09	-	0.0049	-	-	-	-	-	-	-	0.0396	-
05/14/09	-	<0.0141	-	-	-	-	-	-	-	0.0397	-
05/15/09	-	<0.0160	-	-	-	-	-	-	-	-	-
11/15/09	-	0.025	-	-	-	-	-	-	-	-	-
11/16/09	-	0.0152	-	-	-	-	-	-	-	-	-
11/17/09	-	0.0255	-	-	-	-	-	-	-	-	-
11/18/09	-	0.0306	-	-	-	-	-	-	-	-	-
11/19/09	-	0.0204	-	-	-	-	-	-	-	-	-
11/20/09	-	0.0093	-	-	-	-	-	-	-	-	-
05/09/10	-	0.0192	-	-	-	-	-	-	-	-	-
05/10/10	-	0.0055	-	-	-	-	-	-	-	-	-
05/11/10	-	0.0100	-	-	-	-	-	-	0.039	-	-
05/12/10	-	0.0171	-	-	-	-	-	-	0.039	-	-
05/13/10	-	0.0041	-	-	-	-	-	-	0.039	-	-
05/14/10	-	0.0099	-	-	-	-	-	-	0.039	-	-



Table B-1. Sequoyah Nuclear Plant Outfall 101  
Diffuser Discharge Concentrations of Chemicals Used to Control Microbiologically  
Induced Corrosion and Mollusks, During Toxicity Test Sampling,  
February 6, 2005 – August 5, 2016

Date	Sodium Hypo-chlorite mg/L TRC	Towerbrom mg/L TRC	PCL-222 mg/L Phosphate	PCL-401 mg/L Copoly-mer	CL-363 mg/L DMAD	Cuprostat -PF mg/L Azole	H-130M mg/L Quat	Nalco 73551 mg/L EO/PO	Spectrus CT1300 mg/L Quat	H-150M mg/L Quat	MSW 101 mg/L Phosphate	Floguard MS6236 mg/L Phosphate
10/31/10	-	-	-	-	-	-	-	-	-	-	-	-
11/01/10	-	0.0122	-	-	-	-	-	-	-	-	-	-
11/02/10	-	0.0112	-	-	-	-	-	-	-	-	-	-
11/03/10	-	0.0163	-	-	-	-	-	-	-	-	-	-
11/04/10	-	0.0107	-	-	-	-	-	-	-	-	-	-
11/05/10	-	0.0132	-	-	-	-	-	-	-	-	-	-
05/01/2011	-	-	-	-	-	-	-	-	-	-	-	-
05/02/2011	-	-	-	-	-	-	-	-	0.04	-	-	-
05/03/2011	-	-	-	-	-	-	-	-	0.04	-	-	-
05/04/2011	-	0.0155	-	-	-	-	-	-	0.04	-	-	-
05/05/2011	-	0.0179	-	-	-	-	-	-	0.04	-	-	-
05/06/2011	-	0.0089	-	-	-	-	-	-	-	-	-	-
11/06/2011	-	0.0168	-	-	-	-	-	-	-	-	-	-
11/07/2011	-	0.0225	-	-	-	-	-	-	-	-	-	-
11/08/2011	-	0.0141	-	-	-	-	-	-	-	-	-	-
11/09/2011	-	0.0239	-	-	-	-	-	-	-	-	-	-
11/10/2011	-	0.0242	-	-	-	-	-	-	-	-	-	-
11/11/2011	-	0.0231	-	-	-	-	-	-	-	-	-	-
05/06/2012	-	-	-	-	-	-	-	-	-	-	-	-
05/07/2012	-	-	-	-	-	-	-	-	-	-	-	-
05/08/2012	-	-	-	-	-	-	-	-	0.041	-	-	-
05/09/2012	-	0.0145	-	-	-	-	-	-	0.041	-	-	-
05/10/2012	-	0.0298	-	-	-	-	-	-	0.041	-	-	-
05/11/2012	-	0.0174	-	-	-	-	-	-	-	-	-	-
08/12/2012	-	-	-	-	-	-	-	-	-	-	-	0.029
08/13/2012	-	0.0256	-	-	-	-	-	0.028	0.037	-	-	0.029
08/14/2012	-	0.0209	-	-	-	-	-	-	0.037	-	-	0.029
08/15/2012	-	0.0279	-	-	-	-	-	-	-	-	-	0.029
08/16/2012	-	0.0076	-	-	-	-	-	0.028	-	-	-	0.029
08/17/2012	-	0.0446	-	-	-	-	-	-	-	-	-	0.032
05/12/2013	-	0.0099	-	-	-	-	-	-	-	-	-	-
05/13/2013	-	-	-	-	-	-	-	-	-	-	-	0.064
05/14/2013	-	0.0091	-	-	-	-	-	0.039	-	-	-	0.064
05/15/2013	-	0.0096	-	-	-	-	-	0.039	-	-	-	0.064
05/16/2013	-	0.0229	-	-	-	-	-	-	-	-	-	0.032
05/17/2013	-	0.0063	-	-	-	-	-	-	-	-	-	0.032
09/15/2013	-	-	-	-	-	-	-	-	-	-	-	0.03
09/16/2013	-	0.0072	-	-	-	-	-	-	0.0379	-	-	0.03
09/17/2013	-	0.0107	-	-	-	-	-	-	0.0379	-	-	0.03
09/18/2013	-	0.0217	-	-	-	-	-	0.036	0.0379	-	-	0.03
09/19/2013	-	0.0172	-	-	-	-	-	0.036	0.0379	-	-	0.03
09/20/2013	-	0.0173	-	-	-	-	-	-	-	-	-	0.03



Table B-1. Sequoyah Nuclear Plant Outfall 101  
Diffuser Discharge Concentrations of Chemicals Used to Control Microbiologically  
Induced Corrosion and Mollusks, During Toxicity Test Sampling,  
February 6, 2005 – August 5, 2016

Date	Sodium Hypo-chlorite mg/L TRC	Towerbrom mg/L TRC	PCL-222 mg/L Phos-phate	PCL-401 mg/L Copoly-mer	CL-363 mg/L DMAD	Cuprostat -PF mg/L Azole	H-130M mg/L Quat	Nalco 73551 mg/L EO/PO	Spectrus CT1300 mg/L Quat	H-150M mg/L Quat	MSW 101 mg/L Phos-phate	Floguard MS6236 mg/L Phosphate
05/04/2014	-	0.0118	-	-	-	-	-	-	-	-	-	-
05/05/2014	-	0.0112	-	-	-	-	-	-	-	-	-	-
05/06/2014	-	0.0096	-	-	-	-	-	-	-	-	-	-
05/07/2014	-	0.0164	-	-	-	-	-	-	-	-	-	-
05/08/2014	-	0.0235	-	-	-	-	-	-	-	-	-	-
05/09/2014	-	0.0110	-	-	-	-	-	-	-	-	-	-
09/07/2014	-	-	-	-	-	-	-	-	-	-	-	-
09/08/2014	-	-	-	-	-	-	-	-	-	-	-	-
09/09/2014	-	-	-	-	-	-	-	-	0.04	-	-	-
09/10/2014	-	-	-	-	-	-	-	-	0.04	-	-	-
09/11/2014	-	0.0070	-	-	-	-	-	-	0.04	-	-	-
09/12/2014	-	0.0074	-	-	-	-	-	-	-	-	-	-
08/09/2015	-	-	-	-	-	-	-	-	-	-	-	-
08/10/2015	-	0.0195	-	-	-	-	-	-	0.03	-	-	-
08/11/2015	-	0.0275	-	-	-	-	-	-	0.03	-	-	-
08/12/2015	-	0.0213	-	-	-	-	-	-	-	-	-	-
08/13/2015	-	0.0192	-	-	-	-	-	-	-	-	-	0.03
08/14/2015	-	0.0182	-	-	-	-	-	-	-	-	-	0.03
10/18/2015	-	0.0162	-	-	-	-	-	-	-	-	-	-
10/19/2015	-	0.0125	-	-	-	-	-	-	-	-	-	-
10/20/2015	-	0.0120	-	-	-	-	-	-	-	-	-	-
10/21/2015	-	0.0130	-	-	-	-	-	-	-	-	-	-
10/22/2015	-	0.0174	-	-	-	-	-	-	-	-	-	-
10/23/2015	-	0.0156	-	-	-	-	-	-	-	-	-	-
05/15/2016	-	-	-	-	-	-	-	-	-	-	-	-
05/16/2016	-	0.0209	-	-	-	-	-	-	-	-	-	-
05/17/2016	-	0.0210	-	-	-	-	-	-	-	-	-	-
05/18/2016	-	0.0361	-	-	-	-	-	-	-	-	-	-
05/19/2016	-	0.0254	-	-	-	-	-	-	-	-	-	-
05/20/2016	-	0.0261	-	-	-	-	-	-	-	-	-	-
07/31/2016	-	-	-	-	-	-	-	-	-	-	-	-
08/01/2016	-	0.0091	-	-	-	-	-	-	0.03	-	-	-
08/02/2016	-	0.0093	-	-	-	-	-	-	0.03	-	-	-
08/03/2016	-	0.0209	-	-	-	-	-	-	0.03	-	-	-
08/04/2016	-	-	-	-	-	-	-	-	-	-	-	-
08/05/2016	-	-	-	-	-	-	-	-	-	-	-	-

Sequoyah Nuclear Plant Biomonitoring  
August 02 – 09, 2016

Appendix C

Chain of Custody Records and  
Toxicity Test Bench Sheets



## BIOMONITORING CHAIN OF CUSTODY RECORD

Page 1 of 1

Client: TVA

Project Name: Sequoyah NP Toxicity

P.O. Number: N/A

Facility Sampled: Sequoyah NP

NPDES Number: TN0026450

Collected By: *Margaret O. Moore, Andy Patton*

Environmental Testing Solution, Inc.

351 Depot Street.

Asheville, NC

28801

Phone: 828-350-9364

Fax: 828-350-9368

Delivered By (Circle One):

FedEx UPS Bus Client

Other (specify): Sonic Delivery

General Comments:

Took samples from 101 sampler @ 0650  
 Took samples from Intake sampler @ 0713  
 \* 101 Backup samples was shipped to  
 Environmental Testing Solution  
 \* Diss. Metals were collected & kept on site

Field Identification / Sample Description	Grab/Comp.	Collection Date/Time		Container Number & Volume Collected	Flow (MGD)	Rain Event? (Mark as Appropriate)				Laboratory Use				
		Start	End			Yes	If Yes, Inches	No	Trace	ETS Log Number	Arrival Temp. (°C)	By	Time ET	Appearance
SQN-101-TOX	Comp	7-31-16 0705 <sup>ET</sup>	8-1-16 0605 <sup>ET</sup>	2(2.5gal)	1790.876	X	1.13			<del>160801.02</del> 160801.02	1.2, 0.8°C	J	1307	*
SQN-INT-TOX	Comp	7-31-16 0720 <sup>ET</sup>	8-1-16 0620 <sup>ET</sup>	1(2.5 gal)	NA	X	1.13			<del>160801.03</del> 160801.03	0.2°C	J	1307	*

Sample Custody - Fill In From Top Down

\* CUSTODY SEALS INTACT. SAMPLES RECEIVED  
IN GOOD CONDITION. TSC ABSENT IN ALL  
Date/Time SAMPLES.

Relinquished By (Signature):	Date/Time	Received By (Signature):	Date/Time
<i>Margaret O. Moore</i> / TVA	8-1-16 / 0820 <sup>ET</sup>	BR Skiles	8-1-16 / 8:20 ET
BR Skiles	8-1-16 1:07 <sup>ET</sup>	Jm /	08-01-16 1307 ET

Instructions: Clients should fill in all areas except those in the "Laboratory Use" block. Biomonitoring samples are preserved by storing them between 0°C and 6°C and shipping them in ice (samples should never be frozen). The hold time for each sample is 36 hours from the time of collection. Therefore, please collect and ship in such a way that the laboratory will receive the samples with ample time to initiate testing within that time frame. Samples shipped overnight on Friday via FedEx or UPS must be marked for Saturday delivery or they will not arrive until the following Monday.





## Whole Effluent Sample Receipt Log

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\*Sample temperature performed using Sample Receiving Thermometer: SN 130580085

Date Received	Time Received	Received by	Received from	*Sample Temp. (°C)	Project number	Sample number	Sample name and description	State	Comments
08-01-16	1013	K. Keenan	J. Kennedy	4.0	11636	160801 .01	Tuckaseegee WWTP	NC	
08-01-16	1307	J. Sumner	TVA Courier	1.2/0.8	11637	160801 .02	TVA - Sequoyah NP - 101	TN	
08-01-16	1307	J. Sumner	TVA Courier	0.2	11637	160801 .03	TVA - Sequoyah NP - Intake	TN	

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## BIOMONITORING CHAIN OF CUSTODY RECORD

Page 1 of 1

Client: TVA

Project Name: Sequoyah NP Toxicity

P.O. Number: N/A

Facility Sampled: Sequoyah NP

NPDES Number: TN0026450

Collected By: *Marcus D. Moore, Andy Ringer*

Environmental Testing Solution, Inc.

351 Depot Street.

Asheville, NC

28801

Phone: 828-350-9364

Fax: 828-350-9368

Delivered By (Circle One):

FedEx UPS Bus Client

Other (specify): *Sonic Delivery*

General Comments:

*Took samples from 101 sampler @ 0721*  
*Took samples from Intake sampler @ 0741*  
*\* 101 Backup sample was shipped to*  
*Environmental Testing Solution*  
*\* Diss Metals were collected + kept on site*

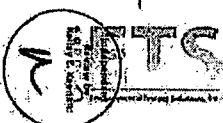
Field Identification / Sample Description	Grab/Comp.	Collection Date/Time		Container Number & Volume Collected	Flow (MGD)	Rain Event? (Mark as Appropriate)				Project # 11637 Laboratory Use				
		Start	End			Yes	If Yes, Inches	No	Trace	ETS Log Number	Arrival Temp. (°C)	By	Time ET	Appearance
SQN-101-TOX	Comp	8-2-16 0705 ET	8-3-16 0605 ET	2(2.5gal)	1797.19	X	0.03			1160803.23	1.2, 1.4°C	J	1220	*
SQN-INT-TOX	Comp	8-2-16 0715 ET	8-3-16 0615 ET	1(2.5 gal)		X	0.03			1160803.24	1.4°C	J	1220	*

Sample Custody - Fill In From Top Down

Relinquished By (Signature):	Date/Time	Received By (Signature):	IN GOOD CONDITION, DATE/TIME	ALL SAMPLES
<i>M.D. Moore / TVA</i>	8-3-16 / 0830 ET	<i>BR Skiles</i> SONIC DELIVERY	08-03-16 / 08:30 ET	
<i>BR Skiles</i> SONIC DELIVERY	08-03-16 / 1220 ET	<i>Jim</i> ETS	08-03-16 · 1220 ET	

Instructions: Clients should fill in all areas except those in the "Laboratory Use" block. Biomonitoring samples are preserved by storing them at 6°C and shipping them in ice. The hold time for each sample is 36 hours from the time of collection. Therefore, please collect and ship in such a way that the laboratory will receive the samples with ample time to initiate testing within that time frame. Samples shipped overnight on Friday via FedEx or UPS must be marked for Saturday delivery or they will not arrive until the following Monday.





# Whole Effluent Sample Receipt Log

Page 104

\*Sample temperature performed using Sample Receiving Thermometer: SN 130580085

Date Received	Time Received	Received by	Received from	*Sample Temp. (°C)	Project number	Sample number	Sample name and description	State	Comments
08-03-16	0940	K. Keenan	UPS	2.6	11650	160803 .01	Rockingham WWTP	NC	
08-03-16	0940	K. Keenan	UPS	1.1	11651	160803 .02	South Cary WWTP	NC	
08-03-16	0940	K. Keenan	UPS	1.3	11652	160803 .03	Morehead City WWTP	NC	
08-03-16	1021	K. Keenan	Fed - Ex	2.2	11653	160803 .04	Belews Creek SS	NC	
08-03-16	1021	K. Keenan	Fed - Ex	1.5	11654	160803 .05	Brunswick County WTP	NC	
08-03-16	1021	K. Keenan	Fed - Ex	1.0	11655	160803 .06	Dobson WTP	NC	
08-03-16	1021	K. Keenan	Fed - Ex	2.4	11656	160803 .07	Marshall SS	NC	
08-03-16	1021	K. Keenan	Fed - Ex	2.7	11657	160803 .08	North Cary WWTP	NC	
08-03-16	1021	K. Keenan	Fed - Ex	1.1	11658	160803 .09	James Loughlin WWTP	NC	
08-03-16	1021	K. Keenan	Fed - Ex	1.0	11659	160803 .10	Performance Fibers	NC	
08-03-16	1021	K. Keenan	Fed - Ex	0.6	11660	160803 .11	Raleigh CC	NC	
08-03-16	1021	K. Keenan	Fed - Ex	1.0	11661	160803 .12	Sparks Road WTP	NC	
08-03-16	1021	K. Keenan	Fed - Ex	1.0	11662	160803 .13	Long Creek WWTP	NC	
08-03-16	1021	K. Keenan	Fed - Ex	1.5	11663	160803 .14	McGuire NS - 001	NC	
08-03-16	1021	K. Keenan	Fed - Ex	1.0	11664	160803 .15	McGuire NS - 002	NC	
08-03-16	1021	K. Keenan	Fed - Ex	1.0	11665	160803 .16	Manteo WWTP	NC	
08-03-16	1021	K. Keenan	Fed - Ex	1.4	11666	160803 .17	Mayo Steam Electric Plant	NC	
08-03-16	1021	K. Keenan	Fed - Ex	2.6	11667	160803 .18	Washington WWTP	NC	
08-03-16	1021	K. Keenan	Fed - Ex	1.3	11668	160803 .19	Woodlake Yacht Club	NC	
08-03-16	1021	K. Keenan	Fed - Ex	2.1	11669	160803 .20	PCS Phosphate, Inc.	NC	
08-03-16	1021	K. Keenan	Fed - Ex	1.7	11670	160803 .21	Carolina Beach WWTP	NC	
08-03-16	1055	K. Keenan	J. Kennedy	4.0	11636	160803 .22	Tuckaseegee WWTP	NC	
08-03-16	1220	J. Sumner	TVA Courier	1.2/1.4	11637	160803 .23	TVA - Sequoyah NP - 101	TN	
08-03-16	1220	J. Sumner	TVA Courier	1.4	11637	160803 .24	TVA - Sequoyah NP - Intake	TN	
08-03-16	1255	K. Keenan	Dash Courier	0.3	11671	160803 .25	OWASA	NC	
08-03-16	1500	J. Sumner	TVA Courier	0.5	11672	160803 .26	TVA - Shawnee FP - 001 AM	KY	
08-03-16	1500	J. Sumner	TVA Courier	0.9	11672	160803 .27	TVA - Shawnee FP - Intake AM	KY	
08-03-16	1500	J. Sumner	TVA Courier	0.8	11672	160803 .28	TVA - Shawnee FP - 001 PM	KY	
08-03-16	1500	J. Sumner	TVA Courier	1.3	11672	160803 .29	TVA - Shawnee FP - Intake PM	KY	

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## BIOMONITORING CHAIN OF CUSTODY RECORD

Page 1 of 1

Client: TVA  
 Project Name: Sequoyah NP Toxicity  
 P.O. Number: N/A  
 Facility Sampled: Sequoyah NP  
 NPDES Number: TN0026450  
 Collected By: *Marcel D. Moore, Andy Payton*

Environmental Testing Solution, Inc.  
 Asheville FedEx Location.  
 628 Patton Ave.  
 Asheville, NC 28806  
 Phone: 828-350-9364  
 Fax: 828-350-9368

Delivered By (Circle One):  
 FedEx UPS Bus Client  
 Other (specify): Sonic Delivery

General Comments:  
 Took samples from ID1 sampler @ 0712 ET  
 Took samples from Intake sampler @ 0740 ET  
 \* Diss Metals were collected & kept on site

Field Identification / Sample Description	Grab/Comp.	Collection Date/Time		Container Number & Volume Collected	Flow (MGD)	Rain Event? (Mark as Appropriate)				Laboratory Use				
		Start	End			Yes	If Yes, Inches	No	Trace	ETS Log Number	Arrival Temp. (°C)	By	Time ET	Appearance
SQN-101-TOX	Comp	8-4-16 0710	8-5-16 0610	2(2.5gal)	1793.065	X	0.42			16080515	0.5, 0.7°C	J	1235	*
SQN-INT-TOX	Comp	8-4-16 0725	8-5-16 0625	1(2.5 gal)	NA	X	0.42			16080516	0.6°C	J	1235	*

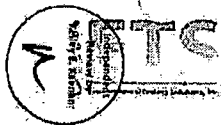
Sample Custody - Fill In From Top Down

\* CUSTODY SEALS INTACT SAMPLES

Relinquished By (Signature):	Date/Time	Received By (Signature):	Date/Time
<i>[Signature]</i>	8-5-16/0820	<i>BR Skelen</i>	08-05-16 08:20 ET
<i>BR Skelen</i> <u>Sonic Delivery</u>	08-05-16/12:30 ET	<i>JM</i> <u>ETS</u>	08-05-16 1235 ET

Instructions: Clients should fill in all areas except those in the "Laboratory Use" block. Biomonitoring samples are preserved by storing them between 0°C and 6°C and shipping them in ice (samples should never be frozen). The hold time for each sample is 36 hours from the time of collection. Therefore, please collect and ship in such a way that the laboratory will receive the samples with ample time to initiate testing within that time frame. Samples shipped overnight on Friday via FedEx or UPS must be marked for Saturday delivery or they will not arrive until the following Monday.





# Whole Effluent Sample Receipt Log

Page 106

\*Sample temperature performed using Sample Receiving Thermometer: SN 130580085

Date Received	Time Received	Received by	Received from	*Sample Temp. (°C)	Project number	Sample number	Sample name and description	State	Comments
08-05-16	0946	K. Keenan	UPS	0.6	11650	160805 .01	Rockingham WWTP	NC	
08-05-16	0946	K. Keenan	UPS	2.4	11651	160805 .02	South Cary WWTP	NC	
08-05-16	1011	K. Keenan	Fed - Ex	1.3	11653	160805 .03	Belews Creek SS	NC	
08-05-16	1011	K. Keenan	Fed - Ex	1.2	11654	160805 .04	Brunswick County WTP	NC	
08-05-16	1011	K. Keenan	Fed - Ex	1.1	11655	160805 .05	Dobson WTP	NC	
08-05-16	1011	K. Keenan	Fed - Ex	3.5	11656	160805 .06	Marshall SS	NC	
08-05-16	1011	K. Keenan	Fed - Ex	0.8	11657	160805 .07	North Cary WWTP	NC	
08-05-16	1011	K. Keenan	Fed - Ex	0.3	11658	160805 .08	James Loughlin WWTP	NC	
08-05-16	1011	K. Keenan	Fed - Ex	1.1	11659	160805 .09	Performance Fibers	NC	
08-05-16	1011	K. Keenan	Fed - Ex	2.1	11660	160805 .10	Raleigh CC	NC	
08-05-16	1011	K. Keenan	Fed - Ex	1.1	11661	160805 .11	Sparks Road WTP	NC	
08-05-16	1011	K. Keenan	Fed - Ex	1.1	11662	160805 .12	Long Creek WWTP	NC	
08-05-16	1011	K. Keenan	Fed - Ex	3.2	11675	160805 .13	ALCOA - 013	NC	
08-05-16	1203	K. Keenan	H. Bingham	1.3	11636	160805 .14	Tuckaseelgee WWTP	NC	
08-05-16	1235	J. Sumner	TVA Courier	0.5/0.7	11637	160805 .15	TVA - Sequoyah NP - 101	TN	
08-05-16	1235	J. Sumner	TVA Courier	0.6	11637	160805 .16	TVA - Sequoyah NP - Intake	TN	
08-05-16	1307	J. Sumner	Dash Courier	1307.0	11671	160805 .17	OWASA - Mason Farms	NC	

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**Chronic Whole Effluent Toxicity Test (EPA-821-R-02-013 Method 1000.0)**

Species: *Pimephales promelas*

Client: Tennessee Valley Authority

Facility: Sequoyah Nuclear Plant

NPDES #: TN0026450

Project #: 11631

County: Hamilton

Outfall: 101

Dilution preparation information:						Comments:
Dilution prep (%)	10.7	21.4	42.8	85.6	100	Each concentration was UV-treated for 2 minutes to remove pathogenic Interferences.
Effluent volume (mL)	267.5	535	1070	2140	2500	
Diluent volume (mL)	2232.5	1965	1430	360	0	
Total volume (mL)	2500	2500	2500	2500	2500	

Test organism information:				Test information:	
Organism source:	In-house culture			Randomizing template:	PURPLE
Age:	<24-hours old			Incubator number and shelf location:	7C
Spawn date:	07-28-16			Artemia CHM number:	CHM882
Hatch dates and times:	08-01-16 1500 TO 08-01-16 0605			Drying information for weight determination:	
Transfer vessel information:	pH = 8.06 S.U. Temperature = 25.1 °C			Date / Time in oven:	08-02-16 0900
Average transfer volume:	0.11 mL			Initial oven temperature:	60°C
				Date / Time out of oven:	08-10-16 0900
				Final oven temperature:	60°C
				Total drying time:	24-HOURS

**Daily feeding and renewal information:**

Day	Date	Morning feeding		Afternoon feeding		Test initiation, renewal, or termination		Sample numbers used		MHSW batch used
		Time	Analyst	Time	Analyst	Time	Analyst	Outfall 101	Intake	
0	08-02-16	0630	JL	1330	JL	0855	JL	160801.02	160801.03	07-21-16
1	08-03-16	0630	JL	1230	JL	0857	JL	160801.02	160801.03	07-28-16
2	08-04-16	0630	JL	1230	JL	0906	JL	160803.23	160803.24	08-02-16A
3	08-05-16	0630	JL	1230	JL	0907	JL	160803.23	160803.24	08-02-16A
4	08-06-16	0710	JL	1310	JL	0939	JL	160805.15	160805.16	08-02-16B
5	08-07-16	0710	JL	1310	JL	0935	JL	160805.15	160805.16	08-02-16B
6	08-08-16	0630	JL	1230	JL	0853	JL	160805.15	160805.16	08-02-16B
7	08-09-16					0848	JL			

Control information: UV-CONTROL		Acceptance criteria	Summary of test endpoints:	
% Mortality:	07	≤20%	7-day LC <sub>50</sub>	>1007
Average weight per initial larvae:	0.518		NOEC	1007
Average weight per surviving larvae:	0.518	≥ 0.25mg/larvae	LOEC	>1007
			ChV	>1007
			IC <sub>25</sub>	>1007

Species: Pimephales promelas

Client: TVA / Sequoyah Nuclear Plant, Outfall 101, UV-treated

Date: 08-02-16

*Survival and Growth Data*

Day	CONTROL				10.7%				21.4%			
	A	B	C	D	E	F	G	H	I	J	K	L
0	10	10	10	10	10	10	10	10	10	10	10	10
1	10	10	10	10	10	10	10	10	10	10	10	10
2	10	10	10	10	10	10	10	10	10	10	10	10
3	10	10	10	10	10	10	10	10	10	10	10	10
4	10	10	10	10	10	10	10	10	10	10	10	10
5	10	10	10	10	10	10	10	10	10	10	10	10
6	10	10	10	10	10	10	10	10	10	10	10	10
7	10	10	10	10	10	10	10	10	10	10	10	10
A = Pan weight (mg) Tray color code: <u>Forest Green</u> Analyst: <u>MB</u> Date: <u>08-30-16</u>												
B = Pan + Larvae weight (mg) Analyst: <u>MB</u> Date: <u>08-31-16</u>												
C = Larvae weight (mg) = B - A Hand calculated: <u>X</u> Analyst: <u>X</u>												
Weight per initial number of larvae (mg) = C / Initial number of larvae Hand calculated: <u>X</u> Analyst: <u>X</u>												
Average weight per initial number of larvae (mg)      Percent reduction from control (%)												
0.518      0.504      2.87      0.468      9.77												

Comment codes: c = clear, d = dead, fg = fungus, k = killed, m = missing, sk = sick, sm = unusually small, lg = unusually large, d&r = decanted and returned, w = wounded.

Comments:

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Species: Pimephales promelas

Client: TVA / Sequoyah Nuclear Plant, Outfall 101, UV-treated

Date: 08-02-16

Survival and Growth Data

Day	42.8%				85.6%				100%			
	M	N	O	P	Q	R	S	T	U	V	W	X
0	10	10	10	10	10	10	10	10	10	10	10	10
1	10	10	10	10	10	10	10	10	10	10	10	10
2	10	10	10	10	10	10	10	10	10	10	10	10
3	10	10	10	10	10	10	10	10	10	10	10	10
4	10	10	10	10	10	10	10	9 <sup>H</sup>	10	10	10	9 <sup>12</sup>
5	10	10	10	10	10	10	10	9	10	10	10	9
6	10	10	10	10	10	10	10	9	10	10	10	9
7	10	10	10	10	10	10	10	9	10	10	10	9
A = Pan weight (mg) Tray color code: <u>Forest Green</u> Analyst: <u>[Signature]</u> Date: <u>12-30-14</u>												
B = Pan + Larvae weight (mg) Analyst: <u>0/6</u> Date: <u>08-11-16</u>												
C = Larvae weight (mg) = B - A Hand calculated. Analyst: <u>[Signature]</u>												
Weight per initial number of larvae (mg) = C / Initial number of larvae Hand calculated. Analyst: <u>[Signature]</u>												
Average weight per initial number of larvae (mg)      Percent reduction from control (%)												
0.514      0.97      0.462      10.87      0.501      3.47												

Comment codes: c = clear, d = dead, fg = fungus, k = killed, m = missing, sk = sick, sm = unusually small, lg = unusually large, d&r = decanted and returned, w = wounded.

