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

June 12, 2013

Ms. Christina Morgan
Tennessee Department of Environment
and Conservation
Division of Water Pollution Control
Enforcement & Compliance Section
6th Floor, L & C Annex
401 Church Street
Nashville, Tennessee 37243

Dear Ms. Morgan:

TENNESSEE VALLEY AUTHORITY (TVA) - SEQUOYAH NUCLEAR PLANT (SQN) - NPDES PERMIT NO. TN0026450 - DISCHARGE MONITORING REPORT (DMR) FOR MAY 2013

Enclosed is the May 2013 Discharge Monitoring Report for Sequoyah Nuclear Plant. There were no exceedances during the monitoring period. If you have any questions or need additional information, please contact Brad Love by email at bmlove@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,

John T. Carlin
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

ATTN: Brad Love

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

TN0026450	101 G
PERMIT NUMBER	DISCHARGE NUMBER

MONITORING PERIOD

	YEAR	MO	DAY		YEAR	MO	DAY
From	13	05	01	To	13	05	31

MAJOR
(SUBR 01)
F - FINAL
DIFFUSER DISCHARGE
EFFLUENT

*** NO DISCHARGE ☐ ***

Form Approved.
OMB No. 2040-0004

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	********	********	**	********	********	36.4	04	0	31 / 31	RCORDR
00010 1 0 EFFLUENT GROSS	PERMIT REQUIREMENT	********	********	****	********	********	**Req. Mon. DAILY MAX**	DEG. C.		CONTI NUOUS	CALCTD
TEMPERATURE, WATER DEG. CENTIGRADE	SAMPLE MEASUREMENT	********	********	**	********	********	24.2	04	0	31 / 31	MODELD
00010 Z 0 INSTREAM MONITORING	PERMIT REQUIREMENT	********	********	****	********	********	**30.5 DAILY MX**	DEG. C.		CONTI NUOUS	CALCTD
TEMP. DIFF. BETWEEN SAMP. & UPSTRM DEG.C	SAMPLE MEASUREMENT	********	********	**	********	********	2	04	0	31 / 31	CALCTD
00016 1 S EFFLUENT GROSS	PERMIT REQUIREMENT	********	********	****	********	********	**3 DAILY MX**	DEG. C.		CONTI NUOUS	CALCTD
FLOW, IN CONDUIT OR THRU TREATMENT PLANT	SAMPLE MEASUREMENT	********	1732	03	********	********	********	**	0	31 / 31	RCORDR
50050 1 0 EFFLUENT GROSS	PERMIT REQUIREMENT	********	**Req. Mon. DAILY MAX**	MGD	********	********	********	****		CONTI NUOUS	RCORDR
CHLORINE, TOTAL RESIDUAL	SAMPLE MEASUREMENT	********	********	**	********	0.014	0.026	19	0	24 / 31	GRAB
50060 1 0 EFFLUENT GROSS	PERMIT REQUIREMENT	********	********	****	********	**0.1 MO AVG**	**0.1 DAILY MAX**	MG/L		FIVE PER WEEK	CALCTD
TEMPERATURE - C, RATE OF CHANGE	SAMPLE MEASUREMENT	********	0	62	********	********		**	0	31 / 31	CALCTD
82234 1 0 EFFLUENT GROSS	PERMIT REQUIREMENT	********	**2 DAILY MX**	DEG C/HR	********	********	*******	****		CONTI NUOUS	CALCTD
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER			TELEPHONE		DATE		
John T. Carlin Site Vice President	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.	Site Vice President	423	843-7001	13	06	12
TYPED OR PRINTED		SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT	AREA CODE	NUMBER	YEAR	MO	DAY

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

Veliger monitoring data is included as an attachment. The following injections occurred: 1. Floguard MS6236 (max. calc. conc. was 0.064mg/L--limit 0.2mg/L) 2. Biodetergent 73551 (max. calc. conc. was 0.039mg/L--limit 2.0mg/L) 3. Spectrus CT1300 (max. calc. conc. was 0.038mg/L--limit 0.050mg/L)

Sample Date	Mean # of ZM/m3	% Settlers	Water Temp. (°C)	Sample Date	Mean# of Asiatic Clams/m3	Water Temp. (°C)	LOCATION	NOTES: % Gravid Asiatic	COLLECTED BY
01/04/2013	0	0	8	01/04/2013	0	8	1-ISV-24-1234		WAW
01/09/2013	0	0	29.7	01/09/2013	0	29.7	1-25-545		CR
01/15/2013	0	0	30.2	01/15/2013	0	30.2	1-25-545		PPG
01/22/2013	0	0	24.9	01/22/2013	0	24.9	1-25-545		BB
01/29/2013	0	0	8.1	01/29/2013	0	8.1	1-ISV-24-1234		BB
02/05/2013	29	100	30.4	02/05/2013	0	30.4	1-25-545		PPG
02/12/2013	0	0	28.9	02/12/2013	0	28.9	1-25-545		PPG
02/19/2013	0	0	27	02/19/2013	0	27	1-25-545		PPG
02/26/2013	0	0	8	02/26/2013	0	8	1-ISV-24-1234		JAG
03/08/2013	0	0	28	03/08/2013	0	28	1-25-545		PPG
03/13/2013	0	0	9.02	03/13/2013	0	9.02	1-ISV-24-1234		ACL
03/18/2013	0	0	28	03/18/2013	0	28	1-25-545		PPG
03/26/2013	0	0	28.3	03/26/2013	0	28.3	1-25-545		SRR
04/02/2013	0	0	25.9	04/02/2013	0	25.9	1-ISV-24-1234		SRR
04/09/2013	0	0	33	04/09/2013	0	33	1-25-545		PPG
04/16/2013	0	0	33	04/16/2013	0	33	1-25-545		PPG
04/23/2013	13	50	15	04/23/2013	0	15	1-ISV-24-1234		PPG
04/30/2013	0	0	33	04/30/2013	0	33	1-25-545		PPG
May 2013									No Samples Collected

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SODDY - DAISY, TN 37384
Facility TVA - SEQUOYAH NUCLEAR PLANT
Location HAMILTON COUNTY

ATTN: Brad Love

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

TN0026450	101 T
PERMIT NUMBER	DISCHARGE NUMBER

MONITORING PERIOD

	YEAR	MO	DAY		YEAR	MO	DAY
From	13	05	01	To	13	05	31

MAJOR
(SUBR 01)
F - FINAL
BIOMONITORING FOR OUTFALL 101
EFFLUENT
*** NO DISCHARGE ☐ ***

Form Approved.
OMB No. 2040-0004

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			
IC25 STATRE 7DAY CHR CERIODAPHNIA	SAMPLE MEASUREMENT	********	********	**	>100.0	********	********	23	0	1 / 180	COMPOS
TRP3B 1 0 EFFLUENT GROSS	PERMIT REQUIREMENT	********	********	****	**43.2 MINIMUM**	********	********	PERCENT		SEMI ANNUAL	COMPOS
IC25 STATRE 7DAY CHR PIMEPHALES	SAMPLE MEASUREMENT	********	********	**	>100.0	********	********	23	0	1 / 180	COMPOS
TRP6C 1 0 EFFLUENT GROSS	PERMIT REQUIREMENT	********	********	****	**43.2 MIMINUM**	********	********	PERCENT		SEMI ANNUAL	COMPOS
	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			TELEPHONE		DATE		
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TYPED OR PRINTED		SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT	AREA CODE	NUMBER	YEAR	MO	DAY

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

Toxicity testing was conducted May 12-17. A minor deviation occurred during aliquot preparation for the sample collected May 17. The TVA Senior Toxicologist and Quality Assurance reviewed the deviation and determined that WET test results remain valid. Further discussion is included in the Quality Assurance section of the Toxicity report on page 13 of 113.