Comments:



Species: Pimephales promelas

Client: TVA / Sequoyah Nuclear Plant, Outfall 101, UV-treated

Date: 08-02-16

**Survival and Growth Data**

Day	100% Intake				Control - Non-treated							
	Y	Z	AA	BB	CC	DD	EE	FF	GG	HH	II	JJ
0	10	10	10	10	10	10	10	10				
1	10	10	10	10	10	10	10	10				
2	10	10	10	10	10	10	10	10				
3	10	10	10	10	10	10	10	10				
4	10	10	10	10	10	10	10	10				
5	10	10	10	10	10	10	10	10				
6	10	10	10	10	10	10	10	10				
7	10	10	10	9 <sup>th</sup>	10	10	10	10				
A = Pan weight (mg) Tray color code: <u>Forest Green</u> Analyst: <u>W</u> Date: <u>08-30-16</u>	15.76	16.39	15.18	15.80	15.44	14.14	16.87	16.02				
B = Pan + Larvae weight (mg) Analyst: <u>W</u> Date: <u>08-11-16</u>	26.55	21.50	20.13	20.46	21.31	20.19	22.12	20.25				
C = Larvae weight (mg) = B - A Hand calculated. Analyst: <u>A</u>	4.79	5.11	4.95	4.60	5.87	5.55	5.25	4.23				
Weight per initial number of larvae (mg) = C / Initial number of larvae Hand calculated. Analyst: <u>W</u>	0.479	0.511	0.495	0.460	0.587	0.555	0.525	0.423				
Average weight per initial number of larvae (mg)	0.486		6.27		0.523		NOT APPLICABLE +3.677 4mm					

Comment codes: c = clear, d = dead, fg = fungus, k = killed, m = missing, sk = sick, sm = unusually small, lg = unusually large, d&r = decanted and returned, w = wounded.

Comments:


TVA / Sequoyah Nuclear Plant, Outfall 101  
August 02-09, 2016

*Pimephales promelas* Chronic Whole Effluent Toxicity Test  
EPA-821-R-02-013, Method 1000.0

Quality Control  
Verification of Data Entry, Calculations, and Statistical Analyses

Environmental Testing Solutions, Inc.

Project numbers: 11637

Concentration (%)	Replicate	Initial number of larvae	Final number of larvae	A = Pan weight (mg)	B = Pan + Larvae weight (mg)	Larvae weight (mg) = B - A	Not for Compliance Assessment, Internal Laboratory QC		Weight / Initial number of larvae (mg)	Mean survival (%)	Mean weight / Initial number of larvae (mg)	Coefficient of variation (Standard deviation / mean weight) (%)	Percent reduction from control (%)
							Weight / Surviving number of larvae (mg)	Mean weight / Surviving number of larvae (mg)					
Control, Non-treated	CC	10	10	15.44	21.31	5.87	0.587	0.523	13.6	100.0	0.523	13.6	Not applicable
	DD	10	10	14.64	20.19	5.55	0.555						
	EE	10	10	16.87	22.12	5.25	0.525						
	FF	10	10	16.02	20.25	4.23	0.423						
Control, UV-treated	A	10	10	14.90	20.55	5.65	0.565	0.518	8.6	100.0	0.518	8.6	Not applicable
	B	10	10	15.50	20.32	4.82	0.482						
	C	10	10	15.82	21.30	5.48	0.548						
	D	10	10	15.69	20.47	4.78	0.478						
10.7%	E	10	10	15.45	20.33	4.88	0.488	0.504	7.5	100.0	0.504	7.5	2.8
	F	10	10	16.70	21.31	4.61	0.461						
	G	10	10	14.92	20.08	5.16	0.516						
	H	10	10	16.18	21.67	5.49	0.549						
21.4%	I	10	10	15.60	20.87	5.27	0.527	0.468	9.0	100.0	0.468	9.0	9.7
	J	10	10	16.69	21.34	4.65	0.465						
	K	10	10	16.02	20.32	4.30	0.430						
	L	10	10	15.88	20.37	4.49	0.449						
42.8%	M	10	10	14.70	19.51	4.81	0.481	0.514	4.8	100.0	0.514	4.8	0.9
	N	10	10	15.50	20.59	5.09	0.509						
	O	10	10	14.86	20.23	5.37	0.537						
	P	10	10	14.72	20.00	5.28	0.528						
85.6%	Q	10	10	15.90	20.60	4.70	0.470	0.475	6.8	97.5	0.462	6.3	10.8
	R	10	10	14.30	19.19	4.89	0.489						
	S	10	10	15.99	20.30	4.31	0.431						
	T	10	9	15.45	19.94	4.49	0.499						
100%	U	10	10	16.13	20.79	4.66	0.466	0.515	7.7	97.5	0.501	5.5	3.4
	V	10	10	15.47	20.49	5.02	0.502						
	W	10	10	16.39	21.73	5.34	0.534						
	X	10	9	15.76	20.77	5.01	0.557						
100% Intake	Y	10	10	15.76	20.55	4.79	0.479	0.499	3.1	97.5	0.486	4.5	6.2
	Z	10	10	16.39	21.50	5.11	0.511						
	AA	10	10	15.18	20.11	4.95	0.495						
	BB	10	9	15.86	20.40	4.60	0.511						

Outfall 101:  
Dunnett's MSD value: 0.0690  
PMSD: 11.6

MSD = Minimum Significant Difference  
PMSD = Percent Minimum Significant Difference  
PMSD is a measure of test precision. The PMSD is the minimum percent difference between the control and treatment that can be declared statistically significant in a whole effluent toxicity test.

Intake:  
Dunnett's MSD value: 0.0484  
PMSD: 9.3

Lower PMSD bound determined by USEPA (10th percentile) = 12%  
Upper PMSD bound determined by USEPA (90th percentile) = 30%

Lower and upper PMSD bounds were determined from the 10th and 90th percentile, respectively, of PMSD data from EPA's WIT Interlaboratory Variability Study (USEPA, 2001a; USEPA, 2001b).

USEPA: 2001a, 2001b. Final Report: Interlaboratory Variability Study of EPA Short-term Chronic and Acute Whole Effluent Toxicity Test Methods, Volumes 1 and 2-Appendix. EPA-821-D-01-004 and EPA-821-D-01-005. U.S. Environmental Protection Agency, Cincinnati, OH.

Reviewed and  
Approved by  
J. L. Leland

**TVA / Sequoyah Nuclear Plant, Outfall 101**  
**August 02-09, 2016**



**Statistical Analyses**

Larval Fish Growth and Survival Test-7 Day Growth			
Start Date: 8/2/2016	Test ID: PpFRCR	Sample ID: TVA / SON Outfall 101	
End Date: 8/9/2016	Lab ID: ETS-Envir. Testing Sol.	Sample Type: DMR-Discharge Monitoring Report	
Sample Date: August 2016	Protocol: FWCHR-EPA-821-R-02-013	Test Species: PP-Pimephales promelas	
Comments:			

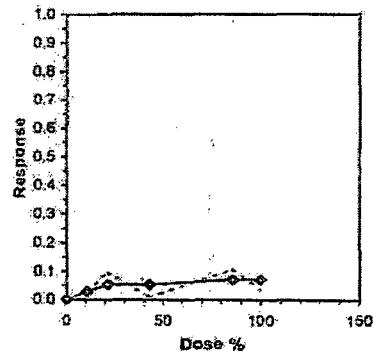
Conc-%	1	2	3	4
Control-NON	0.5870	0.5550	0.5250	0.4230
Control-UV	0.5650	0.4820	0.5480	0.4780
10.7	0.4880	0.4610	0.5160	0.5490
21.4	0.5270	0.4650	0.4300	0.4490
42.8	0.4810	0.5090	0.5370	0.5280
85.6	0.4700	0.4990	0.4310	0.4490
100	0.4660	0.5020	0.5340	0.5010
Intake	0.4790	0.5110	0.4950	0.4600

Conc-%	Mean	N-Mean	Transform: Untransformed			N	t-Stat	1-Tailed Critical	MSD	Isotonic	
			Mean	Min	Max					Mean	N-Mean
Control-NON	0.5225	1.0082	0.5225	0.4230	0.5870	13.689	4				
Control-UV	0.5183	1.0000	0.5183	0.4780	0.5650	8.633	4			0.5183	1.0000
10.7	0.5035	0.9715	0.5035	0.4610	0.5490	7.496	4	0.593	2.410	0.0600	0.5035
21.4	0.4678	0.9026	0.4678	0.4300	0.5270	8.981	4	2.030	2.410	0.0600	0.4908
42.8	0.5138	0.9913	0.5138	0.4810	0.5370	4.819	4	0.181	2.410	0.0600	0.4908
85.6	0.4623	0.8919	0.4623	0.4310	0.4990	6.323	4	2.251	2.410	0.0600	0.4815
100	0.5008	0.9662	0.5008	0.4660	0.5340	5.547	4	0.703	2.410	0.0600	0.4815
Intake	0.4853	0.9383	0.4853	0.4600	0.5110	4.491	4				

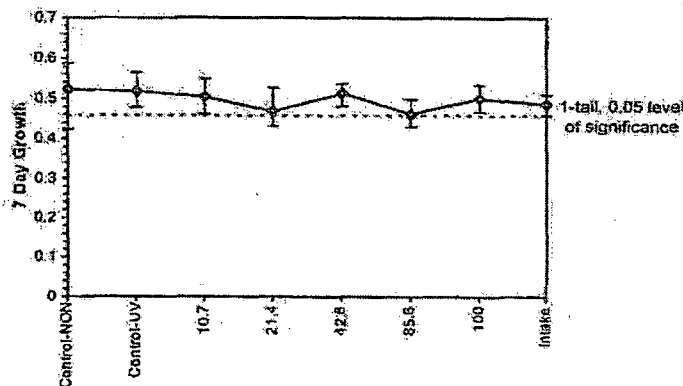
Auxiliary Tests		Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution ( $p > 0.01$ )		0.94198	0.884	0.26917	-1.0903
Bartlett's Test indicates equal variances ( $p = 0.91$ )		1.52143	15.0863		
The control means are not significantly different ( $p = 0.92$ )		0.10129	2.44691		
Hypothesis Test (1-tail, 0.05)		NOEC	LOEC	Chv	TU
Dunnnett's Test		100	>100	1	0.05997
Treatments vs Control-UV					0.11571
					0.00225
					0.00124
					0.16049
					5, 18

Linear Interpolation (200 Resamples)

Point	%	SD	95% CL(Exp)	Skew
IC05	20.088			
IC10	>100			
IC15	>100			
IC20	>100			
IC25	>100			
IC40	>100			
IC50	>100			



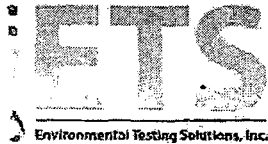
Dose-Response Plot



Reviewed and  
 Approved by  
 [Signature]



**TVA / Sequoyah Nuclear Plant, Outfall 101 - Intake**  
**August 02-09, 2016**



**Statistical Analyses**

**Larval Fish Growth and Survival Test-7 Day Growth**

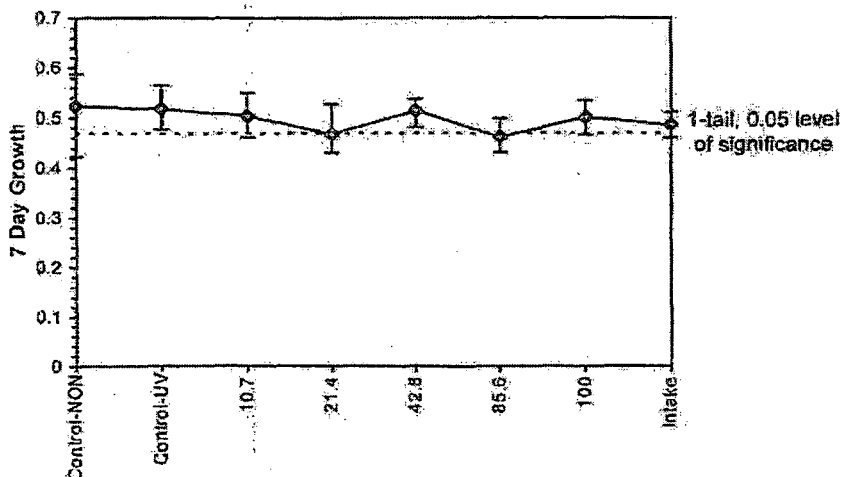
Start Date: 8/2/2016	Test ID: PpFRGR	Sample ID: TVA / SQN Outfall 101 - Intake
End Date: 8/9/2016	Lab ID: ETS-Envir. Testing Sol.	Sample Type: DMR-Discharge Monitoring Report
Sample Date: August 2016	Protocol: FWCHR-EPA-821-R-02-013	Test Species: PP-Pimephales promelas
Comments:		

Conc-%	1	2	3	4
Control-NON	0.5870	0.5550	0.5250	0.4230
Control-UV	0.5650	0.4820	0.5480	0.4780
10.7	0.4880	0.4610	0.5160	0.5490
21.4	0.5270	0.4650	0.4300	0.4490
42.8	0.4810	0.5090	0.5370	0.5280
85.6	0.4700	0.4990	0.4310	0.4490
100	0.4660	0.5020	0.5340	0.5010
Intake	0.4790	0.5110	0.4950	0.4600

Conc-%	Mean	N-Mean	Transform: Untransformed				N	1-Tailed		
			Mean	Min	Max	CV%		t-Stat	Critical	MSD
Control-NON	0.5225	1.0082	0.5225	0.4230	0.5870	13.569	4			
Control-UV	0.5183	1.0000	0.5183	0.4780	0.5650	8.633	4			
10.7	0.5035	0.9715	0.5035	0.4610	0.5490	7.496	4			
21.4	0.4678	0.9026	0.4678	0.4300	0.5270	8.981	4			
42.8	0.5138	0.9913	0.5138	0.4810	0.5370	4.819	4			
85.6	0.4623	0.8919	0.4623	0.4310	0.4990	6.323	4			
100	0.5008	0.9662	0.5008	0.4660	0.5340	5.547	4			
Intake	0.4863	0.9383	0.4863	0.4600	0.5110	4.491	4	1.285	1.943	0.0484

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution ( $p > 0.01$ )	0.9337	0.749	0.07167	-1.6273
F-Test indicates equal variances ( $p = 0.27$ )	4.19692	47.4683		
The control means are not significantly different ( $p = 0.92$ )	0.10129	2.44691		
Hypothesis Test (1-tail, 0.05)	MSDu	MSDp	MSB	MSE
Homoscedastic t Test indicates no significant differences	0.04837	0.09333	0.00205	0.00124
Treatments vs Control-UV	F-Prob	df		
	0.24599	1, 6		

**Dose-Response Plot**



Entered and  
Reviewed by  
JPM/BJM

Independent  
Review by  
Kelley E. Keenan



Species: *Pimephales promelas*

Client: TVA / Sequoyah Nuclear Plant, Outfall 101, UV-treated

Date: 08-02-16

Daily Chemistry:

Analyst		Day (Analyst identified for each day, performed pH, D.O. and conductivity measurements only.)					
		0		1		2	
		N/A	MS NG	MS NG	MS NG	MS NG	NG
Concentration	Parameter						
CONTROL UV-treated	pH (S.U.)	8.04-8.0	7.88	7.89	7.77	7.86	7.78
	DO (mg/L)	7.8	7.8	7.8	7.8 (1.8)	7.8	7.8
	Conductivity (µmhos/cm)	301		315	312	312	
	*Alkalinity (mg CaCO <sub>3</sub> /L)	59				59	
	*Hardness (mg CaCO <sub>3</sub> /L)	90				88	
	*Temperature (°C)	24.8	24.5	24.7	24.5	24.7	24.6
10.7%	pH (S.U.)	8.64	7.84	7.91	7.76	7.88	7.72
	DO (mg/L)	7.8	7.8	7.8	7.9	7.8	7.8
	Conductivity (µmhos/cm)	294		308		305	
	*Temperature (°C)	24.9	24.7	24.8	24.2	24.7	24.2
21.4%	pH (S.U.)	8.04	7.84	7.92	7.77	7.88	7.74
	DO (mg/L)	7.8	7.8	7.8	7.9	7.8	7.9
	Conductivity (µmhos/cm)	285		294		295	
	*Temperature (°C)	25.0	24.6	24.6	24.2	24.7	24.5
42.8%	pH (S.U.)	8.03	7.85	7.93	7.77	7.89	7.74
	DO (mg/L)	7.9	7.9	7.9	7.9	7.9	7.9
	Conductivity (µmhos/cm)	265		270		272	
	*Temperature (°C)	25.0	24.4	24.8	24.4	24.7	24.5
85.6%	pH (S.U.)	8.03	7.89	7.96	7.77	7.93	7.74
	DO (mg/L)	7.9	7.9	7.9	7.9	7.9	7.9
	Conductivity (µmhos/cm)	223		227		226	
	*Temperature (°C)	25.0	24.4	24.8	24.4	24.7	24.6
100%	pH (S.U.)	8.03	7.89	7.98	7.78	7.93	7.74
	DO (mg/L)	8.0	7.9	7.9	8.0	8.0	7.9
	Conductivity (µmhos/cm)	206		210		207	
	*Alkalinity (mg CaCO <sub>3</sub> /L)	74				78	
	*Hardness (mg CaCO <sub>3</sub> /L)	82				82	
	*TR chlorine (mg/L)	<0.10				<0.10	
	*Temperature (°C)	25.1	24.4	24.8	24.2	24.9	24.3
100% Intake	pH (S.U.)	7.99	7.89	7.99	7.80	7.93	7.75
	DO (mg/L)	8.0	7.9	8.0	8.0	8.0	8.0
	Conductivity (µmhos/cm)	199		208		206	
	*Alkalinity (mg CaCO <sub>3</sub> /L)	74				74	
	*Hardness (mg CaCO <sub>3</sub> /L)	73				82	
	*TR chlorine (mg/L)	<0.10				<0.10	
	*Temperature (°C)	25.0	24.5	24.7	24.5	24.8	24.4
		Initial	Final	Initial	Final	Initial	Final

\*Temperatures performed at the time of test initiation, renewal or termination by the analyst identified in the Daily Renewal Information table located on Page 1.  
Total residual chlorine was performed on non-treated Outfall 101 and intake samples.

Species: *Pimephales promelas*

Client: TVA / Sequoyah Nuclear Plant, Outfall 101, UV-treated

Date: 08-02-16

Analyst		Day (Analyst identified for each day, performed pH, D.O. and conductivity measurements only.)							
		3		4		5		6	
		N6	N	N	H5 N	H5 N	N6	N6	H5 N6
Concentration	Parameter								
CONTROL UV-treated	pH (S.U.)	7.94	7.40	7.94	7.75	7.82	7.88	7.88	7.89
	DO (mg/L)	7.8	5.5	7.0	7.3	8.0	7.8	7.8	7.9
	Conductivity (µmhos/cm)	322		308		312		317	
	*Alkalinity (mg CaCO <sub>3</sub> /L)	<del>8.15</del>		58		<del>8.15</del>		<del>8.15</del>	
	*Hardness (mg CaCO <sub>3</sub> /L)	<del>8.15</del>		90		<del>8.15</del>		<del>8.15</del>	
	*Temperature (°C)	24.7	24.4	24.7	24.7	24.7	24.5	24.6	24.6
10.7%	pH (S.U.)	7.94	7.49	7.95	7.73	7.83	7.86	8.02	7.85
	DO (mg/L)	7.8	5.5	7.0	7.2	7.9	7.9	7.9	7.9
	Conductivity (µmhos/cm)	309		290		305		311	
	*Temperature (°C)	24.7	24.6	24.8	24.7	24.8	24.5	24.7	24.3
21.4%	pH (S.U.)	7.94	7.50	8.00	7.74	7.84	7.85	8.02	7.85
	DO (mg/L)	7.8	5.4	7.0	7.0	8.0	7.9	7.9	7.9
	Conductivity (µmhos/cm)	298		287		289		300	
	*Temperature (°C)	24.8	24.6	24.9	24.5	24.8	24.7	24.7	24.6
42.8%	pH (S.U.)	7.94	7.51	8.02	7.74	7.85	7.85	8.02	7.86
	DO (mg/L)	7.9	5.5	7.9	7.1	8.2	7.9	8.0	7.9
	Conductivity (µmhos/cm)	275		267		269		277	
	*Temperature (°C)	24.8	24.3	24.9	24.7	24.9	24.7	24.7	24.7
85.6%	pH (S.U.)	7.95	7.52	8.04	7.74	7.86	7.84	8.03	7.88
	DO (mg/L)	7.9	5.5	7.9	7.1	8.2	7.9	8.1	8.0
	Conductivity (µmhos/cm)	226		223		224		233	
	*Temperature (°C)	24.8	24.5	24.9	24.7	24.9	24.7	24.7	24.5
100%	pH (S.U.)	7.99	7.54	8.00	7.73	7.88	7.82	8.06	7.87
	DO (mg/L)	7.9	5.5	8.0	7.1	8.2	7.8	8.2	8.0
	Conductivity (µmhos/cm)	213		207		205		215	
	*Alkalinity (mg CaCO <sub>3</sub> /L)			76					
	*Hardness (mg CaCO <sub>3</sub> /L)			86					
	*TR chlorine (mg/L)			<0.10					
	*Temperature (°C)	24.9	24.5	25.0	24.7	25.0	24.3	24.8	24.5
100% Intake	pH (S.U.)	7.99	7.65	8.00	7.79	7.89	7.91	8.07	7.90
	DO (mg/L)	8.0	6.3	8.0	7.2	8.2	7.8	8.1	8.0
	Conductivity (µmhos/cm)	209		204		200		208	
	*Alkalinity (mg CaCO <sub>3</sub> /L)			72					
	*Hardness (mg CaCO <sub>3</sub> /L)			78					
	*TR chlorine (mg/L)			<0.10					
	*Temperature (°C)	24.8	24.5	25.0	24.6	24.8	24.6	24.8	24.4
		Initial	Final	Initial	Final	Initial	Final	Initial	Final

\*Temperatures performed at the time of test initiation, renewal or termination by the analyst identified in the Daily Renewal Information table located on Page 1.  
\*Alkalinity, hardness and total residual chlorine performed by the analyst identified on the bench sheet specific for each analysis and transcribed to this bench sheet.  
Total residual chlorine was performed on non-treated Outfall 101 and Intake samples.



Species: Pimephales promelas  
Client: TVA / Sequoyah Nuclear Plant, Outfall 101, UV-treated

Date: 08-02-16

## Daily Chemistry:

		Day (Analyst identified for each day, performed pH, D.O. and conductivity measurements only.)					
		0		1		2	
		Analyst	NG	MS NG	NG	NG	MS NG
Concentration	Parameter						
Control Non-treated	pH (S.U.)	8.09	7.82	7.88	8.06	7.80	7.76
	DO (mg/L)	7.8	7.9	7.8	7.8	7.8	7.8
	Conductivity (µmhos/cm)	308		318		330	
	*Alkalinity (mg CaCO <sub>3</sub> /L)	59		<del>None</del>		62	
	*Hardness (mg CaCO <sub>3</sub> /L)	68				96	
	*Temperature (°C)	24.7	24.6	24.8	24.5	24.7	24.4
		Initial	Final	Initial	Final	Initial	Final

		Day (Analyst identified for each day, performed pH, D.O. and conductivity measurements only.)								
		3		4		5		6		
		Analyst	NG	u	u	MSu	MS u	NG	NG	MS
Concentration	Parameter									
Control Non-treated	pH (S.U.)	7.83	7.51	7.99	7.78	7.73	7.86	7.94	7.91/7.85	
	DO (mg/L)	7.8	6.4	7.8	7.5	7.7	7.8	7.8	7.9	
	Conductivity (umhos/cm)	321		318		389 (320)		317		
	*Alkalinity (mg CaCO <sub>3</sub> /L)	<del>None</del>		59		<del>None</del>		<del>None</del>		
	*Hardness (mg CaCO <sub>3</sub> /L)	<del>None</del>		90		<del>None</del>		<del>None</del>		
	*Temperature (°C)	24.7	24.3	24.8	25.0	24.7	24.3	24.7	24.3	
		Initial	Final	Initial	Final	Initial	Final	Initial	Final	

\*Temperatures performed at the time of test initiation, renewal or termination by the analyst identified in the Daily Renewal Information table located on Page 1.  
Alkalinity, hardness and total residual chlorine performed by the analyst identified on the bench sheet specific for each analysis and transcribed to this bench sheet by: \_\_\_\_\_



**TVA / Sequoyah Nuclear Plant, Outfall 101, UV-treated**  
**August 02-09, 2016**

***Pimephales promelas* Chronic Whole Effluent Toxicity Test**  
**EPA-821-R-02-013, Method 1000.0**

**Daily Chemical Analyses**

Project number: 11637

Concentration	Parameter	Day 0		Day 1		Day 2		Day 3		Day 4		Day 5		Day 6	
		Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final
Control, Non-treated	pH (SU)	8.09	7.82	7.88	8.06	7.80	7.76	7.83	7.51	7.99	7.78	7.73	7.86	7.94	7.85
	DO (mg/L)	7.8	7.8	7.8	7.8	7.8	7.8	7.8	6.4	7.8	7.5	7.7	7.8	7.8	7.9
	Conductivity (umhos/cm)	308		318		330		321		318		320		317	
	Alkalinity (mg/L CaCO <sub>3</sub> )	59				62				59					
	Hardness (mg/L CaCO <sub>3</sub> )	88				96				90					
	Temperature (°C)	24.7	24.6	24.8	24.5	24.7	24.4	24.7	24.3	24.8	25.0	24.7	24.3	24.7	24.3
Control, UV-treated	pH (SU)	8.02	7.88	7.89	7.77	7.86	7.78	7.94	7.48	7.94	7.75	7.82	7.88	8.02	7.89
	DO (mg/L)	7.8	7.8	7.8	7.8	7.8	7.8	7.8	5.5	7.8	7.3	8.0	7.8	7.8	7.9
	Conductivity (umhos/cm)	301		315		312		322		308		312		317	
	Alkalinity (mg/L CaCO <sub>3</sub> )	59				59				58					
	Hardness (mg/L CaCO <sub>3</sub> )	90				88				90					
	Temperature (°C)	24.8	24.5	24.7	24.5	24.7	24.6	24.7	24.4	24.7	24.7	24.7	24.5	24.6	24.6
10.7%	pH (SU)	8.04	7.84	7.91	7.76	7.88	7.72	7.94	7.49	7.95	7.73	7.83	7.86	8.02	7.85
	DO (mg/L)	7.8	7.8	7.8	7.9	7.8	7.8	7.8	5.5	7.8	7.2	7.9	7.9	7.9	7.9
	Conductivity (umhos/cm)	294		308		305		309		298		305		311	
	Temperature (°C)	24.9	24.7	24.8	24.2	24.7	24.2	24.7	24.6	24.8	24.7	24.8	24.5	24.7	24.3
21.4%	pH (SU)	8.04	7.84	7.92	7.77	7.88	7.74	7.94	7.50	8.00	7.74	7.84	7.85	8.02	7.85
	DO (mg/L)	7.8	7.8	7.8	7.9	7.8	7.9	7.8	5.4	7.8	7.0	8.0	7.9	7.9	7.9
	Conductivity (umhos/cm)	285		294		295		298		287		289		300	
	Temperature (°C)	25.0	24.6	24.8	24.2	24.7	24.5	24.8	24.6	24.9	24.5	24.8	24.7	24.7	24.6
42.8%	pH (SU)	8.03	7.85	7.93	7.77	7.89	7.74	7.94	7.51	8.02	7.74	7.85	7.85	8.02	7.86
	DO (mg/L)	7.9	7.9	7.9	7.9	7.9	7.9	7.9	5.3	7.9	7.1	8.2	7.9	8.0	7.9
	Conductivity (umhos/cm)	265		270		272		275		267		269		277	
	Temperature (°C)	25.0	24.4	24.8	24.4	24.7	24.5	24.8	24.3	24.9	24.7	24.9	24.7	24.7	24.7
85.6%	pH (SU)	8.03	7.89	7.96	7.77	7.93	7.74	7.95	7.52	8.04	7.74	7.86	7.84	8.03	7.88
	DO (mg/L)	7.9	7.9	7.9	7.9	7.9	7.9	7.9	5.3	7.9	7.1	8.2	7.9	8.1	8.0
	Conductivity (umhos/cm)	223		227		226		226		223		224		233	
	Temperature (°C)	25.0	24.4	24.8	24.4	24.7	24.6	24.8	24.5	24.9	24.7	24.9	24.7	24.7	24.5
100%	pH (SU)	8.03	7.89	7.98	7.78	7.93	7.74	7.99	7.54	8.08	7.73	7.88	7.82	8.06	7.87
	DO (mg/L)	8.0	7.9	7.9	8.0	8.0	7.9	7.9	5.5	8.0	7.1	8.2	7.8	8.2	8.0
	Conductivity (umhos/cm)	206		210		207		213		207		205		215	
	Alkalinity (mg/L CaCO <sub>3</sub> )	74				78				76					
	Hardness (mg/L CaCO <sub>3</sub> )	82				82				86					
	*Total Residual Chlorine (mg/L)	<0.10				<0.10				<0.10					
100% Intake	Temperature (°C)	25.1	24.4	24.8	24.2	24.9	24.3	24.9	24.5	25.0	24.7	25.0	24.3	24.8	24.5
	pH (SU)	7.99	7.89	7.99	7.80	7.93	7.75	7.99	7.65	8.06	7.79	7.89	7.91	8.07	7.90
	DO (mg/L)	8.0	7.9	8.0	8.0	8.0	8.0	8.0	6.3	8.0	7.2	8.3	7.8	8.1	8.0
	Conductivity (umhos/cm)	199		208		206		209		204		200		208	
	Alkalinity (mg/L CaCO <sub>3</sub> )	74				74				72					
	Hardness (mg/L CaCO <sub>3</sub> )	73				82				78					
100% Intake	*Total Residual Chlorine (mg/L)	<0.10				<0.10				<0.10					
	Temperature (°C)	25.0	24.5	24.7	24.5	24.8	24.4	24.8	24.5	25.0	24.6	24.8	24.6	24.8	24.4

\*Note: Total residual chlorine was performed on non-treated Outfall 101 and Intake samples.

File: sqn101\_080216chem.xlsx  
 Entered by: J. Sumner  
 Reviewed by: *JS*



Environmental Testing Solutions, Inc.



**Chronic Whole Effluent Toxicity Test (EPA-821-R-02-013 Method 1002.0)**  
**Species: Ceriodaphnia dubia**

**Client:** Tennessee Valley Authority  
**Facility:** Sequoyah Nuclear Plant  
**NPDES #:** TN0026450  
**Project #:** 11637

**County:** Hamilton  
**Outfall:** 101

Dilution preparation information:						Comments:
Dilution prep (%)	10.7	21.4	42.8	85.6	100	
Effluent volume (mL)	267.5	535	1070	2140	2500	
Diluent volume (mL)	2232.5	1965	1430	360	0	
Total volume (mL)	2500	2500	2500	2500	2500	

Test organism source information:						Test information:
Organism age:			< 24-hours old			Randomizing template color:
Date and times organisms were born between:			08-02-16 0640 TO 0905			Incubator number and shelf location:
Culture board:			07-26-16 A 07-26-16 B			YWT batch:
Replicate number:			1 2 3 4 5 6 7 8 9 10			Selenastrum batch:
Culture board cup number:			38 39 4 7 8 12 16 18 19 23			
Transfer vessel information:			pH = 8.03 S.U. Temperature = 75.0 °C			
Average transfer volume (mL):			0.03 mL			

**Daily renewal information:**

Day	Date	Test initiation and feeding, renewal and feeding, or termination time	MHSW batch used	Sample numbers used		Analyst
				Outfall 101	Intake	
0	08-02-16	0927	07-29-16	160801.02	160801.03	JH
1	08-03-16	0830	07-29-16	160801.02	160801.03	JH
2	08-04-16	0828	08-02-16A	160803.23	160803.24	JH
3	08-05-16	0827	08-02-16A	160803.23	160803.24	JH
4	08-06-16	0930	08-02-16B	160805.15	160805.16	JH
5	08-07-16	0827	08-02-16B	160805.15	160805.16	JH
6	08-08-16	0827	08-02-16B	160805.15	160805.16	JH
7	08-09-16	0831				JH

Control information:				Summary of test endpoints:	
	Control-1	Control-2	Acceptance criteria		
% of Male Adults:	07.	07.	≤ 20%	7-day LC <sub>50</sub>	> 1007.
% Adults having 3 <sup>rd</sup> Broods:	1007.	1007.	≥ 80%	NOEC	1007.
% Mortality:	07.	07.	≤ 20%	LOEC	> 1007.
Mean Offspring/Female:	30.6	30.5	≥ 15.0 offspring/female	ChV	> 1007.
% CV:	5.67.	4.97.	< 40.0 %	IC <sub>25</sub>	> 1007.



Species: *Ceriodaphnia dubia*

Client: TVA / Sequoyah Nuclear Plant, Outfall 101

Date: 08-02-16

CONTROL-1

Survival and Reproduction Data

Day		Replicate number									
		1	2	3	4	5	6	7	8	9	10
1	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
2	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
3	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
4	Young produced	5	5	4	4	4	5	4	3	4	4
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	10	10	13	12	13	11	10	10	12	10
	Adult mortality	L	L	L	L	L	L	L	L	L	L
6	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
7	Young produced	16	16	14	18	15	14	17	15	13	15
Total young produced		31	31	31	34	32	30	31	28	29	29
Final Adult Mortality		L	L	L	L	L	L	L	L	L	L
X for 3 <sup>rd</sup> Broods		X	X	X	X	X	X	X	X	X	X

Note: Adult mortality (L = live, D = dead), SB = split brood (single brood split between two days), CO = carry over (offspring carried over with adult during transfer).

Concentrations:	
% Mortality:	07.
Mean Offspring/Female:	30.6

CONC: 10.7%

Survival and Reproduction Data

Day		Replicate number									
		1	2	3	4	5	6	7	8	9	10
1	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
2	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
3	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
4	Young produced	5	4	5	4	4	4	5	3	5	4
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	10	13	11	13	12	12	12	10	11	11
	Adult mortality	L	L	L	L	L	L	L	L	L	L
6	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
7	Young produced	16	15	16	18	14	17	18	16	17	17
Total young produced		31	32	32	35	30	33	35	29	33	32
Final Adult Mortality		L	L	L	L	L	L	L	L	L	L

Note: Adult mortality (L = live, D = dead), SB = split brood (single brood split between two days), CO = carry over (offspring carried over with adult during transfer).

Concentrations:	
% Mortality:	07.
Mean Offspring/Female:	32.2
% Reduction from Control-1:	-5.27.



Species: *Ceriodaphnia dubia*

Client: TVA / Sequoyah Nuclear Plant, Outfall 101

Date: 08-02-16

CONC: 21.4%

**Survival and Reproduction Data**

Day		Replicate number									
		1	2	3	4	5	6	7	8	9	10
1	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
2	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
3	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
4	Young produced	4	4	5	4	5	4	4	4	5	5
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	13	10	12	12	12	13	10	12	14	11
	Adult mortality	L	L	L	L	L	L	L	L	L	L
6	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
7	Young produced	14	18	15	18	15	19	16	15	15	15
Total young produced		31	32	32	34	32	36	30	31	34	31
Final Adult Mortality		L	L	L	L	L	L	L	L	L	L

Note: Adult mortality (L = live, D = dead), SB = split brood (single brood split between two days), CO = carry over (offspring carried over with adult during transfer).

<b>Concentration:</b>	
% Mortality:	01.
Mean Offspring/Female:	32.3
% Reduction from Control-1:	-5.67.

CONC: 42.8%

**Survival and Reproduction Data**

Day		Replicate number									
		1	2	3	4	5	6	7	8	9	10
1	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
2	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
3	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
4	Young produced	5	4	5	5	4	6	4	5	5	5
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	11	14	12	12	10	13	12	12	13	11
	Adult mortality	L	L	L	L	L	L	L	L	L	L
6	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
7	Young produced	18	17	18	14	19	15	16	15	19	14
Total young produced		34	35	35	31	33	34	32	32	37	30
Final Adult Mortality		L	L	L	L	L	L	L	L	L	L

Note: Adult mortality (L = live, D = dead), SB = split brood (single brood split between two days), CO = carry over (offspring carried over with adult during transfer).

<b>Concentration:</b>	
% Mortality:	01.
Mean Offspring/Female:	33.3
% Reduction from Control-1:	-8.87.





Species: Ceriodaphnia dubia

Client: TVA / Sequoyah Nuclear Plant, Outfall 101

Date: 08-02-16

CONC: 85.6%

**Survival and Reproduction Data**

Day		Replicate number									
		1	2	3	4	5	6	7	8	9	10
1	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
2	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
3	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
4	Young produced	3	5	5	4	5	5	5	5	6	5
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	14	12	11	13	12	12	11	12	10	12
	Adult mortality	L	L	L	L	L	L	L	L	L	L
6	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
7	Young produced	15	15	18	19	17	19	14	17	14	16
Total young produced		32	32	34	36	34	36	30	34	30	33
Final Adult Mortality		L	L	L	L	L	L	L	L	L	L

Note: Adult mortality (L = live, D = dead), SB = split brood (single brood split between two days), CO = carry over (offspring carried over with adult during transfer).

<b>Concentration:</b>	
% Mortality:	01.
Mean Offspring/Female:	33.1
% Reduction from Control-1:	-8.27.

CONC: 100%

**Survival and Reproduction Data**

Day		Replicate number									
		1	2	3	4	5	6	7	8	9	10
1	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
2	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
3	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
4	Young produced	6	5	5	6	4	5	5	6	6	5
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	13	12	12	10	13	13	14	12	12	13
	Adult mortality	L	L	L	L	L	L	L	L	L	L
6	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
7	Young produced	18	18	19	15	19	17	19	19	15	18
Total young produced		37	35	36	31	36	35	38	37	33	36
Final Adult Mortality		L	L	L	L	L	L	L	L	L	L

Note: Adult mortality (L = live, D = dead), SB = split brood (single brood split between two days), CO = carry over (offspring carried over with adult during transfer).

<b>Concentration:</b>	
% Mortality:	01.
Mean Offspring/Female:	35.4
% Reduction from Control-1:	-15.77.

Independent  
Review by  
Katelyn E. Korman

Species: Ceriodaphnia dubia

Client: TVA / Sequoyah Nuclear Plant, Outfall 101

Date: 08-02-16

**CONTROL-2**

**Survival and Reproduction Data**

Day		Replicate number									
		1	2	3	4	5	6	7	8	9	10
1	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
2	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
3	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
4	Young produced	3	3	5	3	4	4	5	5	3	4
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	10	13	11	13	13	10	10	12	11	11
	Adult mortality	L	L	L	L	L	L	L	L	L	L
6	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
7	Young produced	16	17	15	13	14	14	17	14	17	15
Total young produced		29	33	31	29	31	28	32	31	31	30
Final Adult Mortality		L	L	L	L	L	L	L	L	L	L
X for 3 <sup>rd</sup> Broods		X	X	X	X	X	X	X	X	X	X

Note: Adult mortality (L = live, D = dead), SB = split brood (single brood split between two days), CO = carry over (offspring carried over with adult during transfer).

<b>Concentration:</b>	
% Mortality:	07
Mean Offspring/Female:	30.5

**CONC: 100% Intake**

**Survival and Reproduction Data**

Day		Replicate number									
		1	2	3	4	5	6	7	8	9	10
1	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
2	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
3	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
4	Young produced	5	5	4	5	5	6	4	6	6	4
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	10	10	14	12	12	14	11	13	12	12
	Adult mortality	L	L	L	L	L	L	L	L	L	L
6	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
7	Young produced	20	18	17	15	20	18	17	17	15	18
Total young produced		35	33	35	32	37	38	32	36	33	34
Final Adult Mortality		L	L	L	L	L	L	L	L	L	L

Note: Adult mortality (L = live, D = dead), SB = split brood (single brood split between two days), CO = carry over (offspring carried over with adult during transfer).

<b>Concentration:</b>	
% Mortality:	07
Mean Offspring/Female:	34.5
% Reduction from Control-2:	-13.17

TVA / Sequoyah Nuclear Plant, Outfall 101  
August 02-09, 2016



Verification of *Ceriodaphnia* Reproduction Totals

Control-1

Day	Replicate number										Total
	1	2	3	4	5	6	7	8	9	10	
1	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0
4	5	5	4	4	4	5	4	3	4	4	43
5	10	10	13	12	13	11	10	10	12	10	111
6	0	0	0	0	0	0	0	0	0	0	0
7	16	16	14	18	15	14	17	15	13	15	153
Total	31	31	31	34	32	30	31	28	29	29	306

85.6%

Day	Replicate number										Total
	1	2	3	4	5	6	7	8	9	10	
1	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0
4	3	3	5	4	5	5	5	5	6	5	48
5	14	12	14	13	12	12	11	13	10	12	119
6	0	0	0	0	0	0	0	0	0	0	0
7	15	15	18	19	17	19	14	17	14	16	164
Total	32	32	34	36	34	36	30	34	30	33	331

10.7%

Day	Replicate number										Total
	1	2	3	4	5	6	7	8	9	10	
1	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0
4	5	4	5	4	4	4	5	3	5	4	43
5	10	13	11	13	12	12	12	10	11	11	115
6	0	0	0	0	0	0	0	0	0	0	0
7	16	15	16	18	14	17	18	16	17	17	164
Total	31	32	32	35	30	33	35	29	33	32	322

100%

Day	Replicate number										Total
	1	2	3	4	5	6	7	8	9	10	
1	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0
4	6	5	5	6	4	5	5	6	6	5	53
5	13	12	12	10	13	13	14	12	12	13	124
6	0	0	0	0	0	0	0	0	0	0	0
7	18	18	19	15	19	17	19	15	18	18	177
Total	37	35	36	31	36	35	38	37	33	36	354

21.4%

Day	Replicate number										Total
	1	2	3	4	5	6	7	8	9	10	
1	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0
4	4	4	5	4	5	4	4	4	5	5	44
5	13	10	12	12	12	13	10	12	13	11	119
6	0	0	0	0	0	0	0	0	0	0	0
7	14	15	15	18	15	19	16	15	15	15	160
Total	31	32	32	34	32	36	30	31	34	31	323

Control-2

Day	Replicate number										Total
	1	2	3	4	5	6	7	8	9	10	
1	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0
4	3	3	5	3	4	4	5	5	3	4	39
5	10	13	11	13	13	10	10	12	11	11	114
6	0	0	0	0	0	0	0	0	0	0	0
7	16	17	15	13	14	14	17	14	17	15	152
Total	29	33	31	29	31	28	32	31	31	30	305

42.8%

Day	Replicate number										Total
	1	2	3	4	5	6	7	8	9	10	
1	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0
4	5	4	5	5	4	6	4	5	5	5	48
5	11	10	12	12	10	13	12	12	13	11	120
6	0	0	0	0	0	0	0	0	0	0	0
7	18	17	18	14	19	15	16	15	19	14	165
Total	34	35	35	31	33	34	32	32	37	30	333

100% Intake

Day	Replicate number										Total
	1	2	3	4	5	6	7	8	9	10	
1	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0
4	5	5	4	5	5	6	4	6	6	4	50
5	10	10	14	12	12	14	11	13	12	12	120
6	0	0	0	0	0	0	0	0	0	0	0
7	20	18	17	15	20	18	17	17	15	18	175
Total	35	33	35	32	37	38	32	36	33	34	345

Verified by  
JH



**ETS**

Environmental Testing Solutions, Inc.

## TVA / Sequoyah Nuclear Plant, Outfall 101

August 02-09, 2016

Chronic Whole Effluent Toxicity Test (EPA-821-R-02-013, Method 1002.0)

*Ceriodaphnia dubia* Chronic Whole Effluent Toxicity Test

EPA-821-R-02-013, Method 1002.0

## Quality Control

## Verification of Data Entry, Calculations, and Statistical Analyses

Project number:

11637

Concentration (%)	Replicate number										Survival (%)	Average reproduction (offspring/female)	Coefficient of variation (%)	Percent reduction from pooled controls (%)
	1	2	3	4	5	6	7	8	9	10				
Control - 1	31	31	31	34	32	30	31	28	29	29	100	30.6	5.6	Not applicable
10.7%	31	32	32	35	30	33	35	29	33	32	100	32.2	6.0	-5.2
21.4%	31	32	32	34	32	36	30	31	34	31	100	32.3	5.7	-5.6
42.8%	34	35	35	31	33	34	32	32	37	30	100	33.3	6.3	-8.8
85.6%	32	32	34	36	34	36	30	34	30	33	100	33.1	6.4	-8.2
100%	37	35	36	31	36	35	38	37	33	36	100	35.4	5.8	-15.7
Control - 2	29	33	31	29	31	28	32	31	31	30	100	30.5	4.9	Not applicable
100% Intake	35	33	35	32	37	38	32	36	33	34	100	34.5	6.0	-13.1

**Outfall 101:**

Dunnett's MSD value:

2.014

PMSD:

6.6

MSD = Minimum Significant Difference.

PMSD = Percent Minimum Significant Difference

PMSD is a measure of test precision. The PMSD is the minimum percent difference between the control and treatment that can be declared statistically significant in a whole effluent toxicity test.

**Intake:**

Dunnett's MSD value:

1.404

PMSD:

4.6

Lower PMSD bound determined by USEPA (10<sup>th</sup> percentile) = 13%.Upper PMSD bound determined by USEPA (90<sup>th</sup> percentile) = 47%.

Lower and upper PMSD bounds were determined from the 10th and 90th percentile, respectively, of PMSD data from EPA's WET Interlaboratory Variability Study (USEPA, 2001a; USEPA, 2001b).

**TVA / Sequoyah Nuclear Plant, Outfall 101**  
**August 02-09, 2016**



**Statistical Analyses**

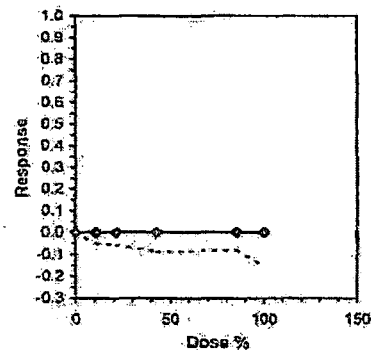
Ceriodaphnia Survival and Reproduction Test-Reproduction					
Start Date:	8/2/2016	Test ID:	CdFRCR	Sample ID:	TVA / SQN Outfall 101
End Date:	8/9/2016	Lab ID:	ETS-Envir. Testing Sol.	Sample Type:	DMR-Discharge Monitoring Report
Sample Date:	August 2016	Protocol:	FWCHR-EPA-821-R-02-013	Test Species:	CD-Ceriodaphnia dubia
Comments:					

Conc-%	1	2	3	4	5	6	7	8	9	10
Control-1	31.000	31.000	31.000	34.000	32.000	30.000	31.000	28.000	29.000	29.000
Control-2	29.000	33.000	31.000	29.000	31.000	28.000	32.000	31.000	31.000	30.000
10.7	31.000	32.000	32.000	35.000	30.000	33.000	35.000	29.000	33.000	32.000
21.4	31.000	32.000	32.000	34.000	32.000	36.000	30.000	31.000	34.000	31.000
42.8	34.000	35.000	35.000	31.000	33.000	34.000	32.000	32.000	37.000	30.000
85.6	32.000	32.000	34.000	39.000	34.000	36.000	30.000	34.000	30.000	33.000
100	37.000	35.000	36.000	31.000	36.000	35.000	38.000	37.000	33.000	36.000
Intake	35.000	33.000	35.000	32.000	37.000	38.000	32.000	36.000	33.000	34.000

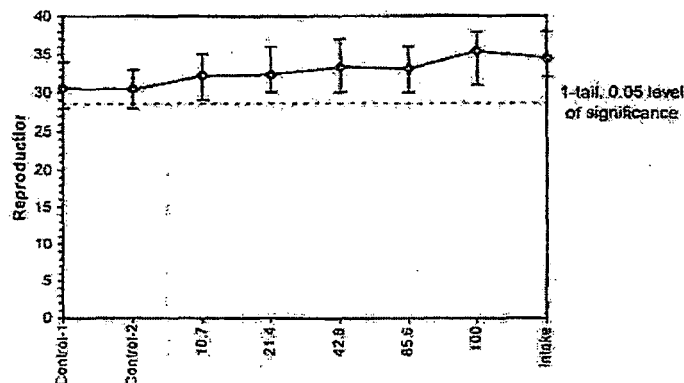
Conc-%	Mean	N-Mean	Transform: Untransformed				N	t-Stat	1-Tailed Critical	MSD	Isotonic	
			Mean	Min	Max	CV%					Mean	N-Mean
Control-1	30.600	1.0033	30.600	28.000	34.000	5.597	10				32.817	1.0000
Control-2	30.500	1.0000	30.500	28.000	33.000	4.948	10					
10.7	32.200	1.0557	32.200	29.000	35.000	6.001	10	-1.816	2.287	2.014	32.817	1.0000
21.4	32.300	1.0590	32.300	30.000	36.000	6.662	10	-1.930	2.287	2.014	32.817	1.0000
42.8	33.300	1.0918	33.300	30.000	37.000	6.339	10	-3.065	2.287	2.014	32.817	1.0000
85.6	33.100	1.0852	33.100	30.000	36.000	6.440	10	-2.838	2.287	2.014	32.817	1.0000
100	35.400	1.1607	35.400	31.000	38.000	5.835	10	-5.449	2.287	2.014	32.817	1.0000
Intake	34.500	1.1311	34.500	32.000	38.000	5.995	10					

Auxiliary Tests					Statistic	Critical	Skew	Kurt
Kolmogorov D Test indicates normal distribution ( $p > 0.01$ )					0.52869	1.035	-0.0462	-0.4108
Bartlett's Test indicates equal variances ( $p = 0.99$ )					0.64537	15.0883		
The control means are not significantly different ( $p = 0.89$ )					0.13853	2.10092		
Hypothesis Test (1-tail, 0.05)					NOEC	LOEC	ChV	TU
Dunnett's Test					100	>100		1
Treatments vs Control-1					MSDu	MSDp	MSB	MSE
					2.01425	0.06563	25.0967	3.87963
					F-Prob	df		
					8.9E-05	5, 54		

Point	%	SD	95% CL	Skew
IC05	>100			
IC10	>100			
IC15	>100			
IC20	>100			
IC25	>100			
IC40	>100			
IC50	>100			



Dose-Response Plot



Reviewed by

Independent  
 Review by  
 Kelly E. Keenan:

# TVA / Sequoyah Nuclear Plant, Outfall 101 - Intake

August 02-09, 2016



Environmental Testing Solutions, Inc.

## Statistical Analyses

### Ceriodaphnia Survival and Reproduction Test-Reproduction

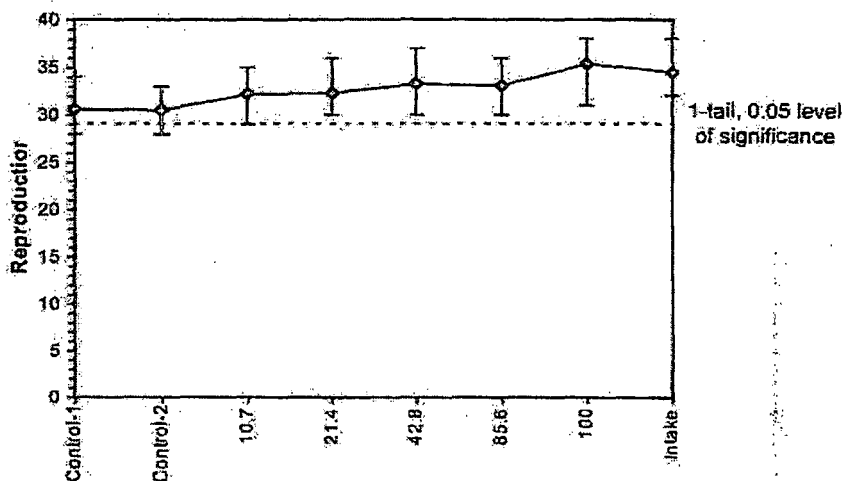
Start Date: 8/2/2016 Test ID: CdFRCR Sample ID: TVA / SQN Outfall 101 - Intake  
End Date: 8/9/2016 Lab ID: ETS-Envir. Testing Sol. Sample Type: DMR-Discharge Monitoring Report  
Sample Date: August 2016 Protocol: FWCHR-EPA-821-R-02-013 Test Species: CD-Ceriodaphnia dubia  
Comments:

Conc-%	1	2	3	4	5	6	7	8	9	10
Control-1	31.000	31.000	31.000	34.000	32.000	30.000	31.000	28.000	29.000	29.000
Control-2	29.000	33.000	31.000	29.000	31.000	28.000	32.000	31.000	31.000	30.000
10.7	31.000	32.000	32.000	35.000	30.000	33.000	35.000	29.000	33.000	32.000
21.4	31.000	32.000	32.000	34.000	32.000	36.000	30.000	31.000	34.000	31.000
42.8	34.000	35.000	35.000	31.000	33.000	34.000	32.000	32.000	37.000	30.000
85.6	32.000	32.000	34.000	36.000	34.000	35.000	30.000	34.000	30.000	33.000
100	37.000	35.000	36.000	31.000	36.000	35.000	38.000	37.000	33.000	36.000
Intake	35.000	33.000	35.000	32.000	37.000	38.000	32.000	36.000	33.000	34.000

Conc-%	Transform: Untransformed							1-Tailed		
	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
Control-1	30.600	1.0033	30.600	28.000	34.000	5.597	10			
Control-2	30.500	1.0000	30.500	28.000	33.000	4.948	10			
10.7	32.200	1.0557	32.200	29.000	35.000	6.001	10			
21.4	32.300	1.0590	32.300	30.000	36.000	5.662	10			
42.8	33.300	1.0918	33.300	30.000	37.000	6.339	10			
85.6	33.100	1.0852	33.100	30.000	36.000	6.440	10			
100	35.400	1.1607	35.400	31.000	38.000	5.835	10			
Intake	34.500	1.1311	34.500	32.000	38.000	5.995	10	-4.940	1.734	1.404

Auxiliary Tests	Statistic	Critical	Skew	Kurt		
Shapiro-Wilk's Test indicates normal distribution ( $p > 0.01$ )	0.9388	0.868	0.22443	-0.7205		
F-Test indicates equal variances ( $p = 0.36$ )	1.87805	6.54109				
The control means are not significantly different ( $p = 0.89$ )	0.13853	2.10092				
Hypothesis Test (1-tail, 0.05)	MSDu	MSDp	MSE	F-Prob	df	
Homoscedastic t Test indicates no significant differences	1.40401	0.04603	80	3.27778	1.1E-04	1, 18
Treatments vs Control-2						

### Dose-Response Plot



Entered and  
Reviewed by  
Jim Sumner  
JK



Species: Ceriodaphnia dubia

Date: 08-02-16

Client: TVA / Sequoyah Nuclear Plant, Outfall 101

**Daily Chemistry:**

Analyst		Day (Analyst identified for each day, performed pH, D.O. and conductivity measurements only.)					
		0		1		2	
		N6	MS N6	MS N6	MS N6	MS N6	N6
Concentration	Parameter						
CONTROL	pH (S.U.)	8.09	7.92	7.88	7.86	7.80	7.89
	DO (mg/L)	7.8	7.8	7.8	7.8	7.8	7.8
	Conductivity (µmhos/cm)	308		318		330	
	*Alkalinity (mg CaCO <sub>3</sub> /L)	59				62	
	*Hardness (mg CaCO <sub>3</sub> /L)	88				96	
	*Temperature (°C)	24.7	25.0	24.7	24.7	24.7	25.0
10.7%	pH (S.U.)	8.06	7.91	7.95	7.85	7.94	7.89
	DO (mg/L)	7.8	7.8	7.8	7.8	7.9	7.9
	Conductivity (µmhos/cm)	295		313		305	
	*Temperature (°C)	24.8	24.7	24.9	24.6	24.7	24.8
21.4%	pH (S.U.)	8.05	7.91	7.94	7.85	7.90	7.89
	DO (mg/L)	7.8	7.8	7.9	7.8	7.9	7.9
	Conductivity (µmhos/cm)	283		297		294	
	*Temperature (°C)	24.8	24.7	24.9	24.6	24.7	24.9
42.8%	pH (S.U.)	8.03	7.93	7.95	7.86	7.90	7.89
	DO (mg/L)	7.8	7.8	7.9	7.8	7.9	7.9
	Conductivity (µmhos/cm)	263		272		271	
	*Temperature (°C)	24.8	24.8	24.9	24.6	24.7	24.9
85.6%	pH (S.U.)	8.01	7.92	7.96	7.89	7.91	7.89
	DO (mg/L)	7.8	7.9	7.9	7.8	8.0	7.9
	Conductivity (µmhos/cm)	216		222		224	
	*Temperature (°C)	24.8	24.7	24.9	24.8	24.7	24.9
100%	pH (S.U.)	8.01	7.97	7.98	7.90	7.92	7.90
	DO (mg/L)	7.8	7.9	8.0	7.9	8.0	7.9
	Conductivity (µmhos/cm)	200		211		203	
	*Alkalinity (mg CaCO <sub>3</sub> /L)	76				80	
	*Hardness (mg CaCO <sub>3</sub> /L)	82				82	
	*TR chlorine (mg/L)	<0.10				<0.10	
	*Temperature (°C)	25.0	24.7	24.9	24.8	24.8	25.2
100% Intake	pH (S.U.)	7.96	7.96	8.00	7.92	7.93	7.95
	DO (mg/L)	8.0	7.9	8.0	7.9	8.0	7.9
	Conductivity (µmhos/cm)	197		210		202	
	*Alkalinity (mg CaCO <sub>3</sub> /L)	74				82	
	*Hardness (mg CaCO <sub>3</sub> /L)	73				82	
	*TR chlorine (mg/L)	<0.10				<0.10	
	*Temperature (°C)	24.9	24.6	24.9	24.7	24.8	25.2
		Initial	Final	Initial	Final	Initial	Final

\*Temperatures performed at the time of test initiation, renewal or termination by the analyst identified in the Daily Renewal Information table located on Page 1. Alkalinity, hardness and total residual chlorine performed by the analyst identified on the bench sheet specific for each analysis and transcribed to this bench sheet by: JS