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SODDY - DAISY, TN 37384
Facility TVA - SEQUOYAH NUCLEAR PLANT
Location HAMILTON COUNTY

ATTN: Brad Love

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

TN0026450	103 G
PERMIT NUMBER	DISCHARGE NUMBER

MONITORING PERIOD

	YEAR	MO	DAY		YEAR	MO	DAY
From	13	05	01	To	13	05	31

MAJOR
(SUBR 01)
F - FINAL
LOW VOL. WASTE TREATMENT POND
EFFLUENT

*** NO DISCHARGE ☐ ***

Form Approved.
OMB No. 2040-0004

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PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
PH	SAMPLE MEASUREMENT	********	********	**	7	********	8	12	0	16 / 31	GRAB
00400 1 0 EFFLUENT GROSS	PERMIT REQUIREMENT	********	********	**	6 MINIMUM	********	9 MAXIMUM	SU		THREE/ WEEK	GRAB
SOLIDS, TOTAL SUSPENDED	SAMPLE MEASUREMENT	********	********	**	********	8	8	19	0	2 / 31	GRAB
00530 1 0 EFFLUENT GROSS	PERMIT REQUIREMENT	********	********	**	********	30 MO AVG	100 DAILY MX	MG/L		TWICE/ MONTH	GRAB
OIL AND GREASE	SAMPLE MEASUREMENT	********	********	**	********	2	2	19	0	2 / 31	GRAB
00556 1 0 EFFLUENT GROSS	PERMIT REQUIREMENT	********	********	**	********	15 MO AVG	20 DAILY MX	MG/L		TWICE/ MONTH	GRAB
FLOW, IN CONDUIT OR THRU TREATMENT PLANT	SAMPLE MEASUREMENT	1.155	1.263	03	********	********	********	**	0	31 / 31	RCORDR
50050 1 0 EFFLUENT GROSS	PERMIT REQUIREMENT	Req. Mon. MO AVG	Req. Mon DAILY MX	MGD	********	********	********	**		SEE PERMIT	RCORDR
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

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TYPED OR PRINTED			AREA CODE	NUMBER	YEAR	MO	DAY

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

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Location HAMILTON COUNTY

ATTN: Brad Love

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

TN0026450	110 G
PERMIT NUMBER	DISCHARGE NUMBER

MONITORING PERIOD

	YEAR	MO	DAY		YEAR	MO	DAY
From	13	05	01	To	13	05	31

MAJOR
(SUBR 01)
F - FINAL
RECYCLED COOLING WATER
EFFLUENT

*** NO DISCHARGE XX ***

Form Approved.
OMB No. 2040-0004

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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	********	********	**	********	********		04			
00010 1 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	********	********	**	********	********	REPORT DAILY MX	DEG C		CONTIN UOUS	CALCTD
TEMPERATURE, WATER DEG. CENTIGRADE	SAMPLE MEASUREMENT	********	********	**	********	********		04			
00010 Z 0 INSTREAM MONITORING	PERMIT REQUIREMENT	********	********	**	********	********	30.5 DAILY MX	DEG C		CONTIN UOUS	CALCTD
TEMP. DIFF. BETWEEN SAMP. & UPSTRM DEG.C	SAMPLE MEASUREMENT	********	********	**	********	********		04			
00016 1 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	********	********	**	********	********	5 DAILY MX	DEG C		CONTIN UOUS	CALCTD
FLOW, IN CONDUIT OR THRU TREATMENT PLANT	SAMPLE MEASUREMENT	********		03	********	********	********	**			
50050 1 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	********	Req. Mon. DAILY MX	MGD	********	********	********	**		CONTIN UOUS	RCORDR
CHLORINE, TOTAL RESIDUAL	SAMPLE MEASUREMENT	********	********	**	********			19			
50060 1 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	********	********	**	********	0.1 MO AVG	0.1 DAILY MX	MG/L		Five per Week	CALCTD
TEMPERATURE - C, RATE OF CHANGE	SAMPLE MEASUREMENT	********		04	********	********	********	**			
82234 1 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	********	2 DAILY MX	DEG C	********	********	********	**		CONTIN UOUS	CALCTD
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

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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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Facility TVA - SEQUOYAH NUCLEAR PLANT
Location HAMILTON COUNTY

ATTN: Brad Love

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

TN0026450	110 T
PERMIT NUMBER	DISCHARGE NUMBER

MONITORING PERIOD

	YEAR	MO	DAY		YEAR	MO	DAY
From	13	05	01	To	13	05	31

MAJOR
(SUBR 01)
F - FINAL
RECYCLED COOLING WATER
EFFLUENT

*** NO DISCHARGE XX ***

Form Approved.
OMB No. 2040-0004

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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 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	********	********	****	43.2 MINIMUM	********	********	PERCENT		SEMI ANNUAL	COMPOS
IC25 STATRE 7DAY CHR PIMEPHALES	SAMPLE MEASUREMENT	********	********	**		********	********	23			
TRP6C 1 0 0 EFFLUENT GROSS VALUE	PERMIT REQUIREMENT	********	********	****	43.2 MINIMUM	********	********	PERCENT		SEMI ANNUAL	COMPOS
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										

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TYPED OR PRINTED			AREA CODE	NUMBER	YEAR	MO	DAY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS *(Reference all attachments here)*
No Discharge this Period

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ATTN: Brad Love

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

TN0026450	118 G
PERMIT NUMBER	DISCHARGE NUMBER

MONITORING PERIOD

	YEAR	MO	DAY		YEAR	MO	DAY
From	13	05	01	To	13	05	31

MAJOR
(SUBR 01)
F - FINAL
WASTEWATER & STORM WATER
EFFLUENT

*** NO DISCHARGE XX ***

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

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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.

TENNESSEE VALLEY AUTHORITY
TOXICITY TEST REPORT

INTRODUCTION / EXECUTIVE SUMMARY

Report Date: June 11, 2013

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: May 12 – 17, 2013
10. Average Flow on Days Sampled (MGD): 1760.46, 1548.33, 1552.94
11. Pertinent Site Conditions: Production / operation data will be provided upon request.
12. Test Dates: May 14 – 21, 2013
13. Test Type: Short-term Chronic Definitive
14. Test Species: Fathead Minnows (*Pimephales promelas*)
    Daphnids (*Ceriodaphnia dubia*)
15. Concentrations Tested (%): Outfall 101: 10.8, 21.6, 43.2, 86.4, 100
    Intake: 100
    Pimephales promelas: UV treated Outfall 101: 10.8, 21.6, 43.2, 86.4, 100
    UV treated Intake: 100
16. Permit Limit Endpoint (%): Outfall 101: $IC_{25} = 43.2\%$
17. Test Results: Outfall 101: *Pimephales promelas:* $IC_{25} > 100\%$
    Ceriodaphnia dubia: $IC_{25} > 100\%$
    UV treated Outfall 101: *Pimephales promelas:* $IC_{25} > 100\%$

18. Facility Contact: Brad Love 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: Outfall 101 samples collected May 12 – 17, 2013, showed no toxic effects to fathead minnows or daphnids. The resulting IC_{25} 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.