Species: *Ceriodaphnia dubia*

Client: TVA / Sequoyah Nuclear Plant, Outfall 101

Date: 08-02-16

Analyst		Day (Analyst identified for each day, performed pH, D.O. and conductivity measurements only.)							
		3		4		5		6	
		MG	MS N	MS N	MS N	MS N	MG	MG	MS NG
Concentration	Parameter								
CONTROL	pH (S.U.)	7.83	8.03	7.99	7.97-9.2	7.73	7.97	7.94	7.99
	DO (mg/L)	7.8	8.0	7.8	8.0	7.7	7.9	7.8	7.8
	Conductivity (umhos/cm)	321		318		320		317	
	*Alkalinity (mg CaCO <sub>3</sub> /L)	<del>35</del>		59		<del>35</del>		<del>35</del>	
	*Hardness (mg CaCO <sub>3</sub> /L)			90					
	*Temperature (°C)	24.8	24.9	24.7	24.9	24.7	24.6	24.7	25.0
10.7%	pH (S.U.)	8.00	8.02	8.12	7.90	7.91	7.97	8.10	7.92
	DO (mg/L)	7.8	8.0	7.9	8.0	7.9	8.0	7.9	7.9
	Conductivity (umhos/cm)	310		295		306		309	
	*Temperature (°C)	24.8	25.0	24.7	24.7	24.8	24.7	24.8	24.8
21.4%	pH (S.U.)	7.96	8.01	8.10	7.90	7.92	7.97	8.03	7.92
	DO (mg/L)	7.9	8.0	8.0	8.0	7.8	8.0	7.9	7.9
	Conductivity (umhos/cm)	304		283		296		301	
	*Temperature (°C)	24.8	24.8	24.8	24.9	24.8	24.7	24.8	24.8
42.8%	pH (S.U.)	7.96	8.03	8.09	7.91	7.94	7.97	8.03	7.93
	DO (mg/L)	7.9	8.0	8.0	8.0	7.9	8.0	7.9	7.9
	Conductivity (umhos/cm)	277		257		270		277	
	*Temperature (°C)	24.9	24.8	24.8	24.9	24.8	24.7	24.9	25.1
85.6%	pH (S.U.)	7.96	8.04	8.09	7.92	7.95	7.98	8.04	7.94
	DO (mg/L)	7.9	8.0	8.0	8.0	7.9	8.0	8.0	8.0
	Conductivity (umhos/cm)	235		216		227		230	
	*Temperature (°C)	24.9	24.8	24.8	24.9	24.8	24.7	24.9	24.9
100%	pH (S.U.)	8.00	8.05	8.11	7.93	7.97	8.02	8.06	7.96
	DO (mg/L)	8.0	8.1	8.1	8.0	8.0	8.0	8.0	8.0
	Conductivity (umhos/cm)	205		197		207		215	
	*Alkalinity (mg CaCO <sub>3</sub> /L)			78					
	*Hardness (mg CaCO <sub>3</sub> /L)			86					
	*TR chlorine (mg/L)			<0.10					
	*Temperature (°C)	25.0	25.0	24.9	25.0	24.9	24.8	24.9	24.9
100% Intake	pH (S.U.)	7.99	8.08	8.10	7.94	7.98	8.03	8.06	7.96-7.98
	DO (mg/L)	8.0	8.2	8.2	8.1	8.1	7.9	8.1	8.0
	Conductivity (umhos/cm)	211		199		205		211	
	*Alkalinity (mg CaCO <sub>3</sub> /L)			16-14					
	*Hardness (mg CaCO <sub>3</sub> /L)			78					
	*TR chlorine (mg/L)			<0.10					
	*Temperature (°C)	25.0	24.8	24.9	24.9	24.8	24.8	24.9	25.2
		Initial	Final	Initial	Final	Initial	Final	Initial	Final

\*Temperatures performed at the time of test initiation, renewal or termination by the analyst identified in the Daily Renewal Information table located on Page 1. Alkalinity, hardness and total residual chlorine performed by the analyst identified on the bench sheet specific for each analysis and transcribed to this bench sheet by: 81




TVA / Sequoyah Nuclear Plant, Outfall 101, Non-treated  
August 02-09, 2016

*Ceriodaphnia dubia* Chronic Whole Effluent Toxicity Test  
EPA-821-R-02-013, Method 1002.0

Daily Chemical Analyses

Project number: 11637

Concentration	Parameter	Day 0		Day 1		Day 2		Day 3		Day 4		Day 5		Day 6	
		Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final
Control	pH (SU)	8.09	7.92	7.88	7.86	7.80	7.89	7.83	8.03	7.99	7.92	7.73	7.97	7.94	7.99
	DO (mg/L)	7.8	7.8	7.8	7.8	7.8	7.8	7.8	8.0	7.8	8.0	7.7	7.9	7.8	7.8
	Conductivity (µmhos/cm)	308		318		330		321		318		320		317	
	Alkalinity (mg/L CaCO <sub>3</sub> )	59				62				59					
	Hardness (mg/L CaCO <sub>3</sub> )	88				96				90					
	Temperature (°C)	24.7	25.0	24.7	24.7	24.7	25.0	24.8	24.9	24.7	24.9	24.7	24.6	24.7	25.0
10.7%	pH (SU)	8.06	7.91	7.95	7.85	7.94	7.89	8.00	8.02	8.12	7.90	7.91	7.97	8.10	7.92
	DO (mg/L)	7.8	7.8	7.8	7.8	7.9	7.9	7.8	8.0	7.9	8.0	7.9	8.0	7.9	7.9
	Conductivity (µmhos/cm)	295		313		305		310		295		306		309	
	Temperature (°C)	24.8	24.7	24.9	24.6	24.7	24.8	24.8	25.0	24.7	24.7	24.8	24.7	24.8	24.8
21.4%	pH (SU)	8.05	7.91	7.94	7.85	7.90	7.89	7.96	8.01	8.10	7.90	7.92	7.97	8.03	7.92
	DO (mg/L)	7.8	7.8	7.9	7.8	7.9	7.9	7.9	8.0	8.0	8.0	7.8	8.0	7.9	7.9
	Conductivity (µmhos/cm)	283		297		294		304		283		296		301	
	Temperature (°C)	24.8	24.7	24.9	24.6	24.7	24.9	24.8	24.8	24.8	24.9	24.8	24.7	24.8	24.8
42.8%	pH (SU)	8.03	7.93	7.95	7.86	7.90	7.89	7.96	8.03	8.09	7.91	7.94	7.97	8.03	7.93
	DO (mg/L)	7.8	7.8	7.9	7.8	7.9	7.9	7.9	8.0	8.0	8.0	7.9	8.0	7.9	7.9
	Conductivity (µmhos/cm)	263		272		271		277		257		270		277	
	Temperature (°C)	24.8	24.8	24.9	24.6	24.7	24.9	24.9	24.8	24.8	24.9	24.8	24.7	24.9	25.1
85.6%	pH (SU)	8.01	7.97	7.96	7.89	7.91	7.89	7.96	8.04	8.09	7.92	7.95	7.98	8.04	7.94
	DO (mg/L)	7.8	7.9	7.9	7.8	8.0	7.9	7.9	8.0	8.0	8.0	7.9	8.0	8.0	8.0
	Conductivity (µmhos/cm)	316		228		224		235		216		227		230	
	Temperature (°C)	24.8	24.7	24.9	24.8	24.7	24.9	24.9	24.8	24.8	24.9	24.8	24.7	24.9	24.9
100%	pH (SU)	8.01	7.97	7.98	7.90	7.92	7.90	8.00	8.05	8.11	7.93	7.97	8.02	8.06	7.96
	DO (mg/L)	7.8	7.9	8.0	7.9	8.0	7.9	8.0	8.1	8.1	8.0	8.0	8.0	8.0	8.0
	Conductivity (µmhos/cm)	200		211		203		205		197		207		215	
	Alkalinity (mg/L CaCO <sub>3</sub> )	76				80				78					
	Hardness (mg/L CaCO <sub>3</sub> )	82				82				86					
	Total Residual Chlorine (mg/L)	<0.10				<0.10				<0.10					
	Temperature (°C)	25.0	24.7	24.9	24.8	24.8	25.2	25.0	25.0	24.9	25.0	24.9	24.8	24.9	24.9
100% Intake	pH (SU)	7.96	7.96	8.00	7.92	7.93	7.95	7.99	8.08	8.10	7.94	7.98	8.03	8.06	7.98
	DO (mg/L)	8.0	7.9	8.0	7.9	8.0	7.9	8.0	8.2	8.2	8.1	8.1	7.9	8.1	8.0
	Conductivity (µmhos/cm)	197		210		203		211		199		205		211	
	Alkalinity (mg/L CaCO <sub>3</sub> )	74				72				74					
	Hardness (mg/L CaCO <sub>3</sub> )	73				82				78					
	Total Residual Chlorine (mg/L)	<0.10				<0.10				<0.10					
	Temperature (°C)	24.9	24.6	24.9	24.7	24.8	25.2	25.0	24.8	24.9	24.9	24.8	24.8	24.9	25.2

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Entered by: J. Summer  
Reviewed by: 





### Total Residual Chlorine (ORION-1977)

Matrix: Water, RL = 0.10 mg/L

Meter: Accumet Model AR25 pH/Ton Meter

Analyst **MS N6**  
Date analyzed **08-02-16**

Iodide reagent: **INR 750**  
Acid reagent: **INR 741**

#### Calibration:

	0.10 mg/L	1.00 mg/L	mV Change (suggested range = 26 to 30 mV)
Reference standard number	<b>INSS 1478</b>	<b>INSS 1478</b>	
Millivolts (mV)	<b>572.3</b>	<b>599.7</b>	<b>27.4</b>

Note: For samples with a residual chlorine of > 1.0 mg/L, the samples must be diluted to be within the calibration range.

#### Laboratory control standard:

Reference standard number	True value (TV) (mg/L)	Measured value (MV) (mg/L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
<b>INSS 1478</b>	<b>0.50</b>	<b>0.532</b>	<b>106.4%</b>

#### Duplicate sample precision:

Sample number	Sample ID	Sample characteristics	Residual chlorine (mg/L)	%RPD = $\frac{(S - D)}{((S + D)/2)} \times 100$ (acceptable range = $\pm 10\%$ )
<b>160802-04</b>	<b>N. CARY</b>	<b>Pale yellow, clear, particles</b>	<b>S &lt; 0.0791</b>	
<b>↓</b>	<b>Duplicate</b>		<b>D &lt; 0.0978</b>	

#### Sample measurements:

Sample number	Sample ID	Sample characteristics	Residual chlorine (mg/L)
	<b>Reagent Blank</b>		<b>20.0576</b>
<b>160802-01</b>	<b>S. CARY</b>	<b>Pale tan, clear, no particles</b>	<b>20.00164</b>
<b>160801-01</b>	<b>TUCKASERGE</b>	<b>Pale yellow, slightly cloudy, particles</b>	<b>20.00106</b>
<b>160802-05</b>	<b>GP</b>	<b>Yellow, cloudy, particles</b>	<b>20.00203</b>
<b>160801-02</b>	<b>TVA / SON 101</b>	<b>Pale yellow, clear</b>	<b>20.00799</b>
<b>160801-05</b>	<b>↓ INTAKE</b>	<b>Pale tan, clear</b>	<b>20.00207</b>
<b>160802-05</b>	<b>BOGUE</b>	<b>Pale yellow, clear</b>	<b>20.0127</b>
<b>160802-07</b>	<b>ENGELHART</b>	<b>Yellow, clear</b>	<b>20.00146</b>
<b>160802-08</b>	<b>PASQUOTANK</b>	<b>Pale tan, clear</b>	<b>20.00159</b>
<b>160802-06</b>	<b>CAMP LAPEUNE</b>	<b>Pale tan, clear</b>	<b>20.00706</b>

Note: All samples were analyzed in excess of EPA recommended holding time (15 minutes) unless otherwise noted.

**160802-02 MILLS RIVER**

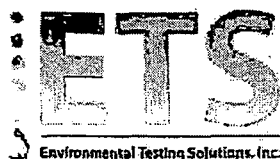
**No color, clear, particles**

**20.00489**

#### Laboratory control standard:

Reference standard number	True value (TV) (mg/L)	Measured value (MV) (mg/L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
<b>INSS 1478</b>	<b>0.50</b>	<b>0.462</b>	<b>92.4%</b>

Reviewed by **JK**  
Date reviewed **08-02-16**



### Total Residual Chlorine (ORION-1977)

Matrix: Water, RL = 0.10 mg/L

Meter: Accumet Model AR25 pH/Ion Meter

Analyst NG  
Date analyzed 08-04-16

Iodide reagent: INA 750  
Acid reagent: INA 741

#### Calibration:

	0.10 mg/L	1.00 mg/L	mV Change (suggested range = 26 to 30 mV)
Reference standard number	<u>INSS 1478</u>	<u>INSS 1478</u>	
Millivolts (mV)	<u>571.2</u>	<u>601.0</u>	<u>29.9</u>

Note: For samples with a residual chlorine of  $\geq 1.0$  mg/L, the samples must be diluted to be within the calibration range.

#### Laboratory control standard:

Reference standard number	True value (TV) (mg/L)	Measured value (MV) (mg/L)	% RS = $MV / TV \times 100$ (acceptable range = 90 to 110%)
<u>INSS 1478</u>	<u>0.50</u>	<u>0.512</u>	<u>102.4 %</u>

#### Duplicate sample precision:

Sample number	Sample ID	Sample characteristics	Residual chlorine (mg/L)	%RPD = $\frac{(S-D)}{((S+D)/2)} \times 100$ (acceptable range = $\pm 10\%$ )
<u>160804.03</u>	<u>N. CANY</u>	<u>Pale Tan, clear</u>	<u>S 0.0702</u>	
<u>↓</u>	<u>Duplicate</u>		<u>D 0.0370</u>	<u>N/A 080416</u>

#### Sample measurements:

Sample number	Sample ID	Sample characteristics	Residual chlorine (mg/L)
	<u>Reagent Blank</u>		<u>0.0316</u>
<u>160804.01</u>	<u>S. CANY</u>	<u>Pale Tan, clear, particles</u>	<u>0.0190</u>
<u>160803.22</u>	<u>TUCKASEEGEE</u>	<u>Pale Tan, clear</u>	<u>0.00879</u>
<u>160804.02</u>	<u>GP</u>	<u>Yellow, slightly cloudy, particles</u>	<u>0.00127</u>
<u>160803.23</u>	<u>TVA   SON 101</u>	<u>Pale Tan, clear</u>	<u>0.0471</u>
<u>160803.24</u>	<u>↓ INTAKE</u>	<u>Pale Tan, clear</u>	<u>0.00872</u>
<u>160804.08</u>	<u>CHEMTRADE</u>	<u>Pale Tan, cloudy</u>	<u>0.00585</u>
<u>160804.04</u>	<u>BOGUE BANKS</u>	<u>Tan, clear,</u>	<u>0.00378</u>
<u>160804.05</u>	<u>CAMP LESEUNE</u>	<u>No color, clear</u>	<u>0.0246</u>
<u>160804.06</u>	<u>ENGELHARD</u>	<u>Yellow, clear, sulfur smell</u>	<u>0.0186</u>

Note: All samples were analyzed in excess of EPA recommended holding time (15 minutes) unless otherwise noted.

160804.07 PASQUOTANK  
Laboratory control standard:

Pale Yellow, clear

0.00504

Reference standard number	True value (TV) (mg/L)	Measured value (MV) (mg/L)	% RS = $MV / TV \times 100$ (acceptable range = 90 to 110%)
<u>INSS 1478</u>	<u>0.50</u>	<u>0.482</u>	<u>96.4 %</u>

Reviewed by JA  
Date reviewed 08-04-16





### Total Residual Chlorine (ORION-1977)

Matrix: Water, RL = 0.10 mg/L

Meter: Accumet Model AR25 pH/Ion Meter

Analyst MS K  
Date analyzed 08-06-16

Iodide reagent: INR 750  
Acid reagent: INR 741

#### Calibration:

	0.10 mg/L	1.00 mg/L	mV Change (suggested range = 26 to 30 mV)
Reference standard number	<u>INSS 1478</u>	<u>INSS 1478</u>	
Millivolts (mV)	<u>575.4</u>	<u>602.4</u>	<u>27.0</u>

Note: For samples with a residual chlorine of > 1.0 mg/L, the samples must be diluted to be within the calibration range.

#### Laboratory control standard:

Reference standard number	True value (TV) (mg/L)	Measured value (MV) (mg/L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
<u>INSS 1478</u>	<u>0.50</u>	<u>0.500</u>	<u>100.0%</u>

#### Duplicate sample precision:

Sample number	Sample ID	Sample characteristics	Residual chlorine (mg/L)	%RPD = $\frac{(S - D)}{[(S + D)/2]} \times 100$ (acceptable range = $\pm 10\%$ )
<u>160806.02</u>	<u>N. CARY</u>	<u>Pale yellow, clear, no particles</u>	<u>S 0.000218</u>	
<u>↓</u>	<u>Duplicate</u>		<u>D 0.000207</u>	<u>4.3%</u> <u>08-06-16</u>

#### Sample measurements:

Sample number	Sample ID	Sample characteristics	Residual chlorine (mg/L)
	<u>Reagent Blank</u>		<u>0.000130</u>
<u>160806.07</u>	<u>S. CARY</u>	<u>Pale yellow, clear, no particles</u>	<u>0.000236</u>
<u>160805.14</u>	<u>TUCKASSEE</u>	<u>Pale yellow, clear, no particles</u>	<u>0.000005</u>
<u>160805.15</u>	<u>TVA / SQN101</u>	<u>No color, clear</u>	<u>0.000658</u>
<u>160805.16</u>	<u>↓ INTAKE</u>	<u>No color, clear</u>	<u>0.00748</u>
<u>160806.03</u>	<u>BOGUE BANKS</u>	<u>Pale yellow, clear, no particles</u>	<u>0.00154</u>
<u>160806.04</u>	<u>CAMP LEJEUNE</u>	<u>Pale yellow, clear, no particles</u>	<u>0.000248</u>
<u>160806.05</u>	<u>ENGELHARD</u>	<u>Yellow, clear, no particles</u>	<u>0.0000217</u>
<u>160806.06</u>	<u>PASQUOTANK</u>	<u>Pale yellow, clear, no particles</u>	<u>0.0000217</u>
<u>160806.01</u>	<u>Georgia Pacific</u>	<u>Pale yellow, clear, no particles</u>	<u>0.0000484</u>

Note: All samples were analyzed in excess of EPA recommended holding time (15 minutes) unless otherwise noted.

#### Laboratory control standard:

Reference standard number	True value (TV) (mg/L)	Measured value (MV) (mg/L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
<u>INSS 1478</u>	<u>0.50</u>	<u>0.468</u>	<u>93.6%</u>

Reviewed by M  
Date reviewed 08-06-16

**Alkalinity (SM 2320 B-1997)**

Matrix: Water, RL = 1.0 mg CaCO<sub>3</sub>/L

Analyst W  
Date analyzed 08.06.16

Time initiated 1254  
Time completed 1434

**Titrate samples to  
pH = 4.5 S.U.**

***Titrant normality and multiplier determination:***

pH of Deionized water = 4.5 S.U.	Titrant reference number	Normality check standard number	Begin ml	End ml	Total ml (E)	Normality (N) of H <sub>2</sub> SO <sub>4</sub> = (5 ml Na <sub>2</sub> CO <sub>3</sub> x 0.05)/E = 0.25/E (acceptable range = 0.0180 - 0.0220)	pH Factor or Multiplier = (N x 50000)/ 100 ml sample = N x 500
6.4	1N2735	1N551470	0.1	12.0	12.5	0.0200	10.0

*BVL correct 0.0 - 0.1 = 0.1 ml*

***Laboratory control standard:***

Reference standard number	True value (TV) (mg CaCO <sub>3</sub> /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (MV) (mg CaCO <sub>3</sub> /L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
1N551414	100	100	12.6	22.4	9.8	100	98	98.07

***Duplicate sample precision:***

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg CaCO <sub>3</sub> /L)	%RPD = ((S - D) / ((S + D) / 2)) x 100 (acceptable range = ± 10%)
07-29-16	SSW	100	22.4	25.5	3.1	100	S 31	
J	Duplicate (B)	J	25.5	28.6	3.1	J	D 31	-4.000016

***Matrix spike recovery:***

Reference standard number	Spike value (SV) (mg CaCO <sub>3</sub> /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Spike alkalinity (A) (mg CaCO <sub>3</sub> /L)
1N551414	60	100	25.5	33.6	8.1	10.0	81

Sample alkalinity (B) (mg CaCO <sub>3</sub> /L)	Measured spike value (MV) MV = A - B (mg CaCO <sub>3</sub> /L)	% R = MV / SV x 100 (acceptable range = 75 to 125%)
31	50	100.07

***Sample measurements:***

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg CaCO <sub>3</sub> /L)
08.04.16	SSW	100	33.6	36.7	3.1	10.0	31
08.02.16 B	MHSW		36.7	42.6	5.9		59
08.04.16	J		42.6	48.6	6.0		60
07-28-16	SSW		0.0	3.2	3.2		32
07-24-16	MHSW		3.2	9.2	6.0		60
07-26-16			9.2	15.2	6.0		60
07-28-16			15.2	21.2	6.0		60
07-24-16			21.2	27.1	5.9		59
08.02.16 A			27.1	33.3	6.2		62

Reviewed by:

W

Date reviewed:

08-06-16

**Alkalinity (SM 2320 B-1997)**  
Matrix: Water, RL = 1.0 mg CaCO<sub>3</sub>/L

Analyst U  
Date analyzed 08.06.14

Time initiated 080916  
Time completed 080916

Titrate samples to  
pH = 4.5 S.U.

**Titrant normality and multiplier determination:**

pH of Deionized water = 4.5 S.U.	Titrant reference number	Normality check standard number	Begin ml	End ml	Total ml (E)	Normality (N) of H <sub>2</sub> SO <sub>4</sub> = (5 ml Na <sub>2</sub> CO <sub>3</sub> x 0.05)/E = 0.25/E (acceptable range = 0.0180 - 0.0220)	pH Factor or Multiplier = (N x 50000)/ 100 ml sample = N x 500
						<u>0.02046</u>	

**Laboratory control standard:**

Reference standard number	True value (TV) (mg CaCO <sub>3</sub> /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (MV) (mg CaCO <sub>3</sub> /L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
<u>1N551414</u>	<u>100</u>	<u>100</u>	<u>33.3</u>	<u>43.1</u>	<u>9.8</u>	<u>10.0</u>	<u>98</u>	<u>98.07</u>

**Duplicate sample precision:**

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg CaCO <sub>3</sub> /L)	%RPD = {(S - D) / ((S+D)/2)} x 100 (acceptable range = ± 10%)
<u>08.03.16</u>	<u>Saltsw</u>	<u>100</u>	<u>4.00</u>	<u>10.6</u>	<u>10.6</u>	<u>100</u>	<u>110</u>	
<u>J</u>	<u>Duplicate (B)</u>	<u>J</u>	<u>10.6</u>	<u>21.1</u>	<u>10.5</u>	<u>J</u>	<u>100</u>	<u>9.57</u>

**Matrix spike recovery:**

Reference standard number	Spike value (SV) (mg CaCO <sub>3</sub> /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Spike alkalinity (A) (mg CaCO <sub>3</sub> /L)
<u>1N551414</u>	<u>50</u>	<u>100</u>	<u>10.6</u>	<u>26.0</u>	<u>15.4</u>	<u>10.0</u>	<u>150</u>

Sample alkalinity (B) (mg CaCO <sub>3</sub> /L)	Measured spike value (MV) MV = A - B (mg CaCO <sub>3</sub> /L)	% R = MV / SV x 100 (acceptable range = 75 to 125%)
<u>110</u>	<u>40</u>	<u>80.07</u>

**Sample measurements:**

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg CaCO <sub>3</sub> /L)
<u>0731.16A</u>	<u>Saltsw</u>	<u>100</u>	<u>26.0</u>	<u>35.9</u>	<u>9.9</u>	<u>10.0</u>	<u>99</u>
<u>0731.16B</u>	<u>J</u>	<u>J</u>	<u>35.9</u>	<u>45.0</u>	<u>9.1</u>	<u>10.0</u>	<u>91</u>
<u>160727.01</u>	<u>Wicks</u>	<u>25</u>	<u>0.0</u>	<u>7.1</u>	<u>7.1</u>	<u>(4)</u>	<u>230</u>
<u>160803.26</u>	<u>SHP Am 001</u>	<u>50</u>	<u>7.1</u>	<u>11.9</u>	<u>4.8</u>	<u>(2)</u>	<u>96</u>
<u>160803.27</u>	<u>Am INT</u>		<u>11.9</u>	<u>15.4</u>	<u>3.5</u>		<u>70</u>
<u>160803.28</u>	<u>Pm 001</u>		<u>15.4</u>	<u>20.0</u>	<u>4.6</u>		<u>92</u>
<u>160803.29</u>	<u>Pm INT</u>		<u>20.0</u>	<u>23.5</u>	<u>3.5</u>		<u>70</u>
<u>160804.08</u>	<u>Chomtrac</u>		<u>23.0</u>	<u>25.5</u>	<u>1.9</u>		<u>30</u>
<u>160804.01</u>	<u>TW5A 1</u>	<u>100</u>	<u>25.5</u>	<u>29.6</u>	<u>4.1</u>		<u>41</u>

Reviewed by: A

Date reviewed: 08-06-16

**Alkalinity (SM 2320 B-1997)**  
Matrix: Water, RL = 1.0 mg CaCO<sub>3</sub>/L

Analyst W  
Date analyzed 08.06.16

Time initiated 08:44  
Time completed W

Titrate samples to  
pH = 4.5 S.U.

**Titrimetric normality and multiplier determination:**

pH of Deionized water = 4.5 S.U.	Titrimetric reference number	Normality check standard number	Begin ml	End ml	Total ml (E)	Normality (N) of H <sub>2</sub> SO <sub>4</sub> = (5 ml Na <sub>2</sub> CO <sub>3</sub> x 0.05)/E = 0.25/E (acceptable range = 0.0180 - 0.0220)	pH Factor or Multiplier = (N x 50000)/100 ml sample = N x 500
							<u>0.00006</u>

**Laboratory control standard:**

Reference standard number	True value (TV) (mg CaCO <sub>3</sub> /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (MV) (mg CaCO <sub>3</sub> /L)	% RS = MV/TV x 100 (acceptable range = 90 to 110%)
1 N551414	100	100	29.6	39.5	9.9	10.0	99	99.02

**Duplicate sample precision:**

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg CaCO <sub>3</sub> /L)	%RPD = ((S - D) / ((S + D) / 2)) x 100 (acceptable range = ± 10%)
160805.72	TW5A 2	100	39.5	43.5	4.0	10.0	S 40	
↓	Duplicate (B)	↓	0.0	4.0	4.0	↓	D 40	<u>0.00%</u>

**Matrix spike recovery:**

Reference standard number	Spike value (SV) (mg CaCO <sub>3</sub> /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Spike alkalinity (A) (mg CaCO <sub>3</sub> /L)
1 N551414	50	100	0.0	9.0	9.0	10.0	90

Sample alkalinity (B) (mg CaCO <sub>3</sub> /L)	Measured spike value (MV) MV = A - B (mg CaCO <sub>3</sub> /L)	% R = MV / SV x 100 (acceptable range = 75 to 125%)
40	50	100.02

**Sample measurements:**

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg CaCO <sub>3</sub> /L)
160805.14	TW5A 3	100	9.0	13.1	4.1	10.0	41
160802.04	NCary 1		13.1	21.1	8.0		80
160804.03	↓ 2		21.1	29.0	7.9		79
160806.02	↓ 3		29.0	36.6	7.6		76
160802.01	SCary 1		36.6	42.5	5.9		59
160804.01	↓ 2		42.5	37.1	4.6		46
160806.07	↓ 3		0.0	4.3	4.3		43
160802.03	Beaqua 1	25	4.3	11.5	7.2	(4)	290
160804.02	↓ 2	↓	11.5	10.9	7.4	↓	300

Reviewed by: W

Date reviewed: 08.06.16



**Alkalinity (SM 2320 B-1997)**  
Matrix: Water, RL = 1.0 mg CaCO<sub>3</sub>/L

Analyst U  
Date analyzed 03/06/14

Time initiated 03/06/14  
Time completed 03/06/14

Titrate samples to  
pH = 4.5 S.U.