    Fathead minnows were also exposed to UV treated Outfall 101 and intake samples since fish pathogens present in intake water have been the suspected cause of interference (anomalous dose response and high variability among replicates) in previous toxicity testing at Sequoyah. At the time this study was conducted, insignificant mortality occurred in minnows exposed to non-treated and UV treated samples.

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	05-12-13 0900 to 05-13-13 0800	05-13-13 1415	1.7, 1.6†	<0.10	05-14-13 1345 05-15-13 1246
Intake	05-12-13 0920 to 05-13-13 0820	05-13-13 1415	1.8	<0.10	05-14-13 1345 05-15-13 1246
101	05-14-13 0750 to 05-15-13 0650	05-15-13 1330	1.4, 1.2†	<0.10	05-16-13 1245 05-17-13 1247
Intake	05-14-13 0805 to 05-15-13 0705	05-15-13 1330	1.2	<0.10	05-16-13 1245 05-17-13 1247
101	05-16-13 0650 to 05-17-13 0550	05-17-13 1315	2.0, 1.5†	<0.10	05-18-13 1245 05-19-13 1245 05-20-13 1245
Intake	05-16-13 0705 to 05-17-13 0605	05-17-13 1315	1.4	<0.10	05-18-13 1245 05-19-13 1245 05-20-13 1245

*TRC = Total Residual Chlorine
†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:	Aquatox, Inc.	In-house Cultures
2. Age:	21.5 – 21.75 hours old	< 24-hours old
Test Method Summary:		
1. Test Conditions:	Static, Renewal	Static, Renewal
2. Test Duration:	7 days	Until at least 60% of control females have 3 broods
3. Control / Dilution Water:	Moderately Hard Synthetic	Moderately Hard Synthetic
4. Number of Replicates:	4	10
5. Organisms per Replicate:	10	1
6. Test Initiation: (Date/Time)		
Outfall 101	05-14-13 1345 ET	05-14-13 1045 ET
UV Treated Outfall 101	05-14-13 1330 ET	
7. Test Termination: (Date/Time)		
Outfall 101	05-21-13 1246 ET	05-21-13 0947 ET
UV Treated Outfall 101	05-21-13 1230 ET	
8. Test Temperature: Outfall 101:	Mean = 24.7°C (24.1 – 25.0°C)	Mean = 24.9°C (24.7 – 25.3°C)
Test Temperature: UV-Treated Outfall 101:	Mean = 24.7°C (24.3 – 25.2°C)	

9. Physical / Chemical Measurements: 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.

10. Statistics: Statistics were performed according to methods prescribed by EPA using ToxCalc version 5.0 statistical software (Tidepool Scientific Software, McKinneyville, CA).

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 May 14 – 21, 2013 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
10.8%	100	100	100	100	100	100	100
21.6%	100	100	100	100	100	100	100
43.2%	100	100	100	100	100	100	100
86.4%	100	100	100	100	100	100	100
100.0%	100	100	100	100	100	100	100
Intake	100	100	100	100	100	100	100

Test Solutions (% Effluent)	Mean Dry Weight (mg) (replicate number)				
	1	2	3	4	Mean
Control	0.629	0.687	0.563	0.620	0.625
10.8%	0.626	0.684	0.612	0.574	0.624
21.6%	0.601	0.642	0.602	0.545	0.598
43.2%	0.550	0.630	0.579	0.638	0.599
86.4%	0.560	0.617	0.595	0.606	0.595
100.0%	0.600	0.560	0.545	0.568	0.568
Intake	0.491	0.629	0.585	0.517	0.556

IC_{25} Value: > 100% Permit Limit: 43.2% 95% Confidence Limits: Upper Limit: NA Lower Limit: NA	Calculated TU Estimates: < 1.0 TUc* Permit Limit: 2.3 TUc

*TUa = $100/LC_{50}$: TUc = $100/ IC_{25}$

TOXICITY TEST RESULTS (see Appendix C for Bench Sheets)

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

Conducted May 14 – 21, 2013 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
10.8%	100	100	100	100	100	100	100
21.6%	100	100	100	100	100	100	100
43.2%	100	100	100	100	100	100	100
86.4%	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	30	32	31	30	32	32	30	30	30	30.8
10.8%	33	30	31	33	33	33	32	30	33	33	32.1
21.6%	34	31	32	34	35	33	32	34	33	34	33.2
43.2%	36	34	36	33	33	34	35	34	33	34	34.2
86.4%	37	31	34	34	38	36	36	34	32	36	34.8
100.0%	35	38	37	34	36	35	36	38	36	37	36.2

IC_{25} Value: > 100% Permit Limit: 43.2% 95% Confidence Limits: Upper Limit: NA Lower Limit: NA	Calculated TU Estimates: < 1.0 TUc* Permit Limit: 2.3 TUc

*TUa = $100/LC_{50}$: TUc = $100/ IC_{25}$

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 May 14 – 21, 2013 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	31	29	28	31	29	27	29	34	29	29	29.6
Intake	34	35	39	36	37	36	37	35	36	34	35.9

IC_{25} Value: ≥ 100% Permit Limit: N/A 95% Confidence Limits: Upper Limit: NA Lower Limit: NA	Calculated TU Estimates: ≤ 1.0 TUc* Permit Limit: N/A

*TUa = $100/LC_{50}$: TUc = $100/ IC_{25}$

TOXICITY TEST RESULTS, UV-TREATED (see Appendix C for Bench Sheets)

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

Conducted May 14 – 21, 2013 using effluent from UV Treated 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
10.8%	100	100	100	100	100	100	100
21.6%	100	100	100	100	100	100	100
43.2%	100	100	100	100	100	100	100
86.4%	100	100	100	100	100	100	100
100.0%	100	100	100	100	100	100	100
Intake	100	100	100	100	100	100	100

Test Solutions (% Effluent)	Mean Dry Weight (mg) (replicate number)				
	1	2	3	4	Mean
Control	0.593	0.548	0.575	0.594	0.578
10.8%	0.559	0.559	0.543	0.511	0.543
21.6%	0.575	0.584	0.618	0.592	0.592
43.2%	0.525	0.573	0.578	0.544	0.555
86.4%	0.532	0.596	0.715	0.615	0.615
100.0%	0.579	0.559	0.605	0.633	0.594
Intake	0.523	0.607	0.565	0.485	0.545

IC_{25} Value: > 100% 95% Confidence Limits: Upper Limit: NA Lower Limit: NA	Calculated TU Estimates: < 1.0 TUc*

*TUa = $100/LC_{50}$: TUc = $100/ IC_{25}$

REFERENCE TOXICANT TEST RESULTS (see Appendix A and D)

Species	Date	Time	Duration	Toxicant	Results (IC_{25})
Pimephales promelas	May 14 – 21, 2013	1500	7 days	KCl	0.78 g/L
Ceriodaphnia dubia	May 07 – 14, 2013	1014	7 days	NaCl	1.06 g/L

PHYSICAL/CHEMICAL SUMMARY

Water Chemistry Mean Values and Ranges for *Pimephales promelas* and *Ceriodaphnia dubia* Tests, Non-treated Sequoyah Nuclear Plant (SQN) Outfall 101 performed May 14-21, 2013.

Test	Sample ID	Temperature (°C)		Dissolved Oxygen (mg/L)		pH (S.U.)		Conductance	Alkalinity	Hardness	Total Residual
		Initial	Final	Initial	Final	Initial	Final	(µmhos/cm)	(mg/L $CaCO_3$)	(mg/L $CaCO_3$)	Chlorine (mg/L)
Pimephales promelas	Control	24.8 24.7 - 24.8	24.5 24.3 - 24.7	7.7 7.6 - 7.8	7.5 7.2 - 7.8	7.95 7.89 - 8.00	7.74 7.64 - 7.81	310 307 - 314	61 61 - 62	87 84 - 88	
	10.8%	24.8 24.7 - 24.8	24.5 24.3 - 24.8	7.8 7.7 - 7.9	7.5 7.2 - 7.9	7.95 7.90 - 7.97	7.71 7.66 - 7.75	286 283 - 290			
	21.6%	24.8 24.7 - 24.8	24.5 24.2 - 24.7	7.8 7.7 - 7.9	7.5 7.2 - 7.9	7.95 7.90 - 7.98	7.69 7.63 - 7.77	270 267 - 272			
	43.2%	24.8 24.7 - 24.9	24.5 24.2 - 24.7	7.8 7.7 - 7.9	7.5 7.3 - 7.9	7.93 7.90 - 7.98	7.68 7.59 - 7.76	234 231 - 237			
	86.4%	24.9 24.8 - 24.9	24.5 24.2 - 24.7	7.8 7.8 - 7.9	7.5 7.2 - 7.9	7.87 7.83 - 7.97	7.66 7.60 - 7.73	160 154 - 168			
	100.0%	24.9 24.8 - 25.0	24.6 24.4 - 24.7	7.9 7.8 - 8.0	7.5 7.2 - 8.0	7.84 7.79 - 7.89	7.64 7.59 - 7.72	131 126 - 137	53 51 - 55	55 52 - 58	< 0.10 < 0.10 - < 0.10
	Intake	24.9 24.8 - 25.0	24.4 24.1 - 24.6	8.0 7.8 - 8.0	7.4 7.0 - 8.0	7.84 7.80 - 7.89	7.66 7.59 - 7.74	131 123 - 138	53 51 - 56	56 54 - 58	< 0.10 < 0.10 - < 0.10
Ceriodaphnia dubia	Control	24.8 24.7 - 24.9	25.0 24.8 - 25.2	7.7 7.6 - 7.8	7.8 7.8 - 8.0	7.95 7.89 - 8.00	7.93 7.87 - 7.96	310 307 - 314	61 61 - 62	87 84 - 88	
	10.8%	24.8 24.7 - 25.0	25.0 24.8 - 25.3	7.8 7.7 - 7.9	7.8 7.8 - 8.0	7.95 7.90 - 7.97	7.94 7.88 - 7.98	286 283 - 290			
	21.6%	24.8 24.7 - 25.0	25.0 24.8 - 25.1	7.8 7.7 - 7.9	7.9 7.8 - 8.0	7.95 7.90 - 7.98	7.94 7.88 - 7.99	270 267 - 272			
	43.2%	24.9 24.7 - 25.0	24.9 24.7 - 25.0	7.8 7.7 - 7.9	7.9 7.8 - 8.0	7.93 7.90 - 7.98	7.94 7.88 - 8.00	234 231 - 237			
	86.4%	24.9 24.8 - 25.1	25.0 24.8 - 25.1	7.8 7.8 - 7.9	7.9 7.8 - 8.0	7.87 7.83 - 7.97	7.92 7.83 - 7.97	160 154 - 168			
	100.0%	25.0 24.8 - 25.3	24.9 24.8 - 25.1	7.9 7.8 - 8.0	7.9 7.8 - 8.0	7.84 7.79 - 7.89	7.90 7.83 - 7.98	131 126 - 137	53 51 - 55	55 52 - 58	< 0.10 < 0.10 - < 0.10
	Intake	25.0 24.9 - 25.2	24.9 24.8 - 25.0	8.0 7.8 - 8.0	8.0 7.9 - 8.1	7.84 7.80 - 7.89	7.89 7.81 - 7.97	131 123 - 138	53 51 - 56	56 54 - 58	< 0.10 < 0.10 - < 0.10

Overall temperature (°C)	Average	Minimum	Maximum
Pimephales promelas	24.7	24.1	25.0
Ceriodaphnia dubia	24.9	24.7	25.3

PHYSICAL/CHEMICAL SUMMARY

Water Chemistry Mean Values and Ranges for *Pimephales promelas* Test, UV-treated Sequoyah Nuclear Plant (SQN) Outfall 101 performed May 14-21, 2013.

Test	Sample ID	Temperature (°C)		Dissolved Oxygen (mg/L)		pH (S.U.)		Conductance (µmhos/cm)	Alkalinity (mg/L $CaCO_3$)	Hardness (mg/L $CaCO_3$)	*Total Residual Chlorine (mg/L)
		Initial	Final	Initial	Final	Initial	Final				
Pimephales promelas	Control	24.8 24.7 - 24.9	24.6 24.5 - 24.7	7.8 7.7 - 7.8	7.4 7.2 - 7.8	7.94 7.89 - 7.96	7.72 7.67 - 7.81	305 301 - 311	62 61 - 62	88 86 - 92	
	10.8%	24.9 24.8 - 25.0	24.6 24.3 - 24.7	7.9 7.8 - 8.0	7.4 7.3 - 7.9	7.94 7.90 - 7.97	7.72 7.68 - 7.80	287 281 - 294			
	21.6%	24.9 24.8 - 25.0	24.5 24.3 - 24.8	7.9 7.8 - 8.0	7.4 7.2 - 7.9	7.94 7.89 - 7.97	7.71 7.67 - 7.76	272 269 - 274			
	43.2%	24.9 24.8 - 25.0	24.5 24.4 - 24.7	7.9 7.9 - 8.0	7.4 7.2 - 7.9	7.92 7.85 - 7.97	7.68 7.57 - 7.77	235 232 - 239			
	86.4%	24.9 24.8 - 25.0	24.6 24.3 - 24.8	8.0 7.9 - 8.0	7.4 7.1 - 7.9	7.87 7.79 - 7.96	7.63 7.54 - 7.72	161 156 - 167			
	100.0%	25.1 24.8 - 25.2	24.5 24.3 - 24.7	8.0 7.9 - 8.0	7.4 7.1 - 7.9	7.83 7.78 - 7.89	7.63 7.55 - 7.71	132 127 - 140	53 51 - 56	58 56 - 62	< 0.10 < 0.10 - < 0.10
	Intake	25.0 24.8 - 25.2	24.5 24.4 - 24.7	8.1 8.0 - 8.1	7.4 7.0 - 7.9	7.82 7.75 - 7.88	7.68 7.65 - 7.77	131 125 - 139	53 50 - 56	56 54 - 58	< 0.10 < 0.10 - < 0.10

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

Overall temperature (°C)	Average	Minimum	Maximum
Pimephales promelas	24.7	24.3	25.2

SUMMARY / CONCLUSIONS

Outfall 101 samples collected May 12 – 17, 2013, showed no toxic effects to fathead minnows or daphnids. The resulting IC_{25} 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.