**Titrant normality and multiplier determination:**

pH of Deionized water = 4.5 S.U.	Titrant reference number	Normality check standard number	Begin ml	End ml	Total ml (E)	Normality (N) of H <sub>2</sub> SO <sub>4</sub> = (5 ml Na <sub>2</sub> CO <sub>3</sub> x 0.05)/E = 0.25/E (acceptable range = 0.0180 - 0.0220)	pH Factor or Multiplier = (N x 50000)/ 100 ml sample = N x 500
							<u>03/06/14</u>

**Laboratory control standard:**

Reference standard number	True value (TV) (mg CaCO <sub>3</sub> /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (MV) (mg CaCO <sub>3</sub> /L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
<u>INSS1414</u>	<u>100</u>	<u>100</u>	<u>18.9</u>	<u>28.8</u>	<u>9.9</u>	<u>10.0</u>	<u>99</u>	<u>99.07</u>

**Duplicate sample precision:**

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg CaCO <sub>3</sub> /L)	%RPD = {(S - D) / ((S + D) / 2)} x 100 (acceptable range = ± 10%)
<u>160806.01</u>	<u>Georgia 3</u>	<u>25</u>	<u>28.8</u>	<u>35.9</u>	<u>7.1</u>	<u>(H) 10.0</u>	<u>S 280</u>	
<u>↓</u>	<u>Duplicate (B)</u>	<u>↓</u>	<u>35.9</u>	<u>43.1</u>	<u>7.2</u>	<u>↓ ↓</u>	<u>D 290</u>	<u>3.5%</u>

**Matrix spike recovery:**

Reference standard number	Spike value (SV) (mg CaCO <sub>3</sub> /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Spike alkalinity (A) (mg CaCO <sub>3</sub> /L)
<u>INSS1414</u>	<u>200</u>	<u>25</u>	<u>35.9</u>	<u>48.1</u>	<u>12.2</u>	<u>(H) 10.0</u>	<u>490</u>

Sample alkalinity (B) (mg CaCO <sub>3</sub> /L)	Measured spike value (MV) MV = A - B (mg CaCO <sub>3</sub> /L)	% R = MV / SV x 100 (acceptable range = 75 to 125%)
<u>290</u>	<u>200</u>	<u>100.07</u>

**Sample measurements:**

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg CaCO <sub>3</sub> /L)
<u>07-29-16</u>	<u>MHSW VV 1</u>	<u>100</u>	<u>0.0</u>	<u>5.9</u>	<u>5.9</u>	<u>10.0</u>	<u>59</u>
<u>08-02-16A</u>	<u>↓ 2</u>		<u>6.0</u>	<u>11.9</u>	<u>6.9</u>		<u>59</u>
<u>08-02-16B</u>	<u>↓ 3</u>		<u>11.9</u>	<u>17.7</u>	<u>6.8</u>		<u>58</u>
<u>160801.02</u>	<u>TVASQW101 1</u>	<u>50</u>	<u>17.7</u>	<u>21.5</u>	<u>3.8</u>	<u>(2)</u>	<u>76</u>
<u>160803.23</u>	<u>↓ 2</u>		<u>21.6</u>	<u>25.4</u>	<u>4.0</u>		<u>80</u>
<u>160805.15</u>	<u>↓ 3</u>		<u>25.6</u>	<u>29.5</u>	<u>3.9</u>		<u>78</u>
<u>160801.02</u>	<u>TVASQW101W 1</u>		<u>29.5</u>	<u>33.2</u>	<u>3.7</u>		<u>74</u>
<u>160803.23</u>	<u>↓ 2</u>		<u>33.2</u>	<u>37.1</u>	<u>3.9</u>		<u>78</u>
<u>160805.15</u>	<u>↓ 3</u>		<u>37.1</u>	<u>40.9</u>	<u>3.8</u>		<u>76</u>

Reviewed by: U Date reviewed: 08-06-16

**Alkalinity (SM 2320 B-1997)**  
Matrix: Water, RL = 1.0 mg CaCO<sub>3</sub>/L

Analyst W  
Date analyzed 08/06/16

Time initiated 08:00  
Time completed 08:15

**Titrate samples to**  
**pH = 4.5 S.U.**

**Titrant normality and multiplier determination:**

pH of Deionized water = 4.5 S.U.	Titrant reference number	Normality check standard number	Begin ml	End ml	Total ml (E)	Normality (N) of H <sub>2</sub> SO <sub>4</sub> = (5 ml Na <sub>2</sub> CO <sub>3</sub> x 0.05)/E = 0.25/E (acceptable range = 0.0180 - 0.0220)	pH Factor or Multiplier = (N x 50000)/100 ml sample = N x 500
							<u>0.00010</u>

**Laboratory control standard:**

Reference standard number	True value (TV) (mg CaCO <sub>3</sub> /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (MV) (mg CaCO <sub>3</sub> /L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
<u>INSS1414</u>	<u>100</u>	<u>100</u>	<u>0.0</u>	<u>9.9</u>	<u>9.9</u>	<u>10.0</u>	<u>99</u>	<u>99.02</u>

**Duplicate sample precision:**

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg CaCO <sub>3</sub> /L)	%RPD = ((S - D) / ((S + D) / 2)) x 100 (acceptable range = ± 10%)
<u>160801.03</u>	<u>SON INT 1</u>	<u>50</u>	<u>10.0</u>	<u>13.7</u>	<u>3.7</u>	<u>2) 10.0</u>	<u>S 74</u>	
<u>↓</u>	<u>Duplicate (B)</u>	<u>↓</u>	<u>13.7</u>	<u>17.5</u>	<u>3.8</u>	<u>↓ ↓</u>	<u>D 76</u>	<u>2.7%</u>

**Matrix spike recovery:**

Reference standard number	Spike value (SV) (mg CaCO <sub>3</sub> /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Spike alkalinity (A) (mg CaCO <sub>3</sub> /L)
<u>INSS1414</u>	<u>100</u>	<u>50</u>	<u>13.7</u>	<u>22.5</u>	<u>8.8</u>	<u>2) 10.0</u>	<u>180</u>

Sample alkalinity (B) (mg CaCO <sub>3</sub> /L)	Measured spike value (MV) MV = A - B (mg CaCO <sub>3</sub> /L)	% R = MV / SV x 100 (acceptable range = 75 to 125%)
<u>76</u>	<u>104</u>	<u>104.02</u>

**Sample measurements:**

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg CaCO <sub>3</sub> /L)
<u>160805.24</u>	<u>TVASON INT 2</u>	<u>25</u>	<u>22.5</u>	<u>26.1</u>	<u>3.6</u>	<u>2) 10.0</u>	<u>72</u>
<u>160805.25</u>	<u>↓ 3</u>			<u>36.1</u>	<u>3.8</u>		<u>74</u>
<u>160801.03</u>	<u>TVASON INT 1</u>			<u>40.0</u>	<u>3.7</u>		<u>74</u>
<u>160805.24</u>	<u>↓ 2</u>			<u>43.7</u>	<u>4.4</u>		<u>74</u>
<u>160805.25</u>	<u>↓ 3</u>			<u>0.0</u>	<u>3.6</u>		<u>72</u>
<u>160802.05</u>	<u>Boque 1</u>	<u>2</u>	<u>3.6</u>	<u>6.9</u>	<u>2.3</u>	<u>(2)</u>	<u>1200</u>
<u>160804.04</u>	<u>↓ 2</u>			<u>6.9</u>	<u>7.9</u>		<u>1000</u>
<u>160806.03</u>	<u>↓ 3</u>			<u>7.9</u>	<u>9.9</u>		<u>1000</u>
<u>160802.06</u>	<u>C. LeJeune 1</u>	<u>25</u>	<u>9.9</u>	<u>12.4</u>	<u>2.5</u>	<u>(4)</u>	<u>100</u>

Reviewed by: J

Date reviewed: 08-06-16

**Alkalinity (SM 2320 B-1997)**  
Matrix: Water, RL = 1.0 mg CaCO<sub>3</sub>/L

Analyst W  
Date analyzed 08.06.16

Time initiated 08044  
Time completed 16

**Titrate samples to**  
**pH = 4.5 S.U.**

***Titrant normality and multiplier determination:***

pH of Deionized water = 4.5 S.U.	Titration reference number	Normality check standard number	Begin ml	End ml	Total ml (E)	Normality (N) of H <sub>2</sub> SO <sub>4</sub> = (5 ml Na <sub>2</sub> CO <sub>3</sub> x 0.05)/E = 0.25/E (acceptable range = 0.0180 - 0.0220)	pH Factor or Multiplier = (N x 50000)/ 100 ml sample = N x 500
							<u>1000</u>

***Laboratory control standard:***

Reference standard number	True value (TV) (mg CaCO <sub>3</sub> /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (MV) (mg CaCO <sub>3</sub> /L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
<u>INSS1414</u>	<u>100</u>	<u>100</u>	<u>12.5</u>	<u>22.2</u>	<u>9.7</u>	<u>10.0</u>	<u>97</u>	<u>97.02</u>

***Duplicate sample precision:***

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg CaCO <sub>3</sub> /L)	%RPD = ((S - D) / ((S+D)/2)) x 100 (acceptable range = ± 10%)
<u>16080405</u>	<u>C. LeJeune 2</u>	<u>25</u>	<u>22.2</u>	<u>24.9</u>	<u>2.7</u>	<u>(4) 10.0</u>	<u>110</u>	
<u>↓</u>	<u>Duplicate (B)</u>	<u>↓</u>	<u>24.9</u>	<u>27.5</u>	<u>2.6</u>	<u>↓ ↓</u>	<u>100</u>	<u>9.51</u>

***Matrix spike recovery:***

Reference standard number	Spike value (SV) (mg CaCO <sub>3</sub> /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Spike alkalinity (A) (mg CaCO <sub>3</sub> /L)
<u>INSS1414</u>	<u>200</u>	<u>25</u>	<u>24.9</u>	<u>32.2</u>	<u>7.3</u>	<u>(4) 10.0</u>	<u>290</u>

Sample alkalinity (B) (mg CaCO <sub>3</sub> /L)	Measured spike value (MV) MV = A - B (mg CaCO <sub>3</sub> /L)	% R = MV / SV x 100 (acceptable range = 75 to 125%)
<u>100</u>	<u>190</u>	<u>95.02</u>

***Sample measurements:***

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg CaCO <sub>3</sub> /L)
<u>16080604</u>	<u>C. LeJeune 3</u>	<u>25</u>	<u>32.2</u>	<u>34.9</u>	<u>2.7</u>	<u>(4) 10.0</u>	<u>110</u>
<u>16080201</u>	<u>Engelhard 1</u>	<u>2</u>	<u>34.9</u>	<u>41.0</u>	<u>6.1</u>	<u>(50)</u>	<u>3000</u>
<u>16080406</u>	<u>↓ 2</u>	<u>↓</u>	<u>41.0</u>	<u>47.3</u>	<u>6.3</u>	<u>↓</u>	<u>3200</u>
<u>16080605</u>	<u>↓ 3</u>	<u>↓</u>	<u>135</u>	<u>20.1</u>	<u>6.6</u>	<u>↓</u>	<u>3300</u>
<u>16080208</u>	<u>Pasquottank 1</u>	<u>↓</u>	<u>20.1</u>	<u>24.2</u>	<u>4.1</u>	<u>↓</u>	<u>2000</u>
<u>16080407</u>	<u>↓ 2</u>	<u>↓</u>	<u>24.2</u>	<u>28.2</u>	<u>3.9</u>	<u>↓</u>	<u>2000</u>
<u>16080606</u>	<u>↓ 3</u>	<u>↓</u>	<u>28.2</u>	<u>32.4</u>	<u>4.2</u>	<u>↓</u>	<u>2100</u>
							<u>u0000</u>

Reviewed by:

W

Date reviewed:

08-06-16

**Hardness (SM 2340 C-1997)**

RL = 1.0 mg CaCO<sub>3</sub>/L

Analyst W  
Date analyzed 08.05.16

Time initiated 1348  
Time completed 1427

***Titrant normality and multiplier determination:***

Titrant reference number	Normality check standard number	Begin ml	End ml	Total ml (E)	Normality (N) of EDTA = 0.2/E (acceptable range = 0.0180 - 0.0220)	pH Factor or Multiplier = (N x 50000) / 50 ml sample = N x 1000
<u>IN2753</u>	<u>INSS1387</u>	<u>0.0</u>	<u>10.0</u>	<u>10.0</u>	<u>0.0200</u>	<u>20.0</u>

***Laboratory control standard:***

Reference standard number	True value (TV) (mg CaCO <sub>3</sub> /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (MV) (mg CaCO <sub>3</sub> /L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
<u>INSS1402</u>	<u>40</u>	<u>50</u>	<u>10.0</u>	<u>12.1</u>	<u>2.1</u>	<u>20.0</u>	<u>42</u>	<u>105.02</u>

***Duplicate sample precision:***

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (mg CaCO <sub>3</sub> /L)	%RPD = [(S - D) / ((S+D)/2)] x 100
<u>072916</u>	<u>SSW</u>	<u>60</u>	<u>12.1</u>	<u>14.1</u>	<u>2.0</u>	<u>20.0</u>	<u>S 40</u>	
<u>1</u>	Duplicate (B)	<u>1</u>	<u>14.1</u>	<u>16.1</u>	<u>2.0</u>	<u>1</u>	<u>D 40</u>	<u>→ 000%</u>

***Matrix spike recovery:***

Reference standard number	Spike value (SV) (mg CaCO <sub>3</sub> /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Spike hardness (A) (mg CaCO <sub>3</sub> /L)
<u>INSS1402</u>	<u>40</u>	<u>50</u>	<u>14.1</u>	<u>18.1</u>	<u>4.0</u>	<u>20.0</u>	<u>80</u>

Sample hardness (B) (mg CaCO <sub>3</sub> /L)	Measured spike value (MV) MV = A - B (mg CaCO <sub>3</sub> /L)	% R = MV / SV x 100 (acceptable range = 75 to 125%)
<u>40</u>	<u>40</u>	<u>100.02</u>

***Sample measurements:***

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (mg CaCO <sub>3</sub> /L)
TV = ND	Blank (should be = 0 mg CaCO <sub>3</sub> /L)	<u>60</u>	<u>0.0</u>	<u>0.0</u>	<u>0.0</u>	<u>20.0</u>	<u>ND</u>
<u>08.04.16</u>	<u>SSW</u>		<u>18.1</u>	<u>20.1</u>	<u>2.0</u>		<u>40</u>
<u>0802.16A</u>	<u>MHSW</u>		<u>20.1</u>	<u>24.9</u>	<u>4.8</u>		<u>96</u>
<u>08.02.16B</u>	<u>1</u>		<u>24.9</u>	<u>29.4</u>	<u>4.5</u>		<u>90</u>
<u>08.04.16</u>	<u>1</u>		<u>29.4</u>	<u>33.8</u>	<u>4.4</u>		<u>88</u>
<u>0720.16</u>	<u>SSW</u>		<u>33.8</u>	<u>35.8</u>	<u>2.0</u>		<u>40</u>
<u>0724.16</u>	<u>MHSW</u>		<u>35.8</u>	<u>40.4</u>	<u>4.6</u>		<u>92</u>
<u>07.26.16</u>	<u>1</u>		<u>40.4</u>	<u>44.9</u>	<u>4.5</u>		<u>90</u>
<u>07.28.16</u>	<u>1</u>		<u>44.9</u>	<u>49.5</u>	<u>4.6</u>		<u>92</u>
<u>07.29.16</u>	<u>1</u>		<u>0.0</u>	<u>4.4</u>	<u>89.44</u>	<u>0.0220</u>	<u>88</u>

Note: If >15ml of titrant is used, sample must be diluted. Reviewed by:

Date reviewed 08-05-16



**Hardness (SM 2340 C-1997)**

RL = 1.0 mg CaCO<sub>3</sub>/L

Analyst JK  
Date analyzed 08.05.16

Time initiated 08:51  
Time completed 09:05

***Titrant normality and multiplier determination:***

Titrant reference number	Normality check standard number	Begin ml	End ml	Total ml (E)	Normality (N) of EDTA = 0.2/E (acceptable range = 0.0180 - 0.0220)	pH Factor or Multiplier = (N x 50000) / 50 ml sample = N x 1000
						<u>0.0051</u>

***Laboratory control standard:***

Reference standard number	True value (TV) (mg CaCO <sub>3</sub> /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (MV) (mg CaCO <sub>3</sub> /L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
<u>1N551402</u>	<u>40</u>	<u>50</u>	<u>4.4</u>	<u>6.4</u>	<u>2.0</u>	<u>200</u>	<u>40</u>	<u>100.02</u>

***Duplicate sample precision:***

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (mg CaCO <sub>3</sub> /L)	%RPD = ((S - D) / ((S + D) / 2)) x 100
<u>139309</u>	<u>EES#091615</u>	<u>50</u>	<u>6.4</u>	<u>8.6</u>	<u>2.2</u>	<u>200</u>	<u>44</u>	
<u>J</u>	Duplicate (B)	<u>J</u>	<u>8.6</u>	<u>10.8</u>	<u>2.2</u>	<u>J</u>	<u>44</u>	<u>0.0516</u>

***Matrix spike recovery:***

Reference standard number	Spike value (SV) (mg CaCO <sub>3</sub> /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Spike hardness (A) (mg CaCO <sub>3</sub> /L)
<u>1N551402</u>	<u>40</u>	<u>50</u>	<u>8.6</u>	<u>12.8</u>	<u>4.2</u>	<u>200</u>	<u>84</u>

Sample hardness (B) (mg CaCO <sub>3</sub> /L)	Measured spike value (MV) MV = A - B (mg CaCO <sub>3</sub> /L)	% R = MV / SV x 100 (acceptable range = 75 to 125%)
<u>44</u>	<u>40</u>	<u>100.07</u>

***Sample measurements:***

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (mg CaCO <sub>3</sub> /L)
TV = ND	Blank (should be = 0 mg CaCO <sub>3</sub> /L)						<u>0.00516</u>
<u>160827.01</u>	<u>Wells</u>	<u>10</u>	<u>12.8</u>	<u>15.3</u>	<u>2.4</u>	<u>(5) 20.0</u>	<u>240</u>
<u>160803.26</u>	<u>SHE Am 001</u>	<u>25</u>	<u>15.3</u>	<u>18.2</u>	<u>2.9</u>	<u>(2)</u>	<u>116 - 120</u>
<u>160803.27</u>	<u>Amint</u>		<u>18.2</u>	<u>20.4</u>	<u>2.2</u>		<u>88</u>
<u>160803.28</u>	<u>Pm 001</u>		<u>20.4</u>	<u>23.2</u>	<u>2.8</u>		<u>112 - 110</u>
<u>160803.29</u>	<u>Pm INT</u>		<u>23.2</u>	<u>25.2</u>	<u>2.0</u>		<u>80</u>
<u>160804.08</u>	<u>Chromhaall</u>	<u>50</u>	<u>25.2</u>	<u>31.5</u>	<u>6.3</u>		<u>130</u>
	<u>Quaiting A</u>		<u>31.5</u>	<u>38.4</u>	<u>6.9</u>		<u>140</u>
	<u>B</u>		<u>38.4</u>	<u>39.6</u>	<u>1.2</u>		<u>24</u>
	<u>C</u>		<u>39.6</u>	<u>42.1</u>	<u>2.5</u>		<u>50</u>

Note: If >12ml of titrant is used, sample must be diluted.

Reviewed by: A

Date reviewed 08-05-16

**Hardness (SM 2340 C-1997)**

RL = 1.0 mg CaCO<sub>3</sub>/L

Analyst W  
Date analyzed 06.05.16

Time initiated 08:51  
Time completed           

**Titrant normality and multiplier determination:**

Titrant reference number	Normality check standard number	Begin ml	End ml	Total ml (E)	Normality (N) of EDTA = 0.2/E (acceptable range = 0.0180 - 0.0220)	pH Factor or Multiplier = (N x 50000) / 50 ml sample = N x 1000
						<u>20.0</u>

**Laboratory control standard:**

Reference standard number	True value (TV) (mg CaCO <sub>3</sub> /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (MV) (mg CaCO <sub>3</sub> /L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
	<u>40</u>	<u>50</u>	<u>42.1</u>	<u>44.1</u>	<u>2.0</u>	<u>20.0</u>	<u>40</u>	<u>100.02</u>

**Duplicate sample precision:**

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (mg CaCO <sub>3</sub> /L)	%RPD = ((S - D) / ((S + D) / 2)) x 100
	<u>Quartz D</u>	<u>50</u>	<u>44.1</u>	<u>45.2</u>	<u>1.1</u>	<u>20.0</u>	<u>22</u>	
	Duplicate (B)	<u>1</u>	<u>45.2</u>	<u>46.3</u>	<u>1.1</u>	<u>1</u>	<u>22</u>	<u>100.51</u>

**Matrix spike recovery:**

Reference standard number	Spike value (SV) (mg CaCO <sub>3</sub> /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Spike hardness (A) (mg CaCO <sub>3</sub> /L)
	<u>40</u>	<u>50</u>	<u>45.2</u>	<u>48.3</u>	<u>3.1</u>	<u>20.0</u>	<u>62</u>

Sample hardness (B) (mg CaCO <sub>3</sub> /L)	Measured spike value (MV) MV = A - B (mg CaCO <sub>3</sub> /L)	% R = MV / SV x 100 (acceptable range = 75 to 125%)
<u>22</u>	<u>40</u>	<u>100.07</u>

**Sample measurements:**

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (mg CaCO <sub>3</sub> /L)
TV = ND	Blank (should be = 0 mg CaCO <sub>3</sub> /L)						
	<u>Quartz E</u>	<u>50</u>	<u>22.9</u>	<u>23.7</u>	<u>0.8</u>	<u>20.0</u>	<u>16</u>
	<u>F</u>		<u>23.7</u>	<u>24.9</u>	<u>1.2</u>		<u>24</u>
	<u>G</u>		<u>24.9</u>	<u>27.0</u>	<u>2.1</u>		<u>42</u>
	<u>H</u>		<u>27.0</u>	<u>29.2</u>	<u>2.2</u>		<u>44</u>
	<u>I</u>		<u>29.2</u>	<u>29.8</u>	<u>0.6</u>		<u>12</u>
	<u>J</u>		<u>29.8</u>	<u>30.7</u>	<u>0.9</u>		<u>18</u>
	<u>K</u>		<u>30.7</u>	<u>31.8</u>	<u>1.1</u>		<u>22</u>

Note: If >15ml of titrant is used, sample must be diluted. Reviewed by: W

Date reviewed 06.05.16

**Hardness (SM 2340 C-1997)**

RL = 1.0 mg CaCO<sub>3</sub>/L

Analyst W  
Date analyzed 08.06.14

Time initiated 1443  
Time completed 1521

***Titrant normality and multiplier determination:***

Titrant reference number	Normality check standard number	Begin ml	End ml	Total ml (E)	Normality (N) of EDTA = 0.2/E (acceptable range = 0.0180 - 0.0220)	pH Factor or Multiplier = (N x 50000) / 50 ml sample = N x 1000
<u>1N2753</u>	<u>1N551307</u>	<u>0.0</u>	<u>9.8</u>	<u>9.8</u>	<u>0.0204</u>	<u>204</u>

***Laboratory control standard:***

Reference standard number	True value (TV) (mg CaCO <sub>3</sub> /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (MV) (mg CaCO <sub>3</sub> /L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
<u>1N551402</u>	<u>40</u>	<u>50</u>	<u>9.8</u>	<u>11.7</u>	<u>19</u>	<u>204</u>	<u>39</u>	<u>97.5%</u>

***Duplicate sample precision:***

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (mg CaCO <sub>3</sub> /L)	%RPD = [(S - D) / ((S+D)/2)] x 100
<u>160801.01</u>	<u>TW5A 1</u>	<u>50</u>	<u>11.7</u>	<u>13.5</u>	<u>1.8</u>	<u>204</u>	<u>S 37</u>	
	Duplicate (B)	<u>1</u>	<u>13.5</u>	<u>15.2</u>	<u>1.7</u>	<u>1</u>	<u>D 35</u>	<u>5.67</u>

***Matrix spike recovery:***

Reference standard number	Spike value (SV) (mg CaCO <sub>3</sub> /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Spike hardness (A) (mg CaCO <sub>3</sub> /L)
<u>1N551402</u>	<u>40</u>	<u>50</u>	<u>13.5</u>	<u>17.2</u>	<u>3.7</u>	<u>204</u>	<u>76</u>

Sample hardness (B) (mg CaCO <sub>3</sub> /L)	Measured spike value (MV) MV = A - B (mg CaCO <sub>3</sub> /L)	% R = MV / SV x 100 (acceptable range = 75 to 125%)
<u>35</u>	<u>41</u>	<u>102.5%</u>

***Sample measurements:***

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (mg CaCO <sub>3</sub> /L)
TV = ND	Blank (should be = 0 mg CaCO <sub>3</sub> /L)	<u>50</u>	<u>0.0</u>	<u>0.0</u>	<u>0.0</u>	<u>204</u>	<u>ND</u>
<u>160803.22</u>	<u>TW5A 2</u>		<u>17.2</u>	<u>18.8</u>	<u>1.6</u>		<u>33</u>
<u>160805.14</u>	<u>1 3</u>		<u>18.0</u>	<u>20.5</u>	<u>1.7</u>		<u>35</u>
<u>160802.04</u>	<u>N Cary 1</u>		<u>20.5</u>	<u>23.9</u>	<u>3.4</u>		<u>69</u>
<u>160804.03</u>	<u>1 2</u>		<u>23.9</u>	<u>27.0</u>	<u>3.1</u>		<u>63</u>
<u>160806.02</u>	<u>1 3</u>		<u>27.0</u>	<u>30.0</u>	<u>3.0</u>		<u>61</u>
<u>160802.01</u>	<u>S Cary 1</u>		<u>30.0</u>	<u>32.5</u>	<u>2.5</u>		<u>61</u>
<u>160804.01</u>	<u>1 2</u>		<u>32.5</u>	<u>35.5</u>	<u>3.0</u>		<u>61</u>
<u>160806.01</u>	<u>1 3</u>		<u>35.5</u>	<u>38.1</u>	<u>2.6</u>		<u>53</u>
<u>160802.03</u>	<u>EW591A 1</u>	<u>10</u>	<u>38.1</u>	<u>41.1</u>	<u>3.0</u>	<u>(5)</u>	<u>310</u>

Note: If >15ml of titrant is used, sample must be diluted.

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Reviewed by:

W

Date reviewed

08-06-14

**Hardness (SM 2340 C-1997)**

RL = 1.0 mg CaCO<sub>3</sub>/L

Analyst K  
Date analyzed 08.06.16

Time initiated 080616  
Time completed K

***Titrant normality and multiplier determination:***

Titrant reference number	Normality check standard number	Begin ml	End ml	Total ml (E)	Normality (N) of EDTA = 0.2/E (acceptable range = 0.0180 - 0.0220)	pH Factor or Multiplier = (N x 50000) / 50 ml sample = N x 1000
						<u>100000</u>

***Laboratory control standard:***

Reference standard number	True value (TV) (mg CaCO <sub>3</sub> /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (MV) (mg CaCO <sub>3</sub> /L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
<u>1NSS1402</u>	<u>40</u>	<u>50</u>	<u>41.1</u>	<u>43.1</u>	<u>2.0</u>	<u>20.4</u>	<u>41</u>	<u>102.5%</u>

***Duplicate sample precision:***

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (mg CaCO <sub>3</sub> /L)	%RPD = ((S - D) / ((S + D) / 2)) x 100
<u>160801.02</u>	<u>Georgia 2</u>	<u>10</u>	<u>43.1</u>	<u>46.1</u>	<u>3.0</u>	<u>(5) 20.4</u>	<u>S 310</u>	
<u>↓</u>	<u>Duplicate (B)</u>	<u>↓</u>	<u>0.0</u>	<u>2.9</u>	<u>2.9</u>	<u>↓</u>	<u>D 300</u>	<u>3.3%</u>

***Matrix spike recovery:***

Reference standard number	Spike value (SV) (mg CaCO <sub>3</sub> /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Spike hardness (A) (mg CaCO <sub>3</sub> /L)
<u>1NSS1402</u>	<u>200</u>	<u>10</u>	<u>0.0</u>	<u>4.9</u>	<u>4.9</u>	<u>(5) 20.4</u>	<u>500</u>

Sample hardness (B) (mg CaCO <sub>3</sub> /L)	Measured spike value (MV) MV = A - B (mg CaCO <sub>3</sub> /L)	% R = MV / SV x 100 (acceptable range = 75 to 125%)
<u>300</u>	<u>200</u>	<u>100.0%</u>

***Sample measurements:***

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (mg CaCO <sub>3</sub> /L)
TV = ND	Blank (should be = 0 mg CaCO <sub>3</sub> /L)					<u>100000</u>	
<u>160806.01</u>	<u>Georgia 3</u>	<u>10</u>	<u>4.4</u>	<u>7.9</u>	<u>3.0</u>	<u>(5) 20.4</u>	<u>310</u>
<u>07-29-16</u>	<u>MHSW UV 1</u>	<u>50</u>	<u>7.9</u>	<u>12.3</u>	<u>4.4</u>		<u>88 90</u>
<u>08-02-16A</u>	<u>↓ 2</u>	<u>↓</u>	<u>12.3</u>	<u>16.0</u>	<u>4.3</u>		<u>88</u>
<u>08-02-16B</u>	<u>↓ 3</u>	<u>↓</u>	<u>16.0</u>	<u>21.0</u>	<u>4.4</u>		<u>90</u>
<u>160801.02</u>	<u>TVASQW101 1</u>	<u>25</u>	<u>21.0</u>	<u>23.0</u>	<u>2.0</u>	<u>(2)</u>	<u>82</u>
<u>160803.23</u>	<u>↓ 2</u>	<u>↓</u>	<u>23.0</u>	<u>25.0</u>	<u>2.0</u>		<u>82</u>
<u>160805.15</u>	<u>↓ 3</u>	<u>↓</u>	<u>25.0</u>	<u>27.1</u>	<u>2.1</u>		<u>80</u>
<u>160801.02</u>	<u>TVASQW101 UV 1</u>		<u>27.1</u>	<u>29.1</u>	<u>2.0</u>		<u>82</u>
<u>160803.23</u>	<u>↓ 2</u>	<u>↓</u>	<u>29.1</u>	<u>31.1</u>	<u>2.0</u>		<u>82</u>

Note: If >15 ml of titrant is used, sample must be diluted.