Fathead minnows were also exposed to UV treated Outfall 101 and intake samples since fish pathogens present in intake water have been the suspected cause of interference (anomalous dose response and high variability among replicates) in previous toxicity testing at Sequoyah. At the time this study was conducted, insignificant mortality occurred in minnows exposed to non-treated and UV treated samples.

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*

   None

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.

During the Quality Assurance review of this report it was noted that the reported Average Flow on Days Sampled (MGD) for the third sample set (26,554.02 MGD) was an order of magnitude higher than expected or previously reported values. Investigations revealed that the technician overseeing the sample collection had used river flow data instead of outfall flow data to determine average flow. Consequently, these flow data were also used in determining the volumes from the 24 aliquots used to prepare the composite sample for this final set. TVA acknowledges that this event was an unintentional deviation from the NPDES Permit requirements. However, calculations using the correct data were completed and compared with those used for the third composite. The average error per aliquot was 1.27% with an error range of 0.02% to 13.74%. Upon review of this information by TVA Quality Assurance personnel, it was determined that the WET test results were not compromised as the result of the sampling error. Corrective actions are being implemented to prevent this type of error from occurring in the future.

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

1. Test Type: 7-day chronic tests with results expressed as IC_{25} 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, 22nd Edition, 2012.

4. Quality Assurance Program: Standard Operating Procedures, Environmental Testing Solutions, Inc (most current version).

Sequoyah Nuclear Plant Biomonitoring
May 14 – 21, 2013

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 Diffuser (Outfall 101) Discharge Concentrations of Chemicals Used to Control Microbiologically Induced Corrosion Mollusks, During Toxicity Test Sampling, March 12, 1998 – May 17, 2013

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
03/12/1998	0.016	-	-	-	-	-	-
03/13/1998	0.015	-	-	-	-	-	-
03/14/1998	0.013	-	-	-	-	-	-
03/15/1998	0.030	-	-	-	-	-	-
03/16/1998	0.013	-	-	-	-	-	-
03/17/1998	0.020	-	-	-	-	-	-
03/18/1998	0.018	-	-	-	-	-	-
09/08/1998	0.015	-	0.014	0.005	-	-	0.021
09/09/1998	0.003	-	0.031	0.011	-	-	-
09/10/1998	0.014	-	0.060	0.021	-	-	-
09/11/1998	0.013	-	0.055	0.019	-	-	-
09/12/1998	< 0.001	-	0.044	0.015	-	-	-
09/13/1998	< 0.001	-	0.044	0.015	-	-	-
09/14/1998	0.008	-	0.044	0.015	-	-	-
02/22/1999	< 0.001	-	-	-	-	-	-
02/23/1999	0.005	-	-	-	-	-	-
02/24/1999	0.009	-	-	-	-	-	-
02/25/1999	0.012	-	-	-	-	-	-
02/26/1999	0.008	-	-	-	-	-	-
02/27/1999	< 0.001	-	-	-	-	-	-
02/28/1999	< 0.001	-	-	-	-	-	-
08/18/1999	-	0.015	0.069	0.024	0.006	-	-
08/19/1999	-	0.012	0.068	0.024	-	-	-
08/20/1999	-	0.023	0.070	0.024	-	0.120	-
08/21/1999	-	0.022	0.068	0.024	-	-	-
08/22/1999	-	0.022	0.068	0.024	-	-	-
08/23/1999	-	0.025	0.068	0.024	0.006	-	-
08/24/1999	-	0.016	0.067	0.023	0.020	-	-

Table B-1. Sequoyah Nuclear Plant Diffuser (Outfall 101) Discharge Concentrations of Chemicals Used to Control Microbiologically Induced Corrosion Mollusks, During Toxicity Test Sampling,
March 12, 1998 – May 17, 2013

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
01/31/2000	-	< 0.002	0.026	0.009	-	-	-
02/01/2000	-	0.011	0.026	0.028	-	-	-
02/02/2000	-	0.028	0.026	0.009	0.006	-	-
02/03/2000	-	0.008	0.027	0.009	-	-	-
02/04/2000	-	0.006	0.027	0.009	0.005	0.109	-
02/05/2000	-	< 0.002	0.027	0.009	-	-	-
02/06/2000	-	< 0.002	0.027	0.009	-	-	-
07/26/2000	-	< 0.0057	0.055	0.019	-	-	-
07/27/2000	-	0.019	0.055	0.019	-	-	-
07/28/2000	-	0.0088	0.053	0.018	0.004	0.108	-
07/29/2000	-	< 0.0088	0.055	0.019	-	-	-
07/30/2000	-	< 0.0076	0.055	0.019	-	-	-
07/31/2000	-	< 0.0152	0.055	0.019	0.006	-	-
08/01/2000	-	< 0.0141	0.055	0.019	0.005	-	-
12/11/2000	-	0.0143	0.025	0.020	0.005	-	-
12/12/2000	-	0.0092	0.025	0.020	0.005	-	-
12/13/2000	-	< 0.0120	0.025	0.020	-	-	-
12/14/2000	-	< 0.0087	0.025	0.020	-	-	-
12/15/2000	-	0.0120	0.025	0.020	0.005	-	-
12/16/2000	-	< 0.0036	0.025	0.020	-	-	-
12/17/2000	-	< 0.0036	0.025	0.020	-	-	-
08/26/2001	-	0.017	0.06	0.021	0.006	-	-
08/27/2001	-	<0.0096	0.06	0.021	0.005	-	0.021
08/28/2001	-	<0.0085	0.06	0.021	-	-	-
08/29/2001	-	<0.0094	0.059	0.020	0.005	-	0.021
08/30/2001	-	<0.0123	0.06	0.021	0.005	-	-
08/31/2001	-	<0.005	0.059	0.020	-	-	-
11/25/2001	-	<0.0044	-	-	-	-	-
11/26/2001	-	<0.0119	0.024	0.02	0.005	-	-
11/27/2001	-	0.0137	0.023	0.019	0.007	-	-
11/28/2001	-	<0.0089	0.022	0.019	0.006	-	-
11/29/2001	-	0.0132	0.024	0.02	0.007	-	-
11/30/2001	-	< 0.0043	0.024	0.02	-	-	-
12/09/2001	-	<0.0042	-	-	-	-	-
12/10/2001	-	<0.0042	-	-	-	-	-
12/11/2001	-	<0.0104	-	-	-	-	-
12/12/2001	-	0.0128	0.024	0.02	0.008	-	-
12/13/2001	-	<0.0088	0.024	0.02	-	-	-
12/14/2001	-	0.0134	0.024	0.02	0.007	-	-

Table B-1. Sequoyah Nuclear Plant Diffuser (Outfall 101) Discharge Concentrations of Chemicals Used to Control Microbiologically Induced Corrosion Mollusks, During Toxicity Test Sampling,
March 12, 1998 – May 17, 2013

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
01/02/2002	-	< 0.0079	0.023	0.02	0.006	-	-
01/03/2002	-	< 0.0042	0.023	0.014	-	-	-
01/04/2002	-	0.0124	0.024	0.014	0.009	-	-
01/05/2002	-	< 0.0042	-	-	-	-	-
01/06/2002	-	< 0.0042	-	-	-	-	-
01/07/2002	-	< 0.0089	0.024	0.014	0.006	-	-
02/24/2002	-	< 0.004	-	-	-	-	-
02/25/2002	-	< 0.004	0.023	0.023	-	-	-
02/26/2002	-	0.0143	0.023	0.023	0.007	-	-
02/27/2002	-	< 0.0041	0.023	0.023	-	-	-
02/28/2002	-	< 0.0041	0.024	0.008	-	-	-
03/01/2002	-	< 0.0041	0.024	0.008	-	-	-
05/05/2002	-	-	-	-	-	-	-
05/06/2002	-	-	0.058	0.02	0.014	-	-
05/07/2002	-	-	0.058	0.02	0.015	-	-
05/08/2002	-	-	0.056	0.019	-	-	-
05/09/2002	-	-	0.057	0.02	0.014	-	-
05/10/2002	-	-	0.056	0.019	-	-	-
08/04/2002	-	<0.0058	-	-	-	-	-
08/05/2002	-	<0.0058	0.053	0.018	-	-	0.025
08/06/2002	-	0.0092	0.053	0.018	-	-	-
08/07/2002	-	<0.0107	0.055	0.019	0.007	-	-
08/08/2002	-	<0.0061	0.055	0.019	-	-	-
08/09/2002	-	0.0152	0.054	0.018	0.008	-	-
10/06/2002	-	<0.00497	-	-	-	-	-
10/07/2002	-	0.0153	0.054	0.018	0.009	-	-
10/08/2002	-	<0.0092	0.054	0.018	0.007	-	-
10/09/2002	-	0.0124	0.053	0.018	0.009	-	-
10/10/2002	-	0.0134	0.054	0.018	0.009	-	-
10/11/2002	-	<0.0042	0.054	0.018	-	-	-
01/12/2003	-	<0.0035	-	-	-	-	-
01/13/2003	-	<0.006	0.025	0.019	0.009	-	-
01/14/2003	-	<0.0118	0.026	0.020		-	-
01/15/2003	-	<0.0063	0.026	0.020	0.009	-	-
01/16/2003	-	<0.0034	0.026	0.020		-	-
01/17/2003	-	<0.0034	0.026	0.009	-	-	-
04/06/2003	-	<0.0073	-	-	-	-	-
04/07/2003	-	<0.0189	-	0.021	-	-	-
04/08/2003	-	<0.0117	-	0.021	-	-	-
04/09/2003	-	<0.0139	-	0.021	0.016	-	-
04/10/2003	-	<0.0113	-	0.021	0.018	-	-
04/11/2003	-	<0.0073	-	0.022	-	-	-

Table B-1 (continued). Sequoyah Nuclear Plant Diffuser (Outfall 101) Discharge Concentrations of Chemicals Used to Control Growth of Microbiologically Induced Bacteria and Mollusks, During Toxicity Test Sampling, March 12, 1998 – May 17, 2013

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
06/15/2003	-	< 0.0045	-	-	-	-	-
06/16/2003	-	< 0.0037	0.057	0.020	-	-	0.022
06/17/2003	-	< 0.0048	0.041	0.014	-	-	0.024
06/18/2003	-	< 0.0048	0.041	0.014	-	-	0.024
06/19/2003	-	< 0.0085	0.058	0.020	-	-	0.025
06/20/2003	-	< 0.0048	0.058	0.020	-	-	0.025
08/03/2003	-	<0.0050	-	-	-	-	-
08/04/2003	-	<0.0050	0.058	0.020	-	-	-
08/05/2003	-	<0.0051	0.057	0.020	-	-	0.025
08/06/2003	-	<0.0084	0.057	0.020	-	-	0.025
08/07/2003	-	0.0129	0.057	0.020	-	-	0.024
08/08/2003	-	0.0153	0.057	0.020	0.009	-	-
10/05/2003	-	<0.0043	0.057	0.020	-	-	-
10/06/2003	-	<0.0043	0.057	0.020	-	-	0.025
10/07/2003	-	<0.0090	0.057	0.020	-	-	0.025
10/08/2003	-	<0.0106	0.057	0.020	-	-	0.025
10/09/2003	-	0.0181	0.026	0.022	-	-	0.025
10/10/2003	-	0.0183	0.026	0.024	0.009	-	-
02/01/2004	-	0.0093	0.027	0.009	-	-	-
02/02/2004	-	<0.0034	0.026	0.009	-	-	-
02/03/2004	-	<0.0034	0.026	0.009	-	-	-
02/04/2004	-	0.0124	0.026	0.009	0.009	-	-
02/05/2004	-	<0.0034	0.026	0.009	-	-	-
02/06/2004	-	0.0105	0.026	0.009	0.010	-	-
05/04/2004	-	<0.0123	0.026	0.019	-	-	0.025
05/05/2004	-	<0.0144	0.026	0.014	0.009	-	0.025
05/06/2004	-	<0.0146	0.037	0.013	-	-	0.025
05/07/2004	-	0.0227	0.058	0.020	0.009	-	0.025
05/08/2004	-	0.016	0.060	0.021	-	-	-
05/09/2004	-	<0.0104	0.058	0.020	-	-	-
07/04/2004	-	0.0217	0.057	0.019	-	-	-
07/05/2004	-	<0.0085	0.057	0.020	0.009	-	-
07/06/2004	-	<0.0077	0.058	0.020	-	-	0.031
07/07/2004	-	0.0252	0.056	0.019	-	-	0.031
07/08/2004	-	0.0223	0.057	0.019	0.009	-	-
07/09/2004	-	0.0182	0.057	0.020	0.009	-	-

Table B-1. Sequoyah Nuclear Plant Diffuser (Outfall 101) Discharge Concentrations of Chemicals Used to Control Microbiologically Induced Corrosion Mollusks, During Toxicity Test Sampling,
March 12, 1998 – May 17, 2013

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
11/07/2004	-	<0.0187	0.000	0.014	-	-	-	-	-
11/08/2004	-	<0.0192	0.047	0.030	-	-	-	-	-
11/09/2004	-	<0.0233	0.048	0.016	-	-	0.041	-	-
11/10/2004	-	<0.0149	0.047	0.016	-	-	0.041	-	-
11/11/2004	-	<0.0149	0.049	0.017	-	-	0.043	-	-
11/12/2004	-	<0.0253	0.048	0.017	-	-	0.042	-	-
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 (continued). Sequoyah Nuclear Plant Diffuser (Outfall 101) Discharge Concentrations of Chemicals Used to Control Growth of Microbiologically Induced Bacteria and Mollusks, During Toxicity Test Sampling, March 12, 1998 – May 17, 2013