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Reviewed by:

K

Date reviewed

08-06-16



**Hardness (SM 2340 C-1997)**

RL = 1.0 mg CaCO<sub>3</sub>/L

Analyst W  
Date analyzed 08.06.14

Time initiated 0806.14  
Time completed 4

***Titrant normality and multiplier determination:***

Titrant reference number	Normality check standard number	Begin ml	End ml	Total ml (E)	Normality (N) of EDTA = 0.2/E (acceptable range = 0.0180 - 0.0220)	pH Factor or Multiplier = (N x 50000) / 50 ml sample = N x 1000
						<u>0.0200, L</u>

***Laboratory control standard:***

Reference standard number	True value (TV) (mg CaCO <sub>3</sub> /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (MV) (mg CaCO <sub>3</sub> /L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
<u>INSS1402</u>	<u>40</u>	<u>50</u>	<u>31.1</u>	<u>33.1</u>	<u>2.0</u>	<u>20.4</u>	<u>41</u>	<u>102.5%</u>

***Duplicate sample precision:***

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (mg CaCO <sub>3</sub> /L)	%RPD = [(S - D) / ((S + D) / 2)] x 100
<u>160805.15</u>	<u>TV A SQN ID 1113</u>	<u>25</u>	<u>33.1</u>	<u>35.2</u>	<u>2.1</u>	<u>(2) 20.4</u>	<u>S 06</u>	
<u>↓</u>	<u>Duplicate (B)</u>	<u>↓</u>	<u>35.2</u>	<u>37.3</u>	<u>2.1</u>	<u>↓ ↓</u>	<u>D 06</u>	<u>→ 0.0016</u>

***Matrix spike recovery:***

Reference standard number	Spike value (SV) (mg CaCO <sub>3</sub> /L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Spike hardness (A) (mg CaCO <sub>3</sub> /L)
<u>INSS1402</u>	<u>80</u>	<u>25</u>	<u>35.2</u>	<u>39.3</u>	<u>4.1</u>	<u>(2) 20.4</u>	<u>170</u>

Sample hardness (B) (mg CaCO <sub>3</sub> /L)	Measured spike value (MV) MV = A - B (mg CaCO <sub>3</sub> /L)	% R = MV / SV x 100 (acceptable range = 75 to 125%)
<u>06</u>	<u>04</u>	<u>105.0%</u>

***Sample measurements:***

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (mg CaCO <sub>3</sub> /L)
TV = ND	Blank (should be = 0 mg CaCO <sub>3</sub> /L)						<u>0.0014</u>
<u>160801.05</u>	<u>TV A SQN INT 1</u>	<u>25</u>	<u>39.3</u>	<u>41.1</u>	<u>1.8</u>	<u>(2) 20.4</u>	<u>73</u>
<u>160805.21</u>	<u>↓ 2</u>		<u>41.1</u>	<u>43.1</u>	<u>2.0</u>		<u>82</u>
<u>160805.16</u>	<u>↓ 3</u>		<u>43.1</u>	<u>45.0</u>	<u>1.9</u>		<u>78</u>
<u>160801.05</u>	<u>TV A SQN INT 111</u>		<u>30.5</u>	<u>32.3</u>	<u>1.8</u>		<u>73</u>
<u>160803.21</u>	<u>↓ 2</u>		<u>32.3</u>	<u>34.3</u>	<u>2.0</u>		<u>82</u>
<u>160805.16</u>	<u>↓ 3</u>		<u>34.3</u>	<u>36.2</u>	<u>1.9</u>		<u>78</u>

Note: If >15ml of titrant is used, sample must be diluted.

Reviewed by:

W

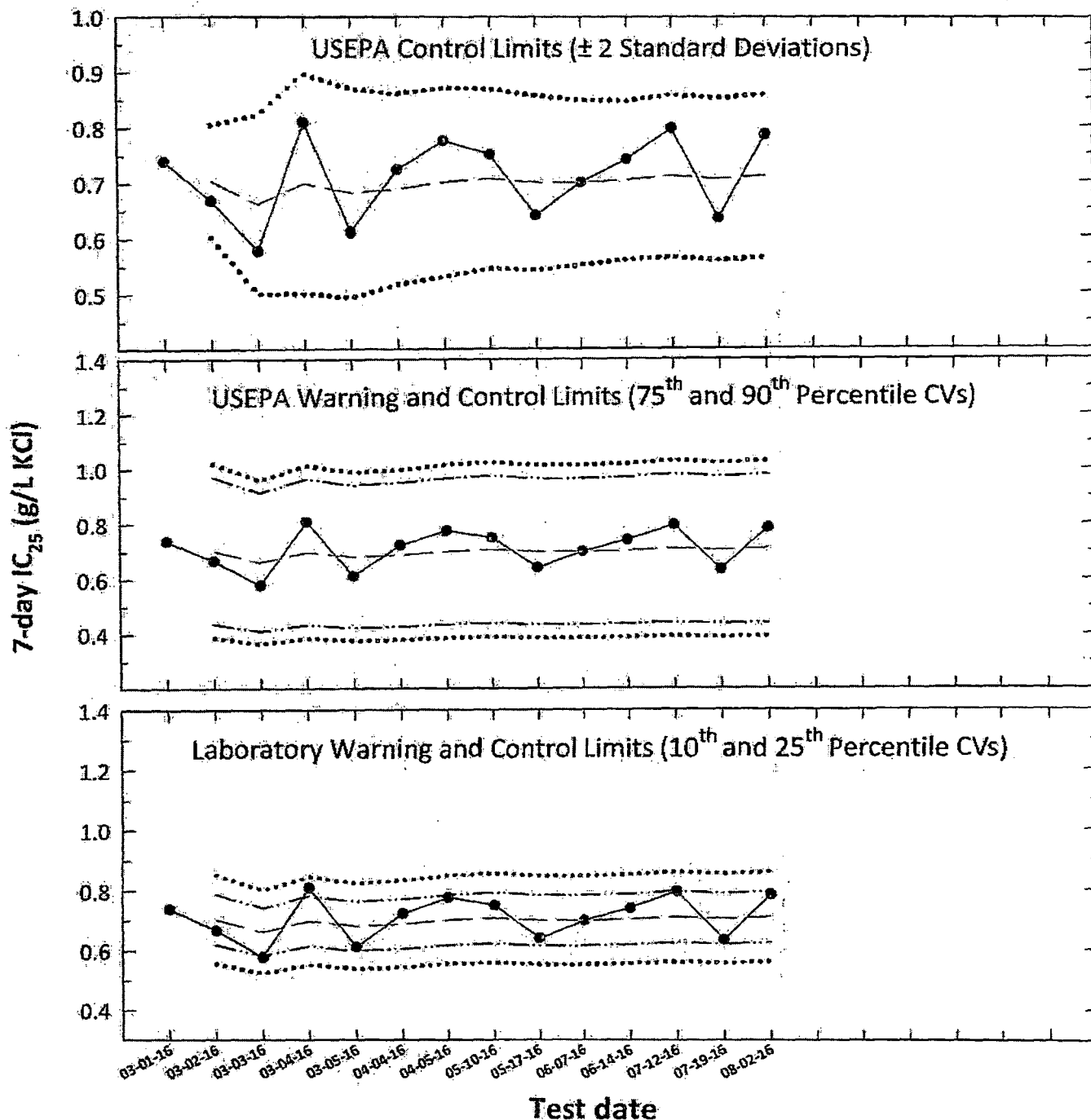
Date reviewed

08.06.14

Sequoyah Nuclear Plant Biomonitoring  
August 02 – 09, 2016

Appendix D  
Reference Toxicant Test and  
Control Chart

*Pimephales promelas*  
Chronic Reference Toxicant Control Chart  
Organism Source: In-house



- 7-day  $IC_{25}$  = 25% inhibition concentration. An estimation of the concentration of potassium chloride that would cause a 25% reduction in *Pimephales* growth for the test population.
- Central Tendency (mean  $IC_{25}$ )
- Warning Limits (mean  $IC_{25} \pm S_{A.10}$  or  $S_{A.75}$ )
- Control Limits (mean  $IC_{25} \pm S_{A.25}$ ,  $S_{A.90}$ , or 2 Standard Deviations)

**ETS**

Environmental Testing Solutions, Inc.

*Pimephales promelas*  
Chronic Reference Toxicant Control Chart

Test number	Test date	7-day $IC_{25}$ (g/L KCl)	CT (g/L KCl)	S	State and USEPA Control Limits		Laboratory Warning Limits		Laboratory Control Limits		USEPA Warning Limits		USEPA Control Limits		CV
					CT - 2S	CT + 2S	CT - $S_{A,10}$	CT + $S_{A,10}$	CT - $S_{A,25}$	CT + $S_{A,25}$	CT - $S_{A,75}$	CT + $S_{A,75}$	CT - $S_{A,90}$	CT + $S_{A,90}$	
1	03-01-16	0.74													
2	03-02-16	0.67	0.70	0.05	0.60	0.81	0.08	0.62	0.79	0.15	0.56	0.85	0.27	0.44	0.07
3	03-03-16	0.58	0.66	0.08	0.50	0.82	0.08	0.58	0.74	0.14	0.52	0.80	0.25	0.41	0.12
4	03-04-16	0.81	0.70	0.10	0.50	0.90	0.08	0.62	0.78	0.15	0.55	0.85	0.27	0.43	0.14
5	03-05-16	0.61	0.68	0.09	0.49	0.87	0.08	0.60	0.76	0.14	0.54	0.82	0.26	0.42	0.14
6	04-04-16	0.72	0.69	0.09	0.52	0.86	0.08	0.61	0.77	0.14	0.54	0.83	0.26	0.43	0.12
7	04-05-16	0.78	0.70	0.08	0.53	0.87	0.08	0.62	0.79	0.15	0.55	0.85	0.27	0.43	0.12
8	05-10-16	0.75	0.71	0.08	0.55	0.87	0.08	0.62	0.79	0.15	0.56	0.86	0.27	0.44	0.11
9	05-17-16	0.64	0.70	0.08	0.54	0.86	0.08	0.62	0.78	0.15	0.55	0.85	0.27	0.43	0.11
10	06-07-16	0.70	0.70	0.07	0.55	0.85	0.08	0.62	0.78	0.15	0.55	0.85	0.27	0.43	0.11
11	06-14-16	0.74	0.70	0.07	0.56	0.85	0.08	0.62	0.79	0.15	0.56	0.85	0.27	0.44	0.10
12	07-12-16	0.80	0.71	0.07	0.57	0.86	0.09	0.63	0.80	0.15	0.56	0.86	0.27	0.44	0.10
13	07-19-16	0.63	0.71	0.07	0.56	0.85	0.08	0.62	0.79	0.15	0.56	0.85	0.27	0.44	0.10
14	08-02-16	0.79	0.71	0.07	0.56	0.86	0.09	0.63	0.80	0.15	0.56	0.86	0.27	0.44	0.10
15															
16															
17															
18															
19															
20															

Note: 7-d  $IC_{25}$  = 7-day 25% inhibition concentration. An estimation of the concentration of potassium chloride that would cause a 25% reduction in *Pimephales* growth for the test population.

CT = Central tendency (mean  $IC_{25}$ ).

S = Standard deviation of the  $IC_{25}$  values.

**Laboratory Control and Warning Limits**

Laboratory control and warning limits were established using the standard deviation of the  $IC_{25}$  values corresponding to the 10th and 25th percentile CVs. These ranges are more stringent than the control and warning limits recommended by USEPA for the test method and endpoint.

$S_{A,10}$  = Standard deviation corresponding to the 10<sup>th</sup> percentile CV. ( $S_{A,10} = 0.12$ ).

$S_{A,25}$  = Standard deviation corresponding to the 25<sup>th</sup> percentile CV. ( $S_{A,25} = 0.21$ ).

**USEPA Control and Warning Limits**

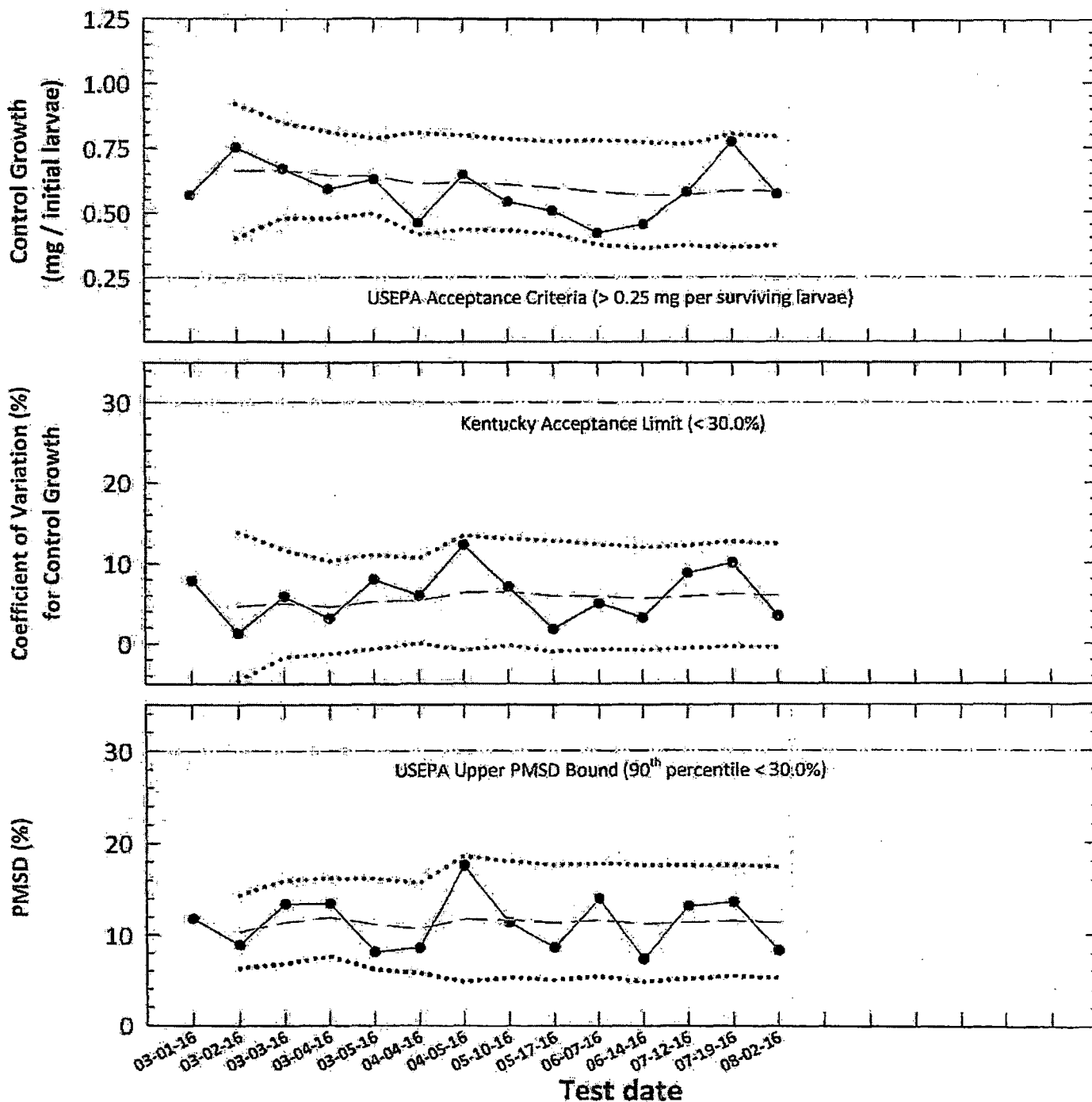
$S_{A,75}$  = Standard deviation corresponding to the 75<sup>th</sup> percentile CV. ( $S_{A,75} = 0.38$ ).

$S_{A,90}$  = Standard deviation corresponding to the 90<sup>th</sup> percentile CV. ( $S_{A,90} = 0.45$ ).

CV = Coefficient of variation of the  $IC_{25}$  values.



*Pimephales promelas*  
**Chronic Reference Toxicant Control Chart**  
**Precision of Endpoint Measurements**  
**Organism Source: In-house**



Control Reproduction, Coefficient of Variation (CV), or Percent Minimum Significant Difference (PMSD) - PMSD is the minimum significant difference between the control and treatment that can be declared statistically significant.

Central Tendency (mean Control Growth, CV, or PMSD)

Control Limits (mean Control Growth, CV, or PMSD  $\pm$  2 Standard Deviations)



Entered and Reviewed by  
Jim Sumner



## Precision of Endpoint Measurements

### *Pimephales promelas* Chronic Reference Toxicant Data

Test number	Test date	Control Survival (%)	Control Mean Growth (mg/larvae)	CT for Control Growth (mg/larvae)	CV (%)	CT for Control Growth CV (%)	MSD (%)	PMSD (%)	CT for PMSD (%)
1	03-01-16	100	0.569		7.9		0.07	11.8	
2	03-02-16	100	0.753	0.661	1.3	4.6	0.07	8.9	10.4
3	03-03-16	100	0.671	0.664	5.8	5.0	0.09	13.4	11.4
4	03-04-16	100	0.591	0.646	3.1	4.5	0.08	13.5	11.9
5	03-05-16	97.5	0.630	0.643	8.0	5.2	0.05	8.1	11.2
6	04-04-16	100	0.461	0.612	5.9	5.3	0.04	8.6	10.7
7	04-05-16	100	0.647	0.617	12.3	6.3	0.11	17.6	11.7
8	05-10-16	100	0.541	0.508	7.0	6.4	0.06	11.3	11.7
9	05-17-16	100	0.507	0.597	1.8	5.9	0.04	8.6	11.3
10	06-07-16	100	0.421	0.579	5.0	5.8	0.06	14.1	11.6
11	06-14-16	100	0.455	0.568	3.2	5.6	0.03	7.3	11.2
12	07-12-16	100	0.578	0.569	8.8	5.9	0.08	13.2	11.4
13	07-19-16	100	0.774	0.584	10.1	6.2	0.11	13.6	11.5
14	08-02-16	100	0.570	0.583	3.4	6.0	0.05	8.3	11.3
15									
16									
17									
18									
19									
20									

Note:

CV = Coefficient of variation for control growth.

Lower CV bound determined by USEPA (10<sup>th</sup> percentile) = 3.5%.

Upper CV bound determined by USEPA (90<sup>th</sup> percentile) = 20%

MSD = Minimum Significant Difference

PMSD = Percent Minimum Significant Difference

PMSD is a measure of test precision. The PMSD is the minimum percent difference between the control and treatment that can be declared statistically significant in a whole effluent toxicity test.

Lower PMSD bound determined by USEPA (10<sup>th</sup> percentile) = 12%.

Upper PMSD bound determined by USEPA (90<sup>th</sup> percentile) = 30%.

CT = Central Tendency (mean Control Growth, CV, or PMSD)

USEPA. 2000. Understanding and Accounting for Method Variability in Whole Effluent Toxicity Applications Under the National Pollutant Discharge Elimination Program.

EPA-833-R-00-003. US Environmental Protection Agency, Cincinnati, OH.

USEPA. 2001a, 2001b. Final Report: Interlaboratory Variability Study of EPA Short-term Chronic and Acute Whole Effluent Toxicity Test Methods, Volumes 1 and 2.

Appendix. EPA-821-B-01-004 and EPA-821-B-01-005. US Environmental Protection Agency, Cincinnati, OH.

Entered and  
Reviewed by  
Jim Sumner  
01



**Potassium Chloride Chronic Reference Toxicant Test**  
(EPA-821-R-02-013 Method 1000.0)

Species: Pimephales promelas

PpKCICR Test Number: 14

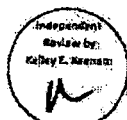
Dilution preparation information:							Comments:
KCl Stock INSS number:			INSS <u>15.07</u>				
Stock preparation:			50 g KCl/L: Dissolve 50 g KCl in 1-L Milli-Q water.				
Dilution prep (mg/L)	300	450	600	750	900	1050	
Stock volume (mL)	6	9	12	15	18	21	
Diluent volume (mL)	994	991	988	985	982	979	
Total volume (mL)	1000	1000	1000	1000	1000	1000	

Test organism information:		Test information:	
Organism source:	In-house culture	Randomizing template:	<u>RED</u>
Age:	< 24-hours old	Incubator number and shelf location:	<u>7B</u>
Spawn date:	<u>07-28-16</u>	Artemia CHM number:	<u>CHM882</u>
Hatch dates and times:	<u>08-01-16 1500 TO</u> <u>08-02-16 0615</u>	Drying information for weight determination:	
Transfer vessel information:	pH = <u>8.06</u> S.U. Temperature = <u>25.1</u> °C	Date / Time in oven:	<u>08-09-16 0900</u>
Average transfer volume:	<u>0.11 mL</u>	Initial oven temperature:	<u>60°C</u>
		Date / Time out of oven:	<u>08-10-16 0900</u>
		Final oven temperature:	<u>60°C</u>
		Total drying time:	<u>24-Hours</u>

**Daily feeding and renewal information:**

Day	Date	Morning feeding		Afternoon feeding		Test initiation, renewal, or termination		MHSW batch used
		Time	Analyst	Time	Analyst	Time	Analyst	
0	<u>08-02-16</u>	<u>0630</u>	<u>J</u>	<u>1330</u>	<u>J</u>	<u>0830</u>	<u>J</u>	<u>07-29-16</u>
1	<u>08-03-16</u>	<u>0630</u>	<u>J</u>	<u>1230</u>	<u>J</u>	<u>0838</u>	<u>J</u>	<u>07-29-16</u>
2	<u>08-04-16</u>	<u>0630</u>	<u>J</u>	<u>1230</u>	<u>J</u>	<u>0840</u>	<u>J</u>	<u>08-02-16 A</u>
3	<u>08-05-16</u>	<u>0630</u>	<u>J</u>	<u>1230</u>	<u>J</u>	<u>0840</u>	<u>J</u>	<u>08-02-16 A</u>
4	<u>08-06-16</u>	<u>0710</u>	<u>J</u>	<u>1310</u>	<u>J</u>	<u>0910</u>	<u>J</u>	<u>08-02-16 A</u>
5	<u>08-07-16</u>	<u>0710</u>	<u>J</u>	<u>1310</u>	<u>J</u>	<u>0912</u>	<u>J</u>	<u>08-02-16 B</u>
6	<u>08-08-16</u>	<u>0630</u>	<u>J</u>	<u>1230</u>	<u>J</u>	<u>0830</u>	<u>J</u>	<u>08-02-16 B</u>
7	<u>08-09-16</u>					<u>0732</u>	<u>J</u>	

Control information:		Acceptance criteria	Summary of test endpoints:	
% Mortality:	<u>07</u>	≤ 20%	7-day LC <sub>50</sub>	<u>922.1</u>
Average weight per initial larvae:	<u>0.570</u>		NOEC	<u>450</u>
Average weight per surviving larvae:	<u>0.570</u>	≥ 0.25 mg/larvae	LOEC	<u>600</u>
			ChV	<u>519.6</u>
			IC <sub>25</sub>	<u>785.0</u>



Species: *Pimephales promelas*

PpKCICR Test Number: 14

*Survival and Growth Data*

Day	Control				300 mg KCl/L				450 mg KCl/L			
	A	B	C	D	E	F	G	H	I	J	K	L
0	10	10	10	10	10	10	10	10	10	10	10	10
1	10	10	10	10	10	10	10	10	10	10	10	10
2	10	10	10	10	10	10	10	10	10	10	10	10
3	10	10	10	10	10	10	10	10	10	10	10	10
4	10	10	10	10	10	10	10	10	10	10	10	10
5	10	10	10	10	10	10	10	10	10	10	10	10
6	10	10	10	10	10	10	10	10	10	10	10	10
7	10	10	10	10	10	10	10	10	10	10	10	10
A = Pan weight (mg) Tray color code: <u>lavender</u> Analyst: <u>JA</u> Date: <u>11-30-16</u>												
B = Pan + Larvae weight (mg) Analyst: <u>JA</u> Date: <u>08-11-16</u>												
C = Larvae weight (mg) = B - A Hand calculated. Analyst: <u>JA</u>												
Weight per initial number of larvae (mg) = C / Initial number of larvae Hand calculated. Analyst: <u>JA</u>												
Average weight per initial number of larvae (mg)      Percent reduction from control (%)												
0.570 <span style="background-color: black; color: black;">XXXXXXXXXX</span> 0.546      4.27      0.533      6.57												

Comment codes: c = clear, d = dead, fg = fungus, k = killed, m = missing, sk = sick, sm = unusually small, lg = unusually large, d&r = decanted and returned, w = wounded.

Comments:



Species: Pimephales promelas

PpKClCR Test Number: 14

Survival and Growth Data

Day	600 mg KCl/L				750 mg KCl/L				900 mg KCl/L			
	M	N	O	P	Q	R	S	T	U	V	W	X
0	10	10	10	10	10	10	10	10	10	10	10	10
1	10	10	10	10	10	10	10	10	10	9 <sup>nd</sup>	10	9 <sup>nd</sup>
2	10	10	10	10	10	10	10	10	10	9	10	9
3	10	10	10	10	10	10	10	9 <sup>nd</sup>	9 <sup>nd</sup>	9	9 <sup>nd</sup>	9
4	10	10	10	10	10	10	10	8 <sup>ld</sup>	9	7 <sup>ld</sup>	8 <sup>ld</sup>	8 <sup>ld</sup>
5	10	10	10	10	10	10	10	8	8 <sup>nd</sup>	7	7 <sup>nd</sup>	6 <sup>2d</sup>
6	10	10	10	10	10	10	10	8	8	7	7	6
7	10	10	10	10	9 <sup>nd</sup>	10	10	8	6 <sup>2d</sup>	6 <sup>nd</sup>	5 <sup>2d</sup>	6
A = Pan weight (mg) Tray color code: <u>lavender</u> Analyst: <u>                    </u> Date: <u>11-30-14</u>												
B = Pan + Larvae weight (mg) Analyst: <u>NB</u> Date: <u>11-11-14</u>												
C = Larvae weight (mg) = B - A Hand calculated: <u>                    </u> Analyst: <u>                    </u>												
Weight per initial number of larvae (mg) = C / Initial number of larvae Hand calculated: <u>                    </u> Analyst: <u>                    </u>												
Average weight per initial number of larvae (mg)      Percent reduction from control (%)												
0.472      17.27      0.477      16.47      0.274      51.97												

Comment codes: c = clear, d = dead, fg = fungus, k = killed, m = missing, sk = sick, sm = unusually small, lg = unusually large, d&r = decanted and returned, w = wounded.

Comments:

Species: *Pimephales promelas*

PpKCICR Test Number: 14

*Survival and Growth Data*

Day	1050 mg KCl/L			
	Y	Z	AA	BB
0	10	10	10	10
1	5 <sup>2d</sup>	7 <sup>3d</sup>	8 <sup>2d</sup>	8 <sup>2d</sup>
2	6 <sup>2d</sup>	7	7 <sup>1d</sup>	8
3	5 <sup>1d</sup>	6 <sup>1d</sup>	6 <sup>1d</sup>	8
4	3 <sup>2d</sup>	4 <sup>2d</sup>	6	8
5	3	4	6	5 <sup>3d</sup>
6	1 <sup>2d</sup>	3 <sup>1d</sup>	6	5
7	1	2 <sup>1d</sup>	3 <sup>2d</sup>	1 <sup>4d</sup>
A = Pan weight (mg) Tray color code: <u>lavender</u> Analyst: <u>nb</u> Date: <u>07-30-14</u>				
B = Pan + Larvae weight (mg) Analyst: <u>nb</u> Date: <u>08-11-14</u>				
C = Larvae weight (mg) = B - A Hand calculated. Analyst: <u>jk</u>				
Weight per initial number of larvae (mg) = C / Initial number of larvae Hand calculated. Analyst: <u>jk</u>				
Average weight per initial number of larvae (mg)		Percent reduction from control (%)		

Comment codes: c = clear, d = dead, fg = fungus, k = killed, m = missing, sk = sick, sm = unusually small, lg = unusually large, d&r = decanted and returned, w = wounded.

Comments:



Environmental Testing Solutions, Inc.

Pimephales promelas Chronic Reference Toxicant Test  
EPA-821-R-02-013, Method 1000.0Quality Control  
Verification of Data Entry, Calculations, and Statistical AnalysesTest numbers: 14  
Test dates: August 02-09, 2015

Concentration (mg/L KCl)	Replicate	Initial number of larvae	Final number of larvae	A = Pan weight (mg)	B = Pan + larvae weight (mg)	Larvae weight (mg) = B - A	Weight / Surviving number of larvae (mg)	Mean weight / Surviving number of larvae (mg)	Coefficient of variation (mean weight per surviving number of larvae) (%)	Weight / Initial number of larvae (mg)	Mean survival (%)	Mean weight / Initial number of larvae (mg)	Coefficient of variation (%)	Percent reduction from control (%)
Control	A	10	10	13.03	18.87	5.84	0.584	0.570	3.4	0.584	100.0	0.570	3.4	Not applicable
	B	10	10	15.59	20.95	5.42	0.542			0.542				
	C	10	10	15.51	21.33	5.82	0.582			0.582				
	D	10	10	16.12	21.84	5.72	0.572			0.572				
300	E	10	10	15.96	21.41	5.45	0.545	0.546	2.8	0.545	100.0	0.546	2.8	4.2
	F	10	10	13.39	18.85	5.46	0.546			0.546				
	G	10	10	14.49	19.77	5.28	0.528			0.528				
	H	10	10	15.78	21.43	5.65	0.565			0.565				
450	I	10	10	15.40	20.11	4.71	0.471	0.533	8.0	0.471	100.0	0.533	8.0	8.5
	J	10	10	15.17	20.58	5.41	0.541			0.541				
	K	10	10	16.22	21.86	5.64	0.564			0.564				
	L	10	10	16.43	21.99	5.56	0.556			0.556				
600	M	10	10	15.00	19.60	4.60	0.460	0.472	6.6	0.460	100.0	0.472	6.6	17.2
	N	10	10	15.78	20.19	4.41	0.441			0.441				
	O	10	10	15.73	20.88	5.15	0.515			0.515				
	P	10	10	15.92	20.64	4.72	0.472			0.472				
750	Q	10	9	15.14	19.95	4.81	0.534	0.518	8.1	0.481	92.5	0.477	5.3	16.4
	R	10	10	16.44	21.54	5.10	0.510			0.510				
	S	10	10	15.28	19.92	4.64	0.464			0.464				
	T	10	8	16.23	20.74	4.51	0.564			0.451				
900	U	10	6	16.45	19.19	2.74	0.457	0.480	10.7	0.274	57.5	0.274	4.6	51.9
	V	10	6	15.08	17.97	2.89	0.482			0.289				
	W	10	5	14.39	17.14	2.75	0.550			0.275				
	X	10	6	16.36	18.94	2.58	0.430			0.258				
1050	Y	10	1	15.84	16.45	0.61	0.610	0.573	6.7	0.061	17.5	0.098	46.6	82.8
	Z	10	2	15.60	16.78	1.18	0.590			0.118				
	AA	10	3	16.09	17.65	1.56	0.520			0.156				
	BB	10	1	15.07	15.64	0.57	0.570			0.057				

Dunnnett's MSD value: 0.0474  
PMSD: 8.3MSD = Minimum Significant Difference  
PMSD = Percent Minimum Significant Difference

PMDS is a measure of test precision. The PMSD is the minimum percent difference between the control and treatment that can be declared statistically significant in a whole effluent toxicity test.  
Lower PMSD bound determined by USEPA (10th percentile) = 12%.  
Upper PMSD bound determined by USEPA (90th percentile) = 30%.