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	-	-	-	-	-	0.018	0.041	0.030
10/30/08	-	-	-	-	-	-	-	-	0.041	0.030
10/31/08	-	0.0086	-	-	-	-	-	-	0.041	0.030

Table B-1. Sequoyah Nuclear Plant Diffuser (Outfall 101) Discharge Concentrations of Chemicals Used to Control Microbiologically Induced Corrosion Mollusks, During Toxicity Test Sampling,
March 12, 1998 – May 17, 2013

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	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 Diffuser (Outfall 101) Discharge Concentrations of Chemicals Used to Control Microbiologically Induced Corrosion Mollusks, During Toxicity Test Sampling,
March 12, 1998 – May 17, 2013

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
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	-	-	-	-	-	0.028	-	-	-	0.029
08/16/2012	-	0.0076	-	-	-	-	-	-	-	-	-	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

Sequoyah Nuclear Plant Biomonitoring
May 14 – 21, 2013

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: Dustin Bineger, Andy Painter, Obie Moore

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 samplers @ 0800
Took samples from Intake sampler @ 0836

Field Identification / Sample Description	Grab/Comp.	Collection Date/Time Start	Collection Date/Time End	Container Number & Volume Collected	Flow (MGD)	Rain Event? (Mark as Appropriate) Yes	If Yes, Inches	No	Trace	Laboratory Use: ETS Log Number	Arrival Temp. (°C)	By	Time ET	Appearance
SQN-101-TOX 6/8/13	Comp	5/12/13 0900 ET	5/13/13 0800 ET	2(2.5gal)	1760.46			X		130513.01	1.7, 1.6°C		1415	*
SQN-INT-TOX 6/8/13	Comp	5/12/13 0920 ET	5/13/13 0820 ET	1(2.5 gal)				X		130513.02	9.8°C		1415	*

Laboratory Use: Project # 8968

Sample Custody – Fill In From Top Down

Relinquished By (Signature):	Date/Time	Received By (Signature):	Date/Time
TVA	05-13-13 / 1005 ET	SONIC	5/13/13 / 1005 ET
SONIC	5/13/13 / 2:15 ET	ETS	05-13-13 1415 ET

* CUSTODY SEALS WERE INTACT. SAMPLES RECEIVED IN GOOD CONDITION. TRC ABSENT IN ALL SAMPLES

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.

Independent Review by Kelley E. Keenan Initials: [initials]

ETS

Whole Effluent Sample Receipt Log

*Sample temperature performed using Sample Receiving Thermometer: SN 122164697

Date Received	Time Received	Received by	Received from	*Sample Temp. (°C)	Project number	Sample number	Sample name and description	State	Comments
05-13-13	1415	J. Sumner	TVA Courier	1.7/1.6	8968	130513 .01	TVA - Sequoyah Nuclear - 101	TN	
05-13-13	1415	J. Sumner	TVA Courier	1.8	8968	130513 .02	TVA - Sequoyah Nuclear - Intake	TN	
05-13-13	1612	J. Sumner	TVA Courier	1.8	8969	130513 .03	TVA - Watts Bar - 101	TN	
05-13-13	1612	J. Sumner	TVA Courier	2.2	8969	130513 .04	TVA - Watts Bar - 101 Intake	TN	
05-13-13	1612	J. Sumner	TVA Courier	2.1	8969	130513 .05	TVA - Watts Bar - 113	TN	
05-13-13	1612	J. Sumner	TVA Courier	2.5	8969	130513 .06	TVA - Watts Bar - 113 Intake	TN	

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: Obie Moore, Dustin Bineger, Andy Panther

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 samplers @ 0705
Took samples from Intake sampler @ 0733

project # 0908

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-3 6/3/13	Comp	0750 ET 5-14-13	0650 ET 5-15-13	2(2.5gal)	1548.33			X		1309508	1.4, 1.2°C	JH	1330	*
SQN-INT-TOX-3 6/3/13	Comp	0805 ET 5-14-13	0705 ET 5-15-13 6/3/13	1(2.5 gal)				X		1309509	1.2°C	JH	1330	*

Sample Custody – Fill In From Top Down

* Custody seals intact. Samples received in good condition. TRC absent in all samples JH

Relinquished By (Signature):	Date/Time	Received By (Signature):	Date/Time
TVA	05 | 15 | 13 | 0918 ET	SONIC	5/15/13 9:18 ET
SONIC	5/15/13 1:35 ET	ETS	05-15-13 1330 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.

ETS

Whole Effluent Sample Receipt Log

*Sample temperature performed using Sample Receiving Thermometer: SN 122164697

Date Received	Time Received	Received by	Received from	*Sample Temp. (°C)	Project number	Sample number	Sample name and description	State	Comments
05-15-13	0931	K. Keenan	Fed - Ex	1.1	8979	130515 .01	Bladenboro WWTP	NC	
05-15-13	0931	K. Keenan	Fed - Ex	0.5	8980	130515 .02	Craven County Wood Energy	NC	
05-15-13	0931	K. Keenan	Fed - Ex	1.9	8981	130515 .03	Dallas WWTP	NC	
05-15-13	0931	K. Keenan	Fed - Ex	1.0	8982	130515 .04	North Cary WWTP	NC	
05-15-13	0931	K. Keenan	Fed - Ex	0.5	8983	130515 .05	Progress Energy - Shearon Harris E & E	NC	
05-15-13	0931	K. Keenan	Fed - Ex	1.0	8984	130515 .06	Progress Energy - Shearon Harris	NC	
05-15-13	1009	K. Keenan	UPS	0.6	8985	130515 .07	South Cary WWTP	NC	
05-15-13	1330	J. Sumner	TVA Courier	1.4/1.2	8968	130515 .08	TVA - Sequoyah Nuclear Plant - 101	TN	
05-15-13	1330	J. Sumner	TVA Courier	1.2	8968	130515 .09	TVA - Sequoyah Nuclear Plant - Intake	TN	
05-15-13	1630	J. Sumner	TVA Courier	0.9	8969	130515 .10	TVA - Watts Bar - Outfall 101	TN	
05-15-13	1630	J. Sumner	TVA Courier	0.7	8969	130515 .11	TVA - Watts Bar - Intake 101	TN	
05-15-13	1630	J. Sumner	TVA Courier	1.8	8969	130515 .12	TVA - Watts Bar - Outfall 113	TN	
05-15-13	1630	J. Sumner	TVA Courier	1.3	8969	130515 .13	TVA - Watts Bar - Intake 113	TN	

BIOMONITORING CHAIN OF CUSTODY RECORD

Page 1 of 1

Client: TVA	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
Project Name: Sequoyah NP Toxicity		
P.O. Number: N/A		General Comments: Took samples from 101 samplers @ 0645. Took samples from Intake sampler @ 0730.
Facility Sampled: Sequoyah NP		
NPDES Number: TN0026450		
Collected By: Lyndell Williams, Dustin Binegar, Andy Porter		

project# 8960

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	0650 ET 05/16/2013	0550 ET 05/17/2013	2(2.5gal)	~~26554.02~~ 1552.94			X		13051707	2.0, 1.5°C	J	1315	*
SQN-INT-TOX	Comp	0705 ET 05/16/2013	0605 ET 05/16/2013	1(2.5 gal)	dw 6-11-13			X		13051708	1.4°C	J	1315	*

6/11/13 Sample Custody -- Fill In From Top Down

* CUSTODY SEALS INTACT. SAMPLES RECEIVED IN GOOD CONDITION. TRC ABSENT IN ALL SAMPLES.