Lower and upper PMSD bounds were determined from the 10th and 90th percentile, respectively, of PMSD data from EPA's WET Interlaboratory Variability Study (USEPA, 2001a; USEPA, 2001b).

USEPA. 2001a, 2001b. Final Report: Interlaboratory Variability Study of EPA Short-term Chronic and Acute Whole Effluent Toxicity Test Methods, Volumes 1 and 2: Appendix. EPA-821-B-01-004 and EPA-821-B-01-005. US Environmental Protection Agency, Cincinnati, OH.





### Larval Fish Growth and Survival Test-7 Day Survival

Start Date: 8/2/2016 Test ID: PpKGIOR Sample ID: REF-Ref Toxicant  
 End Date: 8/9/2016 Lab ID: ETS-Envir. Testing Sol. Sample Type: KCL-Potassium chloride  
 Sample Date: Protocol: FWCHR-EPA-821-R-02-013 Test Species: PP-Pimephales promelas  
 Comments:

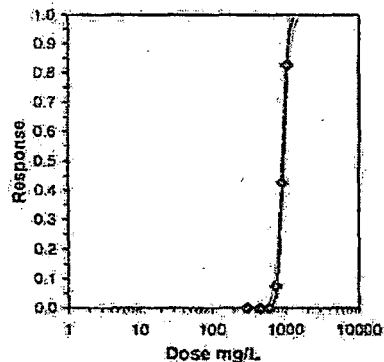
Conc-mg/L	1	2	3	4
D-Control	1.0000	1.0000	1.0000	1.0000
300	1.0000	1.0000	1.0000	1.0000
450	1.0000	1.0000	1.0000	1.0000
600	1.0000	1.0000	1.0000	1.0000
750	0.9000	1.0000	1.0000	0.8000
900	0.6000	0.6000	0.5000	0.6000
1050	0.1000	0.2000	0.3000	0.1000

Transform: Arcsin Square Root								Rank	1-Tailed	Number	Total
Cont-mg/L	Mean	N-Mean	Mean	Min	Max	CV%	N	Sum	Critical	Resp	Number
D-Control	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	4			0	40
300	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	4	18.00	10.00	0	40
450	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	4	18.00	10.00	0	40
600	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	4	18.00	10.00	0	40
750	0.9260	0.9260	1.2951	1.1071	1.4120	11.347	4	14.00	10.00	3	40
900	0.5750	0.5750	0.8609	0.7654	0.8861	5.847	4	10.00	10.00	17	40
1050	0.1750	0.1750	0.4217	0.3218	0.5795	29.582	4	10.00	10.00	33	40

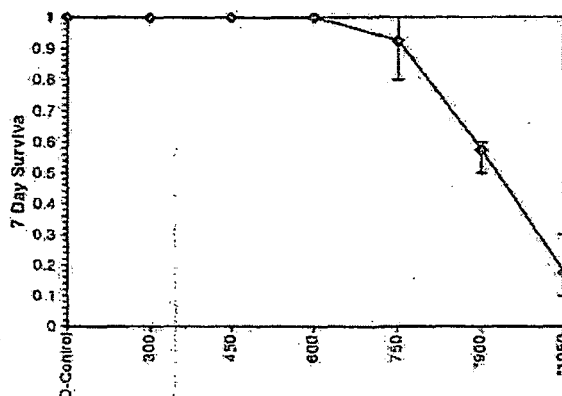
Auxiliary Tests					Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)					0.83328	0.896	-0.2585	2.54514
Equality of variance cannot be confirmed								
Hypothesis Test (1-tail, 0.05)					NOEC	LOEC	Chv	TU
Steel's Many-One Rank Test					750	900	821.584	
Treatments vs D-Control								

Maximum Likelihood-Probit										
Parameter	Value	SE	95% Fiducial Limits	Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	16.4547	2.45609	11.8408 21.2686	0	0.0555	9.48773	0.99948	2.96478	0.06077	3
Intercept	-43.785	7.26946	-58.033 -29.535							

Point	Probits	mg/L	95% Fiducial Limits
EC01	2.674	665.892	580.901 719.902
EC05	3.355	732.522	662.869 777.202
EC10	3.718	770.725	710.468 810.416
EC15	3.964	797.62	743.941 834.25
EC20	4.158	819.663	771.149 854.262
EC25	4.326	839.059	794.751 872.396
EC40	4.747	889.993	853.898 923.673
EC50	5.000	922.111	888.067 959.741
EC60	5.253	955.388	920.64 1000.43
EC75	5.674	1013.38	972.105 1077.81
EC80	5.842	1037.36	992.073 1111.54
EC85	6.036	1066.03	1015.29 1152.86
EC90	6.282	1103.23	1044.63 1207.77
EC95	6.645	1160.77	1088.77 1295.09
EC99	7.326	1275.91	1174.93 1478.46



Dose-Response Plot



Reviewed and  
 Approved by  
 [Signature]







## Statistical Analyses

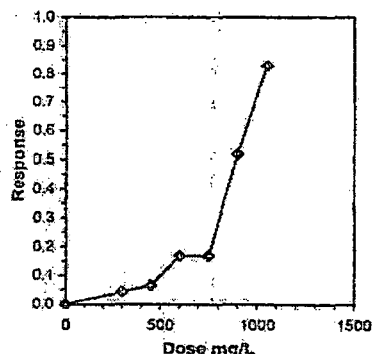
Larval Fish Growth and Survival Test-7 Day Growth					
Start Date:	8/2/2016	Test ID:	PpKICR	Sample ID:	REF-Ref Toxicant
End Date:	8/9/2016	Lab ID:	ETS-Envir. Testing Sol.	Sample Type:	KCL-Potassium chloride
Sample Date:		Protocol:	FWCHR-EPA-821-R-02-013	Test Species:	PP-Pimephales promelas
Comments:					

Conc-mg/L	1	2	3	4
D-Control	0.5840	0.5420	0.5820	0.5720
300	0.5450	0.5460	0.5280	0.5650
450	0.4710	0.5410	0.5640	0.5560
600	0.4600	0.4410	0.5150	0.4720
750	0.4810	0.5100	0.4640	0.4510
900	0.2740	0.2890	0.2750	0.2580
1050	0.0610	0.1180	0.1560	0.0570

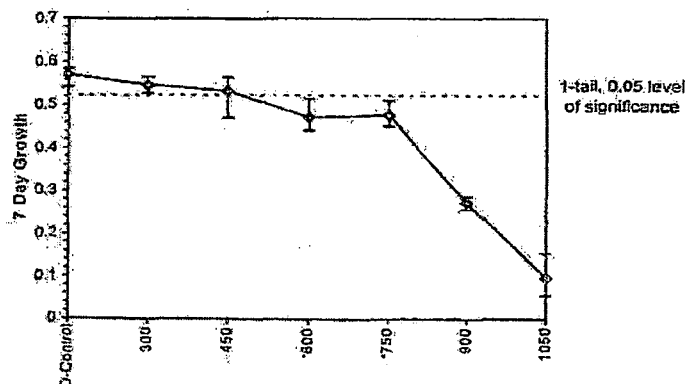
Conc-mg/L	Transform: Untransformed							1-Tailed		Isotonic	
	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	N-Mean
D-Control	0.5700	1.0000	0.5700	0.5420	0.5840	3.402	4				0.5700
300	0.5460	0.9579	0.5460	0.5280	0.5650	2.770	4	1.194	2.360	0.0474	0.5460
450	0.5330	0.9351	0.5330	0.4710	0.5640	7.958	4	1.841	2.360	0.0474	0.5330
*600	0.4720	0.8281	0.4720	0.4410	0.5150	6.848	4	4.877	2.360	0.0474	0.4743
*750	0.4765	0.8360	0.4765	0.4510	0.5100	5.349	4	4.653	2.360	0.0474	0.4743
900	0.2740	0.4807	0.2740	0.2580	0.2890	4.626	4				0.2740
1050	0.0980	0.1719	0.0980	0.0570	0.1560	48.631	4				0.0980

Auxiliary Tests				Statistic		Critical		Skew		Kurt	
Shapiro-Wilk's Test indicates normal distribution ( $p > 0.01$ )				0.97576		0.868		-0.5272		0.54083	
Bartlett's Test indicates equal variances ( $p = 0.51$ )				3.26548		13.2767					
Hypothesis Test (1-tail, 0.05)				NOEC	LOEC	Chv	TU	MSDu	MSDp	MSB	MSE
Dunnnett's Test				450	600	519.615		0.04743	0.0832	0.00754	0.00081
Treatments vs D-Control											5.4E-04
											4, 15

Linear Interpolation (200 Resamples)					
Point	mg/L	SD	95% CL(Exp)	Skew	
IC05	351.92	92.58	125.98	578.33	0.0791
IC10	501.06	46.85	304.90	606.13	-0.7299
IC15	573.83	72.36	459.54	864.43	1.1226
IC20	763.67	36.97	484.67	781.91	-3.7244
IC25	785.02	6.99	756.21	800.69	-0.1888
IC40	949.06	4.82	851.85	891.36	0.0293
IC50	891.76	4.39	878.12	904.95	0.1492



Dose-Response Plot



✓  
Reviewed and  
Approved for  
100 accuracy  
H



Species: Pimephales promelas

PpKCICR Test Number: 14

**Daily Chemistry:**

		Day (Analyst identified for each day, performed pH, D.O. and conductivity measurements only.)					
		0		1		2	
		Analyst	Analyst	Analyst	Analyst	Analyst	Analyst
Concentration	Parameter	MG	MS MG	MS MG	MS MG	MS MG	MG
CONTROL	pH (S.U.)	8.09	7.85	7.83	7.74	7.80	7.80
	DO (mg/L)	7.8	7.9	7.8	7.7	7.8	7.7
	Conductivity (umhos/cm)	308		308		330	
	*Alkalinity (mg CaCO <sub>3</sub> /L)	59				62	
	*Hardness (mg CaCO <sub>3</sub> /L)	88				96	
	*Temperature (°C)	24.8	24.5	24.6	24.5	24.7	24.4
300 mg KCl/L	pH (S.U.)	8.13	7.86	7.95	7.72	7.93	7.73
	DO (mg/L)	7.8	7.9	7.9	7.7	7.8	7.7
	Conductivity (umhos/cm)	800		862		868	
	*Temperature (°C)	24.9	24.7	24.6	24.5	24.7	24.6
450 mg KCl/L	pH (S.U.)	8.12	7.85	7.95	7.71	7.91	7.70
	DO (mg/L)	7.7	7.9	7.9	7.6	7.8	7.8
	Conductivity (umhos/cm)	1100		1130		1130	
	*Temperature (°C)	24.9	24.3	24.6	24.6	24.7	24.6
600 mg KCl/L	pH (S.U.)	8.10	7.84	7.94	7.73	7.90	7.72
	DO (mg/L)	7.8	7.9	8.0	7.6	7.8	7.8
	Conductivity (umhos/cm)	1340		1390		1400	
	*Temperature (°C)	24.9	24.3	24.6	24.6	24.7	24.6
750 mg KCl/L	pH (S.U.)	8.11	7.84	7.94	7.70	7.89	7.70
	DO (mg/L)	7.8	7.9	8.0	7.6	7.8	7.9
	Conductivity (umhos/cm)	1610		1660		1650	
	*Temperature (°C)	24.9	24.6	24.6	24.6	24.7	24.3
900 mg KCl/L	pH (S.U.)	8.09	7.84	7.93	7.71	7.89	7.73
	DO (mg/L)	7.9	7.9	8.0	7.6	7.9	7.8
	Conductivity (umhos/cm)	1860		1860		1920	
	*Temperature (°C)	24.9	24.4	24.6	24.3	24.7	24.6
1050 mg KCl/L	pH (S.U.)	8.09	7.84	7.93	7.72	7.87	7.73
	DO (mg/L)	8.0	8.0	8.1	7.6	7.9	7.8
	Conductivity (umhos/cm)	2150		2200		2190	
	*Temperature (°C)	25.0	24.4	24.6	24.5	24.7	24.2
		Initial	Final	Initial	Final	Initial	Final

\*Temperatures performed at the time of test initiation, renewal or termination by the analyst identified in the Daily Renewal Information table located on Page 1.  
Alkalinity and hardness performed by the analyst identified on the bench sheet specific for each analysis and transcribed to this bench sheet by: JA

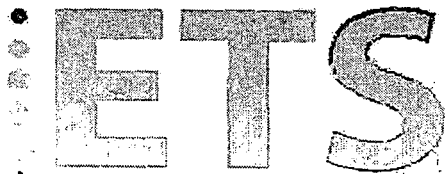
Independent  
Review by  
Kellie E. Keenan  
K

Species: *Pimephales promelas*

PpKClCR Test Number: 14

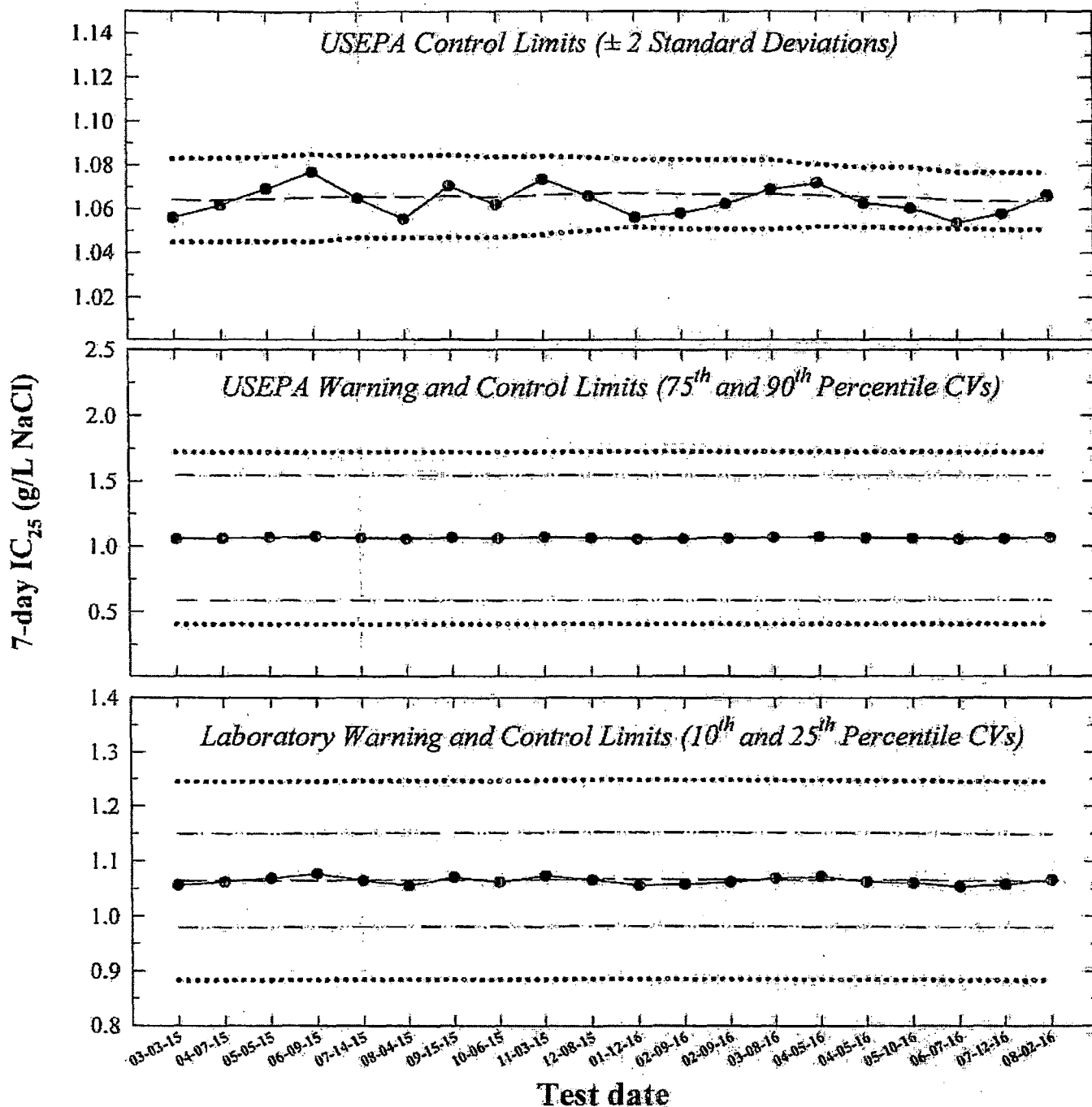
Analyst		Day (Analyst identified for each day, performed pH, D.O. and conductivity measurements only.)							
		3		4		5		6	
		NOG	W	W	MS W	MS W	NOG	MS	MS
Concentration	Parameter								
CONTROL	pH (S.U.)	7.83	7.47	7.99	7.70	7.84	7.84	7.94	7.75
	DO (mg/L)	7.8	10.6	7.8	7.6	7.7	7.7	7.8	7.8
	Conductivity (µmhos/cm)	321		318		327		317	
	*Alkalinity (mg CaCO <sub>3</sub> /L)	<del>none</del>		59		<del>none</del>		<del>none</del>	
	*Hardness (mg CaCO <sub>3</sub> /L)	<del>none</del>		90		<del>none</del>		<del>none</del>	
	*Temperature (°C)	24.8	24.6	24.7	24.6	24.7	24.5	24.6	24.2
300 mg KCl/L	pH (S.U.)	7.93	7.45	7.99	7.68	7.85	7.80	8.04	7.81
	DO (mg/L)	7.8	6.4	7.7	7.5	7.7	7.7	7.9	7.8
	Conductivity (µmhos/cm)	871		852		850		869	
	*Temperature (°C)	24.8	24.8	24.8	24.5	24.7	24.6	24.6	24.6
450 mg KCl/L	pH (S.U.)	7.95	7.42	7.99	7.72	7.88	7.78	8.03	7.80
	DO (mg/L)	7.9	6.6	7.7	7.6	7.7	7.7	8.0	7.9
	Conductivity (µmhos/cm)	1146		1120		1110		1130	
	*Temperature (°C)	24.8	24.5	24.8	24.5	24.7	24.6	24.6	24.3
600 mg KCl/L	pH (S.U.)	7.94	7.40	8.00	7.70	7.88	7.83	8.02	7.81
	DO (mg/L)	7.9	6.5	7.7	7.7	7.8	7.7	8.0	7.9
	Conductivity (µmhos/cm)	1400		1380		1380		1400	
	*Temperature (°C)	24.7	24.6	24.8	24.5	24.6	24.2	24.6	24.5
750 mg KCl/L	pH (S.U.)	7.93	7.42	8.01	7.67	7.89	7.80	8.01	7.81
	DO (mg/L)	7.9	6.4	7.8	7.7	7.8	7.7	8.0	8.0
	Conductivity (µmhos/cm)	1640		1630		1630		1640	
	*Temperature (°C)	24.7	24.6	24.8	24.6	24.8	24.2	24.7	24.5
900 mg KCl/L	pH (S.U.)	7.93	7.53	8.01	7.71	7.91	7.85	8.01	7.82
	DO (mg/L)	7.9	6.4	7.8	7.7	7.9	7.6	8.0	8.0
	Conductivity (µmhos/cm)	1910		1890		1880		1920	
	*Temperature (°C)	24.7	24.6	24.9	24.4	24.8	24.2	24.7	24.6
1050 mg KCl/L	pH (S.U.)	7.93	7.57	8.02	7.71	7.91	7.83	8.02	7.79
	DO (mg/L)	8.0	6.9	7.9	7.7	8.0	7.6	8.1	7.9
	Conductivity (µmhos/cm)	2170		2110		2120		2220	
	*Temperature (°C)	24.7	24.5	24.9	24.7	24.9	24.5	24.7	24.4
		Initial	Final	Initial	Final	Initial	Final	Initial	Final

Independent  
\*Temperatures performed at the time of test initiation, renewal or termination by the analyst identified in the Daily Renewal Information table located on Page 1.  
\*Alkalinity and hardness performed by the analyst identified on the bench sheet specific for each analysis and transcribed to this bench sheet by: JK



Environmental Testing Solutions, Inc.

# *Ceriodaphnia dubia* Chronic Reference Toxicant Control Chart



- 7-day  $IC_{25}$  = 25% inhibition concentration. An estimation of the concentration of sodium chloride that would cause a 25% reduction in *Ceriodaphnia* reproduction for the test population.
- - - Central Tendency (mean  $IC_{25}$ )
- ..... Warning Limits (mean  $IC_{25} \pm S_{A,10}$  or  $S_{A,75}$ )
- \_\_\_\_\_ Control Limits (mean  $IC_{25} \pm S_{A,25}, S_{A,90}$ , or 2 Standard Deviations)





# ETS

Environmental Testing Solutions, Inc.

## *Ceriodaphnia dubia* Chronic Reference Toxicant Control Chart

Test number	Test date	7-day $IC_{25}$ (g/L NaCl)	CT (g/L NaCl)	S	State and USEPA Control Limits		$S_{A10}$	Laboratory Warning Limits		$S_{A25}$	Laboratory Control Limits		$S_{A75}$	USEPA Warning Limits		$S_{A90}$	USEPA Control Limits		CV
					CT - 2S	CT + 2S		CT - $S_{A10}$	CT + $S_{A10}$		CT - $S_{A25}$	CT + $S_{A25}$		CT - $S_{A75}$	CT + $S_{A75}$		CT - $S_{A90}$	CT + $S_{A90}$	
1	03-03-15	1.05	1.06	0.01	1.04	1.08	0.09	0.98	1.15	0.18	0.88	1.24	0.48	0.59	1.54	0.66	0.40	1.72	0.01
2	04-07-15	1.06	1.06	0.01	1.04	1.08	0.09	0.98	1.15	0.18	0.88	1.24	0.48	0.59	1.54	0.66	0.40	1.72	0.01
3	05-05-15	1.07	1.06	0.01	1.05	1.08	0.09	0.98	1.15	0.18	0.88	1.25	0.48	0.59	1.54	0.66	0.40	1.72	0.01
4	06-09-15	1.08	1.06	0.01	1.04	1.08	0.09	0.98	1.15	0.18	0.88	1.25	0.48	0.59	1.54	0.66	0.40	1.72	0.01
5	07-14-15	1.06	1.07	0.01	1.05	1.08	0.09	0.98	1.15	0.18	0.88	1.25	0.48	0.59	1.54	0.66	0.40	1.73	0.01
6	08-04-15	1.06	1.07	0.01	1.05	1.08	0.09	0.98	1.15	0.18	0.88	1.25	0.48	0.59	1.55	0.66	0.40	1.73	0.01
7	09-15-15	1.07	1.07	0.01	1.05	1.08	0.09	0.98	1.15	0.18	0.88	1.25	0.48	0.59	1.55	0.66	0.41	1.73	0.01
8	10-06-15	1.06	1.07	0.01	1.05	1.08	0.09	0.98	1.15	0.18	0.88	1.25	0.48	0.59	1.54	0.66	0.40	1.73	0.01
9	11-03-15	1.07	1.07	0.01	1.05	1.08	0.09	0.98	1.15	0.18	0.89	1.25	0.48	0.59	1.55	0.66	0.41	1.73	0.01
10	12-08-15	1.07	1.07	0.01	1.05	1.08	0.09	0.98	1.15	0.18	0.89	1.25	0.48	0.59	1.55	0.66	0.41	1.73	0.01
11	01-12-16	1.06	1.07	0.01	1.05	1.08	0.09	0.98	1.15	0.18	0.89	1.25	0.48	0.59	1.55	0.66	0.41	1.73	0.01
12	02-09-16	1.06	1.07	0.01	1.05	1.08	0.09	0.98	1.15	0.18	0.89	1.25	0.48	0.59	1.55	0.66	0.41	1.73	0.01
13	02-09-16	1.06	1.07	0.01	1.05	1.08	0.09	0.98	1.15	0.18	0.89	1.25	0.48	0.59	1.55	0.66	0.41	1.73	0.01
14	03-08-16	1.07	1.07	0.01	1.05	1.08	0.09	0.98	1.15	0.18	0.89	1.25	0.48	0.59	1.55	0.66	0.41	1.73	0.01
15	04-05-16	1.07	1.07	0.01	1.05	1.08	0.09	0.98	1.15	0.18	0.88	1.25	0.48	0.59	1.55	0.66	0.41	1.73	0.01
16	04-05-16	1.06	1.07	0.01	1.05	1.08	0.09	0.98	1.15	0.18	0.88	1.25	0.48	0.59	1.55	0.66	0.41	1.73	0.01
17	05-10-16	1.06	1.07	0.01	1.05	1.08	0.09	0.98	1.15	0.18	0.88	1.25	0.48	0.59	1.55	0.66	0.40	1.73	0.01
18	06-07-16	1.05	1.06	0.01	1.05	1.08	0.09	0.98	1.15	0.18	0.88	1.25	0.48	0.59	1.54	0.66	0.40	1.73	0.01
19	07-12-16	1.06	1.06	0.01	1.05	1.08	0.09	0.98	1.15	0.18	0.88	1.24	0.48	0.59	1.54	0.66	0.40	1.72	0.01
20	08-02-16	1.07	1.06	0.01	1.05	1.08	0.09	0.98	1.15	0.18	0.88	1.24	0.48	0.59	1.54	0.66	0.40	1.72	0.01

Note: 7-d  $IC_{25}$  = 7-day 25% inhibition concentration. An estimation of the concentration of sodium chloride that would cause a 25% reduction in *Ceriodaphnia* reproduction for the test population.

CT = Central tendency (mean  $IC_{25}$ ).

S = Standard deviation of the  $IC_{25}$  values.

### Laboratory Control and Warning Limits

Laboratory control and warning limits were established using the standard deviation of the  $IC_{25}$  values corresponding to the 10th and 25th percentile CVs. These ranges are more stringent than the control and warning limits recommended by USEPA for the test method and endpoint.

$S_{A10}$  = Standard deviation corresponding to the 10<sup>th</sup> percentile CV. ( $S_{A10} = 0.08$ )

$S_{A25}$  = Standard deviation corresponding to the 25<sup>th</sup> percentile CV. ( $S_{A25} = 0.17$ )

### USEPA Control and Warning Limits

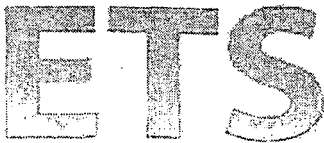
$S_{A75}$  = Standard deviation corresponding to the 75<sup>th</sup> percentile CV. ( $S_{A75} = 0.45$ )

$S_{A90}$  = Standard deviation corresponding to the 90<sup>th</sup> percentile CV. ( $S_{A90} = 0.62$ )

CV = Coefficient of variation of the  $IC_{25}$  values.

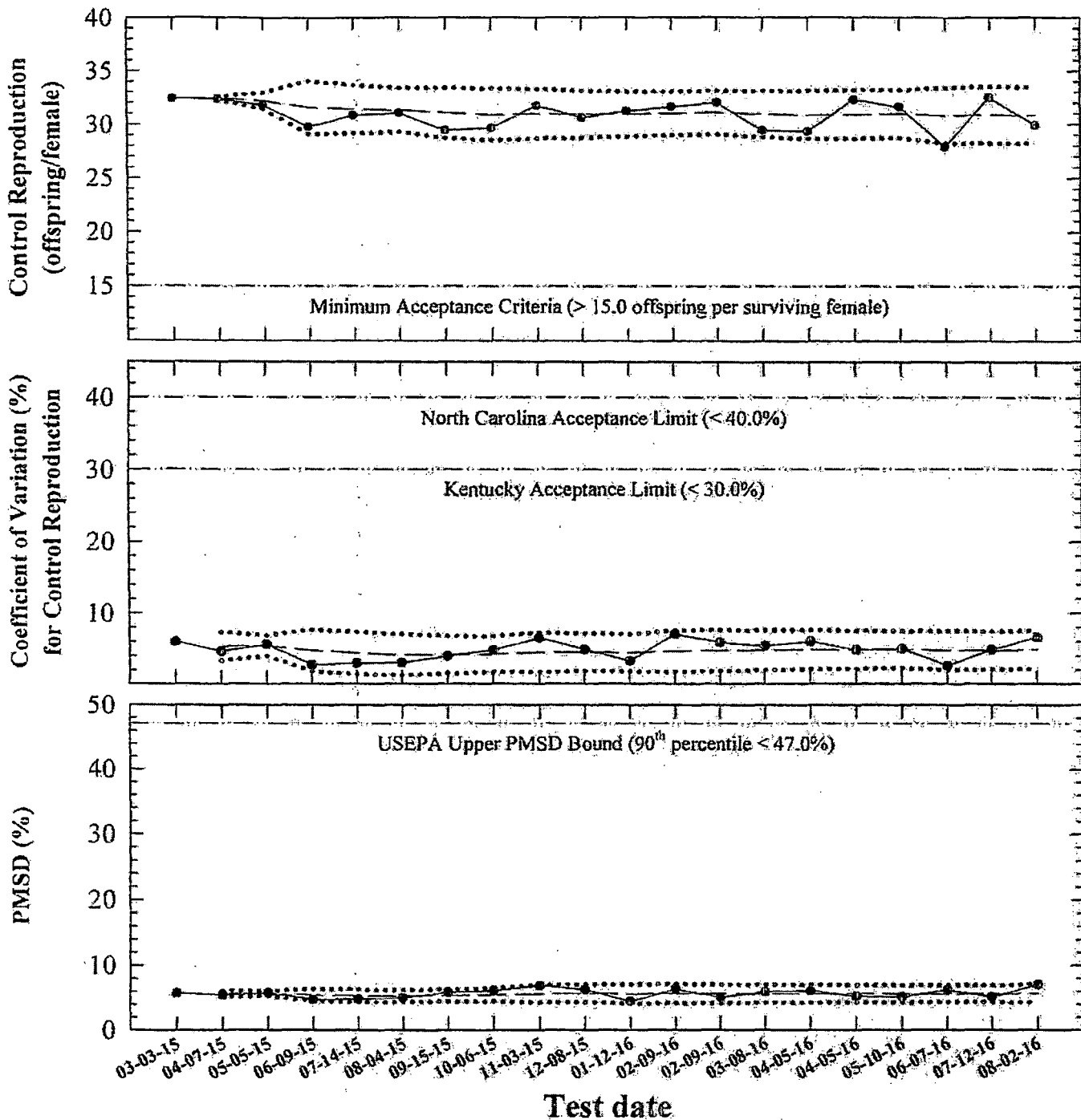
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8





Environmental Testing Solutions, Inc.

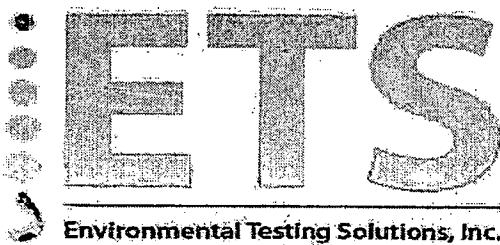
# *Ceriodaphnia dubia* Chronic Reference Toxicant Control Chart Precision of Endpoint Measurements



- Control Reproduction, Coefficient of Variation (CV), or Percent Minimum Significant Difference (PMSD) PMSD is the minimum significant difference between the control and treatment that can be declared statistically significant.
- Central Tendency (mean Control Reproduction, CV, or PMSD)
- - - Control Limits (mean Control Reproduction, CV, or PMSD  $\pm$  2 Standard Deviations)

Independent  
• Endorsed by •  
Kelley C. Keenan

Entered and  
Reviewed by  
Jim Sumner



## Precision of Endpoint Measurements

### *Ceriodaphnia dubia* Chronic Reference Toxicant Data

Test number	Test date	Control Survival (%)	Control Mean Reproduction (offspring/female)	CT for Control Mean Reproduction (offspring/female)	CV (%)	CT for Control Reproduction CV (%)	MSD	PMSD (%)	CT for PMSD (%)
1	03-03-15	100	32.4		6.0		1.9	5.8	
2	04-07-15	100	32.3	32.4	4.6	5.3	1.8	5.5	5.6
3	05-05-15	100	31.7	32.1	5.6	5.4	1.8	5.8	5.7
4	06-09-15	100	29.7	31.5	2.8	4.8	1.4	4.8	5.5
5	07-14-15	100	30.8	31.4	3.0	4.4	1.5	4.8	5.3
6	08-04-15	100	31.0	31.3	3.0	4.2	1.6	5.0	5.3
7	09-15-15	100	29.4	31.0	4.0	4.2	1.7	5.9	5.4
8	10-06-15	100	29.6	30.9	4.8	4.2	1.8	6.1	5.5
9	11-03-15	100	31.7	31.0	6.5	4.5	2.2	6.9	5.6
10	12-08-15	100	30.6	30.9	4.9	4.5	1.9	6.3	5.7
11	01-12-16	100	31.2	30.9	3.3	4.4	1.4	4.4	5.6
12	02-09-16	100	31.6	31.0	7.0	4.6	2.0	6.3	5.6
13	02-09-16	100	32.0	31.1	5.9	4.7	1.6	5.1	5.6
14	03-08-16	100	29.4	31.0	5.4	4.8	1.7	5.9	5.6
15	04-05-16	100	29.3	30.8	6.0	4.9	1.8	6.1	5.7
16	04-05-16	100	32.3	30.9	4.9	4.9	1.7	5.2	5.6
17	05-10-16	100	31.6	31.0	5.0	4.9	1.6	5.2	5.6
18	06-07-16	100	27.9	30.8	2.6	4.7	1.7	6.2	5.6
19	07-12-16	100	32.5	30.9	4.9	4.8	1.7	5.1	5.6
20	08-02-16	100	29.9	30.8	6.6	4.8	2.1	7.0	5.7

**Note:**

CV = Coefficient of variation for control reproduction.

Lower CV bound determined by USEPA (10<sup>th</sup> percentile) = 8.9%.

Upper CV bound determined by USEPA (90<sup>th</sup> percentile) = 42%

MSD = Minimum Significant Difference

PMSD = Percent Minimum Significant Difference

PMSD is a measure of test precision. The PMSD is the minimum percent difference between the control and treatment that can be declared statistically significant in a whole effluent toxicity test.

Lower PMSD bound determined by USEPA (10<sup>th</sup> percentile) = 13%.

Upper PMSD bound determined by USEPA (90<sup>th</sup> percentile) = 47%.

CT = Central Tendency (Mean Control Reproduction, CV, or PMSD)

USEPA. 2000. Understanding and Accounting for Method Variability in Whole Effluent Toxicity Applications Under the National Pollutant Discharge Elimination Program. EPA-833-R-00-003. US Environmental Protection Agency, Cincinnati, OH.

USEPA. 2001a, 2001b. Final Report: Interlaboratory Variability Study of EPA Short-term Chronic and Acute Whole Effluent Toxicity Test Methods, Volumes 1 and 2-Appendix. EPA-821-B-01-004 and EPA-821-B-01-005. US Environmental Protection Agency, Cincinnati, OH.



**Sodium Chloride Chronic Reference Toxicant Test**  
(EPA-821-R-02-013 Method 1002.0)  
Species: Ceriodaphnia dubia

CdNaClCR #: 191

Dilution preparation information:						Comments:
NaCl Stock INSS number:		INSS 1508				
Stock preparation:		100 g NaCl/L: Dissolve 50 g NaCl in 500 mL Milli-Q water.				
Dilution prep (mg/L)	600	800	1000	1200	1400	
Stock volume (mL)	9	12	15	18	21	
Diluent volume (mL)	1491	1488	1485	1482	1479	
Total volume (mL)	1500	1500	1500	1500	1500	

Test organism source information:											Test information:		
Organism age:				< 24-hours old							Randomizing template color:		BLACK
Date and times organisms were born between:				08-02-16 0640 to 0905							Incubator number and shelf location:		2B1
Culture board:		07-26-16 A									YWT batch:		07-26-16
Replicate number:		1	2	3	4	5	6	7	8	9	10	Selenastrum batch:	07-26-16
Culture board cup number:		6	8	12	16	18	21	24	27	32	35		
Transfer vessel information:		pH = 8.03 S.U. Temperature = 25.0 °C											
Average transfer volume (mL):		0.03 mL											

**Daily renewal information:**

Day	Date	Test initiation and feeding, renewal and feeding, or termination time	MHSW batch used	Analyst
0	08-02-16	0915	07-29-16	JH
1	08-03-16	0816	07-29-16	JH
2	08-04-16	0815	08-02-16 A	JH
3	08-05-16	0815	08-02-16 A	JH
4	08-06-16	0817	08-02-16 B	JH
5	08-07-16	0815	08-02-16 B	JH
6	08-08-16	0815	08-02-16 B	JH
7	08-09-16	0815		JH

Control information:		Acceptance criteria	Summary of test endpoints:	
% of Male Adults:	07.	≤ 20%	7-day LC <sub>50</sub>	71400
% Adults having 3 <sup>rd</sup> Broods:	1007.	≥ 80%	NOEC	1000
% Mortality:	07.	≤ 20%	LOEC	1200
Mean Offspring/Female:	29.9	≥ 15.0 offspring/female	ChV	1095.5
% CV:	6.67.	< 40.0 %	IC <sub>25</sub>	1066.2

Species: Ceriodaphnia dubia

CdNaClCR #: 191

CONTROL

Survival and Reproduction Data

Day		Replicate number									
		1	2	3	4	5	6	7	8	9	10
1	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
2	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
3	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
4	Young produced	4	4	3	3	5	3	4	4	4	3
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	10	10	11	10	12	12	9	12	10	10
	Adult mortality	L	L	L	L	L	L	L	L	L	L
6	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
7	Young produced	13	17	16	14	16	17	17	15	15	16
Total young produced		21	31	30	21	33	32	30	31	29	29
Final Adult Mortality		L	L	L	L	L	L	L	L	L	L
X for 3 <sup>rd</sup> Broods		X	X	X	X	X	X	X	X	X	X

Note: Adult mortality (L = live, D = dead), SB = split brood (single brood split between two days), CO = carry over (offspring carried over with adult during transfer).

Concentration:

% Mortality:	07.
Mean Offspring/Female:	29.9

600 mg NaCl/L

Survival and Reproduction Data

Day		Replicate number									
		1	2	3	4	5	6	7	8	9	10
1	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
2	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
3	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
4	Young produced	4	4	5	3	4	4	4	5	3	3
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	12	10	11	10	12	12	11	11	13	11
	Adult mortality	L	L	L	L	L	L	L	L	L	L
6	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
7	Young produced	16	15	15	18	17	15	17	15	15	15
Total young produced		32	29	31	31	33	31	32	31	31	29
Final Adult Mortality		L	L	L	L	L	L	L	L	L	L

Note: Adult mortality (L = live, D = dead), SB = split brood (single brood split between two days), CO = carry over (offspring carried over with adult during transfer).

Concentration:

% Mortality:	07.
Mean Offspring/Female:	31.0
% Reduction from Control:	-3.77.



Species: Ceriodaphnia dubia  
800 mg NaCl/L

CdNaClCR #: 191

*Survival and Reproduction Data*

Day		Replicate number									
		1	2	3	4	5	6	7	8	9	10
1	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
2	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
3	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
4	Young produced	3	5	4	4	3	3	5	4	4	4
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	12	12	12	11	13	10	11	11	13	11
	Adult mortality	L	L	L	L	L	L	L	L	L	L
6	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
7	Young produced	15	13	16	14	16	15	18	14	16	14
Total young produced		30	30	32	29	32	28	34	29	33	29
Final Adult Mortality		L	L	L	L	L	L	L	L	L	L

Note: Adult mortality (L = live, D = dead), SB = split brood (single brood split between two days), CO = carry over (offspring carried over with adult during transfer).

Concentration:	
% Mortality:	07.
Mean Offspring/Female:	30.6
% Reduction from Control:	-237.

1000 mg NaCl/L

*Survival and Reproduction Data*

Day		Replicate number									
		1	2	3	4	5	6	7	8	9	10
1	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
2	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
3	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
4	Young produced	4	3	4	5	4	4	4	3	3	4
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	12	10	10	11	10	13	10	10	10	11
	Adult mortality	L	L	L	L	L	L	L	L	L	L
6	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
7	Young produced	15	15	14	16	13	14	13	13	16	13
Total young produced		31	28	28	32	27	31	27	26	29	28
Final Adult Mortality		L	L	L	L	L	L	L	L	L	L

Note: Adult mortality (L = live, D = dead), SB = split brood (single brood split between two days), CO = carry over (offspring carried over with adult during transfer).

Concentration:	
% Mortality:	07.
Mean Offspring/Female:	28.7
% Reduction from Control:	407.



Species: Ceriodaphnia dubia  
1200 mg NaCl/L

CdNaCICR #: 191

Survival and Reproduction Data

Day		Replicate number									
		1	2	3	4	5	6	7	8	9	10
1	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
2	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
3	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
4	Young produced	3	3	2	3	3	3	1	2	2	2
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	6	4	7	3	6	6	5	2	2	5
	Adult mortality	L	L	L	L	L	L	L	L	L	L
6	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
7	Young produced	5	2	4	7	5	6	4	4	2	2
	Adult mortality	L	L	L	L	L	L	L	L	L	L
Total young produced		14	9	13	13	14	15	10	8	6	9
Final Adult Mortality		L	L	L	L	L	L	L	L	L	L

Note: Adult mortality (L = live, D = dead), SB = split brood (single brood split between two days), CO = carry over (offspring carried over with adult during transfer).

<u>Concentration:</u>	
% Mortality:	07.
Mean Offspring/Female:	11.1
% Reduction from Control:	62.97.

1400 mg NaCl/L

Survival and Reproduction Data

Day		Replicate number									
		1	2	3	4	5	6	7	8	9	10
1	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
2	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
3	Young produced	0	0	0	0	0	0	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
4	Young produced	0	0	1	2	0	1	0	0	2	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	2	1	0	0	3	0	2	1	0	4
	Adult mortality	L	L	L	L	L	L	L	L	L	L
6	Young produced	0	0	0	0	0	3	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
7	Young produced	2	0	1	3	2	0	2	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
Total young produced		4	1	2	5	5	4	4	1	2	4
Final Adult Mortality		L	L	L	L	L	L	L	L	L	L

Note: Adult mortality (L = live, D = dead), SB = split brood (single brood split between two days), CO = carry over (offspring carried over with adult during transfer).

<u>Concentration:</u>	
% Mortality:	07.
Mean Offspring/Female:	3.2
% Reduction from Control:	89.37.





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# Verification of *Ceriodaphnia* Reproduction Totals

## Control

Day	Replicate number										Total
	1	2	3	4	5	6	7	8	9	10	
1	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0
4	4	4	3	3	5	3	4	4	4	3	37
5	10	10	11	10	12	12	9	12	10	10	106
6	0	0	0	0	0	0	0	0	0	0	0
7	13	17	16	14	16	17	17	15	15	16	156
Total	27	31	30	27	33	32	30	31	29	29	299

## 600 mg NaCl/L

Day	Replicate number										Total
	1	2	3	4	5	6	7	8	9	10	
1	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0
4	4	4	5	3	4	4	4	5	3	3	39
5	12	10	11	10	12	12	11	11	13	14	113
6	0	0	0	0	0	0	0	0	0	0	0
7	16	15	15	18	17	15	17	15	15	15	158
Total	32	29	31	31	33	31	32	31	31	29	310

## 800 mg NaCl/L

Day	Replicate number										Total
	1	2	3	4	5	6	7	8	9	10	
1	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0
4	3	5	4	4	3	3	5	4	4	4	39
5	12	12	12	11	13	10	11	11	13	11	116
6	0	0	0	0	0	0	0	0	0	0	0
7	15	13	16	14	16	15	18	14	16	14	151
Total	30	30	32	29	32	28	34	29	33	29	306

## 1000 mg NaCl/L

Day	Replicate number										Total
	1	2	3	4	5	6	7	8	9	10	
1	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0
4	4	3	4	5	4	4	4	3	3	4	38
5	12	10	10	11	10	13	10	10	10	11	107
6	0	0	0	0	0	0	0	0	0	0	0
7	15	15	14	16	13	14	13	13	16	13	142
Total	31	28	28	32	27	31	27	26	29	28	287

## 1200 mg NaCl/L

Day	Replicate number										Total
	1	2	3	4	5	6	7	8	9	10	
1	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0
4	3	3	2	3	3	3	1	2	2	2	24
5	6	4	7	3	6	6	5	2	2	5	46
6	0	0	0	0	0	0	0	0	0	0	0
7	5	2	4	7	5	6	4	4	2	2	41
Total	14	9	13	13	14	15	10	8	6	9	111

## 1400 mg NaCl/L

Day	Replicate number										Total
	1	2	3	4	5	6	7	8	9	10	
1	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0
4	0	0	1	2	0	1	0	0	2	0	6
5	2	1	0	0	3	0	2	1	0	4	13
6	0	0	0	0	0	3	0	0	0	0	3
7	2	0	1	3	2	0	2	0	0	0	10
Total	4	1	2	5	5	4	4	1	2	4	32

Reviewed and  
Approved by  
[Signature]



# ETS

Environmental Testing Solutions, Inc.

## *Ceriodaphnia dubia* Chronic Reference Toxicant Test EPA-821-R-02-013, Method 1002.0

### Quality Control Verification of Data Entry, Calculations, and Statistical Analyses

Test number: CdNaClCR #191Test dates: August 02-09, 2016

Concentration (mg/L NaCl)	Replicate number										Survival (%)	Average reproduction (offspring/female)	Coefficient of variation (%)	Percent reduction from control (%)
	1	2	3	4	5	6	7	8	9	10				
Control	27	31	30	27	33	32	30	31	29	29	100	29.9	6.6	Not applicable
600	32	29	31	31	33	31	32	31	31	29	100	31.0	4.0	-3.7
800	30	30	32	29	32	28	34	29	33	29	100	30.6	6.6	-2.3
1000	31	28	28	32	27	31	27	26	29	28	100	28.7	7.0	4.0
1200	14	9	13	13	14	15	10	8	6	9	100	11.1	27.7	62.9
1400	4	1	2	5	5	4	4	1	2	4	100	3.2	48.4	89.3

Dunnnett's MSD value: 2.101  
PMSD: 7.0

MSD = Minimum Significant Difference

PMSD = Percent Minimum Significant Difference

PMSD is a measure of test precision. The PMSD is the minimum percent difference between the control and treatment that can be declared statistically significant in a whole effluent toxicity test.

Lower PMSD bound determined by USEPA (10<sup>th</sup> percentile) = 13%.Upper PMSD bound determined by USEPA (90<sup>th</sup> percentile) = 47%.

Lower and upper PMSD bounds were determined from the 10th and 90th percentile, respectively, of PMSD data from EPA's WET Interlaboratory Variability Study (USEPA, 2001a; USEPA, 2001b).

USEPA. 2001a, 2001b. Final Report: Interlaboratory Variability Study of EPA Short-term Chronic and Acute Whole Effluent Toxicity Test Methods, Volumes 1 and 2-Appendix, EPA-821-B-01-004 and EPA-821-B-01-005. US Environmental Protection Agency, Cincinnati, OH.

  
Reviewed and  
signed by  
the reviewer

## Statistical Analyses

### Ceriodaphnia Survival and Reproduction Test-Reproduction

Start Date: 8/2/2016 Test ID: CdNaClCR Sample ID: REF-Ref Toxicant  
End Date: 8/9/2016 Lab ID: ETS-Envir. Testing Sol. Sample Type: NaCl-Sodium chloride  
Sample Date: Protocol: FWCHR-EPA-821-R-02-013 Test Species: CD-Ceriodaphnia dubia  
Comments:

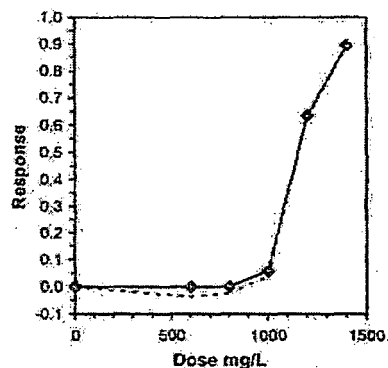
Conc-mg/L	1	2	3	4	5	6	7	8	9	10
D-Control	27,000	31,000	30,000	27,000	33,000	32,000	30,000	31,000	29,000	29,000
500	32,000	29,000	31,000	31,000	33,000	31,000	32,000	31,000	31,000	29,000
800	30,000	30,000	32,000	29,000	32,000	28,000	34,000	29,000	33,000	29,000
1000	31,000	28,000	28,000	32,000	27,000	31,000	27,000	26,000	29,000	28,000
1200	14,000	9,000	13,000	13,000	14,000	15,000	10,000	8,000	6,000	9,000
1400	4,000	1,000	2,000	5,000	5,000	4,000	4,000	1,000	2,000	4,000

Conc-mg/L	Mean	N-Mean	Transform: Untransformed				N	t-Stat	1-Tailed Critical	MSD	Isotonic	
			Mean	Min	Max	CV%					Mean	N-Mean
D-Control	29,900	1.0000	29,900	27,000	33,000	5.586	10				30,500	1.0000
500	31,000	1.0368	31,000	29,000	33,000	4.023	10	-1.197	2.287	2.101	30,500	1.0000
800	30,600	1.0234	30,600	28,000	34,000	6.572	10	-0.782	2.287	2.101	30,500	1.0000
1000	28,700	0.9598	28,700	26,000	32,000	6.978	10	1.306	2.287	2.101	28,700	0.9410
*1200	11,100	0.3712	11,100	6,000	15,000	27.670	10	20.463	2.287	2.101	11,100	0.3639
*1400	3,200	0.1070	3,200	1,000	5,000	48.412	10	29.062	2.287	2.101	3,200	0.1049

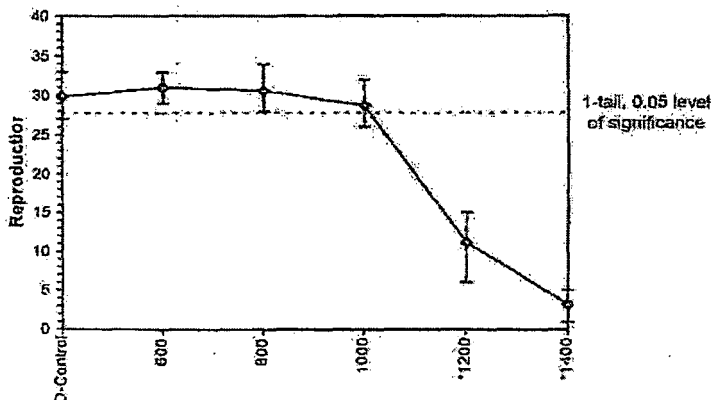
Auxiliary Tests					Statistic	Critical	Skew	Kurt						
Kolmogorov D Test indicates normal distribution ( $p > 0.01$ )					0.59264	1.035	-0.0646	-0.5499						
Bartlett's Test indicates equal variances ( $p = 0.15$ )					8.07777	15.0863								
Hypothesis Test (1-tail, 0.05)					NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnell's Test					1000	1200	1095.45		2.10084	0.07026	1486.94	4.22037	9.3E-40	5, 54
Treatments vs D-Control														

### Linear Interpolation (200 Resamples)

Point	mg/L	SD	95% CL		Skew
IC05	969.444	46.6905	857.991	1010.6	-0.6536
IC10	1014.2	8.37526	998.045	1027.84	-1.3544
IC15	1031.53	6.57571	1018.59	1044.28	0.0950
IC20	1048.86	6.1725	1036.55	1060.77	0.1788
IC25	1066.19	5.94226	1054.75	1077.91	0.2398
IC40	1118.18	6.40685	1104.94	1131.2	0.2308
IC50	1152.84	7.5251	1137.93	1169	0.1919



Dose-Response Plot



Species: Ceriodaphnia dubia

CdNaClCR #: 191

**Daily Chemistry:**

		Day (Analyst identified for each day, performed pH, D.O. and conductivity measurements only.)					
		0		1		2	
Analyst		MG	MS MG	MS MG	MS MG	MS MG	MG
Concentration	Parameter						
CONTROL	pH (S.U.)	8.09	7.96	7.88	7.88	7.80	7.90
	DO (mg/L)	7.8	7.9	7.8	7.8	7.8	7.8
	Conductivity (umhos/cm)	308		318		330	
	*Alkalinity (mg CaCO <sub>3</sub> /L)	59		<del>40</del>		62	
	*Hardness (mg CaCO <sub>3</sub> /L)	88				96	
	*Temperature (°C)	24.8	24.7	24.8	24.9	24.8	24.9
600 mg NaCl/L	pH (S.U.)	8.12	7.92	7.90	7.84	7.85	7.86
	DO (mg/L)	7.8	7.9	7.8	7.8	7.8	7.9
	Conductivity (umhos/cm)	1410		1470		1460	
	*Temperature (°C)	24.9	24.6	24.7	24.6	24.9	24.8
800 mg NaCl/L	pH (S.U.)	8.10	7.91	7.92	7.83	7.86	7.86
	DO (mg/L)	7.8	7.9	7.9	7.8	7.9	7.9
	Conductivity (umhos/cm)	1770		1860		1830	
	*Temperature (°C)	24.9	24.6	24.8	24.6	24.9	24.8
1000 mg NaCl/L	pH (S.U.)	8.09	7.91	7.92	7.82	7.86	7.85
	DO (mg/L)	7.8	8.0	7.9	7.9	7.9	8.0
	Conductivity (umhos/cm)	2120		2240		2190	
	*Temperature (°C)	24.9	24.6	24.8	24.7	24.9	24.8
1200 mg NaCl/L	pH (S.U.)	8.11	7.90	7.91	7.82	7.86	7.84
	DO (mg/L)	7.9	8.0	8.0	7.9	8.0	8.0
	Conductivity (umhos/cm)	2260		2610		2540	
	*Temperature (°C)	24.9	24.6	24.8	24.7	24.9	24.8
1400 mg NaCl/L	pH (S.U.)	8.07	7.90	7.91	7.81	7.85	7.83
	DO (mg/L)	7.9	8.0	8.0	8.0	8.0	8.0
	Conductivity (umhos/cm)	2600		3010		2920	
	*Temperature (°C)	24.9	24.6	24.8	24.7	25.0	24.8
		Initial	Final	Initial	Final	Initial	Final

\*Temperatures performed at the time of test initiation, renewal or termination by the analyst identified in the Daily Renewal Information table located on Page 1. Alkalinity and hardness performed by the analyst identified on the bench sheet specific for each analysis and transcribed to this bench sheet by: JA



Species: Ceriodaphnia dubia

CdNaClCR #: 191

Analyst		Day (Analyst identified for each day, performed pH, D.O. and conductivity measurements only.)							
		3		4		5		6	
		NG	MS	MS	MS	MS	NG	NG	MS
Concentration	Parameter								
CONTROL	pH (S.U.)	7.83	8.04	7.99	7.94	7.73	8.00	7.94	8.09
	DO (mg/L)	7.8	8.0	7.8	7.8	7.7	7.9	7.8	7.8
	Conductivity (µmhos/cm)	321		318		320		317	
	*Alkalinity (mg CaCO <sub>3</sub> /L)	<del>XXXX</del>		59		<del>XXXX</del>		<del>XXXX</del>	
	*Hardness (mg CaCO <sub>3</sub> /L)	<del>XXXX</del>		90		<del>XXXX</del>		<del>XXXX</del>	
	*Temperature (°C)	24.7	24.7	24.7	24.6	24.7	24.8	24.7	24.8
600 mg NaCl/L	pH (S.U.)	7.89	7.97	8.01	7.87	7.91	7.94	7.87	7.95
	DO (mg/L)	7.8	7.8	7.8	7.7	7.7	7.8	7.8	7.9
	Conductivity (µmhos/cm)	1470		1400		1460		1480	
	*Temperature (°C)	24.6	24.8	24.8	24.8	24.7	24.7	24.7	25.0
800 mg NaCl/L	pH (S.U.)	7.90	7.95	8.02	7.87	7.91	7.93	7.99	7.94
	DO (mg/L)	7.8	7.8	7.8	7.7	7.7	7.8	7.9	7.9
	Conductivity (µmhos/cm)	1830		1760		1830		1860	
	*Temperature (°C)	24.6	24.7	24.8	24.7	24.8	24.7	24.7	24.8
1000 mg NaCl/L	pH (S.U.)	7.90	7.96	8.02	7.86	7.91	7.92	7.99	7.92
	DO (mg/L)	7.9	7.8	7.8	7.7	7.8	7.8	7.9	8.0
	Conductivity (µmhos/cm)	2210		2140		2190		2220	
	*Temperature (°C)	24.8	24.7	24.8	24.7	24.8	24.7	24.7	24.8
1200 mg NaCl/L	pH (S.U.)	7.90	7.95	8.02	7.86	7.90	7.92	7.99	7.91
	DO (mg/L)	8.0	7.9	8.0	7.8	7.8	7.9	8.0	8.0
	Conductivity (µmhos/cm)	2570		2470		2550		2710	
	*Temperature (°C)	24.6	24.9	24.9	24.7	24.8	24.6	24.7	24.8
1400 mg NaCl/L	pH (S.U.)	7.90	7.94	8.01	7.86	7.90	7.92	8.00	7.90
	DO (mg/L)	8.0	8.0	8.0	7.8	7.8	7.9	8.0	8.0
	Conductivity (µmhos/cm)	3010		2930		2990		3100	
	*Temperature (°C)	24.7	24.7	24.9	24.8	24.8	24.6	24.7	24.7
		Initial	Final	Initial	Final	Initial	Final	Initial	Final

\*Temperatures performed at the time of test initiation, renewal or termination by the analyst identified in the Daily Renewal Information table located on Page 1. Alkalinity and hardness performed by the analyst identified on the bench sheet specific for each analysis and transcribed to this bench sheet by: A