Relinquished By (Signature):	Date/Time	Received By (Signature):	Date/Time
[signature] TVA	05-17-13 / 0835 ET	[signature] SONIC	5/17/13 / 0835 ET
[signature] SONIC	5/17/13 / 1315 ET	[signature] ETS	05-17-13 1315 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

*Sample temperature performed using Sample Receiving Thermometer: SN 122164697

Date Received	Time Received	Received by	Received from	*Sample Temp. (°C)	Project number	Sample number	Sample name and description	State	Comments
05-17-13	0935	K. Keenan	UPS	0.7	8985	130517 .01	South Cary WWTP	NC	
05-17-13	0940	K. Keenan	Fed - Ex	1.3	8979	130517 .02	Bladenboro WWTP	NC	
05-17-13	0940	K. Keenan	Fed - Ex	3.4	8980	130517 .03	Craven County Wood Energy	NC	
05-17-13	0940	K. Keenan	Fed - Ex	1.8	8981	130517 .04	Dallas WWTP	NC	
05-17-13	0940	K. Keenan	Fed - Ex	2.2	8982	130517 .05	North Cary WWTP	NC	
05-17-13	0940	K. Keenan	Fed - Ex	2.7	8987	130517 .06	Duke Energy - McGuire NS - Outfall 002	NC	
05-17-13	1315	J. Sumner	TVA Courier	2.0/1.5	8968	130517 .07	TVA - Sequoyah Nuclear Plant - 101	TN	
05-17-13	1315	J. Sumner	TVA Courier	1.4	8968	130517 .08	TVA - Sequoyah Nuclear Plant - Intake	TN	
05-17-13	1517	J. Sumner	TVA Courier	2.5	8969	130517 .09	TVA - Watts Bar - Outfall 101	TN	
05-17-13	1517	J. Sumner	TVA Courier	2.3	8969	130517 .10	TVA - Watts Bar - Intake 101	TN	
05-17-13	1517	J. Sumner	TVA Courier	2.6	8969	130517 .11	TVA - Watts Bar - Outfall 113	TN	
05-17-13	1517	J. Sumner	TVA Courier	2.1	8969	130517 .12	TVA - Watts Bar - Intake 113	TN	

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 #: ~~TN0020168~~ TN 0026450
Project #: 8968

County: ~~Rhea~~ HAMILTON
Outfall: 101

Dilution preparation information:						*Comments:*
Dilution prep (%)	10.8	21.6	43.2	86.4	100	
Effluent volume (mL)	270	540	1080	2160	2500	
Diluent volume (mL)	2230	1960	1420	340	0	
Total volume (mL)	2500	2500	2500	2500	2500	

Test organism information:		*Test information:*	
Organism age:	21.75 HOURS OLD	Randomizing template:	YELLOW
Date and times organisms were born between:	05-13-13 1600	Incubator number and shelf location:	3C
Organism source:	ATOX BATCH #'s 05.13.13	*Artemia* CHM number:	CHM720
		Drying information for weight determination:	
Transfer bowl information:	pH = 7.75 S.U. Temperature = 24.7 °C	Date / Time in oven:	05-21-13 1440
		Initial oven temperature:	60°C
Average transfer volume:	1.1665 mL	Date / Time out of oven:	05-22-13 1440
		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	05-14-13			1545	JH	1345	JH	130513.01	130513.02	05-11-13
1	05-15-13	0800	JH	1415	JH	1246	JH	130513.01	130513.02	05-11-13
2	05-16-13	0830	JH	1430	JH	1245	JH	130515.08	130515.09	05-13-13A
3	05-17-13	0830	JH	1430	JH	1247	JH	130515.08	130515.09	05-13-13A
4	05-18-13	0830	JH	1430	JH	1245	JH	130517.07	130517.08	05-15-13
5	05-19-13	0815	JH	1415	JH	1245	JH	130517.07	130517.08	05-17-13A
6	05-20-13	0815	JH	1415	JH	1245	JH	130517.07	130517.08	05-17-13A
7	05-21-13					1246	JH			

Control information:		Acceptance criteria	*Summary of test endpoints:*	
% Mortality:	0%	≤ 20%	7-day LC_{50}	>100%
Average weight per initial larvae:	0.625		NOEC	100%
Average weight per surviving larvae:	0.625	≥ 0.25mg/larvae	LOEC	>100%
			ChV	>100%
			IC_{25}	>100%

Species: ***Pimephales promelas***
Client: **TVA / Sequoyah Nuclear Plant, Outfall 101, Non-treated** **Date:** 05.14.13

Survival and Growth Data

Day	CONTROL				10.8%				21.6%			
	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:: ruby Analyst: JTB Date: 05.09.13	14.90	14.50	12.53	13.80	13.19	15.65	13.81	14.79	13.55	13.78	12.53	13.49
B = Pan + Larvae weight (mg) Analyst: JTB Date: 05.22.13	21.19	21.37	18.16	20.00	19.45	22.49	19.93	20.53	19.56	20.20	18.55	18.94
C = Larvae weight (mg) = B – A Hand calculated. Analyst:	6.29	6.87	5.63	6.20	6.26	6.84	6.12	5.74	6.01	6.42	6.02	5.45
Weight per initial number of larvae (mg) = C / Initial number of larvae Hand calculated. Analyst:	0.629	0.687	0.563	0.620	0.626	0.684	0.612	0.574	0.601	0.642	0.602	0.545
Average weight per initial number of larvae (mg) / Percent reduction from control (%)	0.625				0.624		0.17.		0.598		4.47.	

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:

Independent Review by Kelley E. Keenan Initial: KK

Species: ***Pimephales promelas***
Client: TVA / Sequoyah Nuclear Plant, Outfall 101, Non-treated **Date:** 05-14-13

Survival and Growth Data

Day	43.2%				86.4%				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	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:: ruby Analyst: JTB Date: 05-09-13	13.44	14.21	14.60	14.39	14.59	13.35	13.88	14.12	13.71	15.01	13.90	14.38
B = Pan + Larvae weight (mg) Analyst: JTB Date: 05-22-13	18.94	20.51	20.39	20.77	20.19	19.52	19.83	20.18	19.71	20.61	19.35	20.06
C = Larvae weight (mg) = B – A Hand calculated. Analyst: JTB	5.50	6.30	5.79	6.38	5.60	6.17	5.95	6.06	6.00	5.60	5.45	5.68
Weight per initial number of larvae (mg) = C / Initial number of larvae Hand calculated. Analyst: JTB	0.550	0.630	0.579	0.638	0.560	0.617	0.595	0.606	0.600	0.560	0.545	0.568
Average weight per initial number of larvae (mg) / Percent reduction from control (%)	0.599		4.17.		0.595		4.87.		0.568		9.07.	

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:

Independent Review by Kelley E. Keenan Initials: KK

Species: ***Pimephales promelas***
Client: TVA / Sequoyah Nuclear Plant, Outfall 101, Non-treated **Date:** 05-14-13

Survival and Growth Data

Day	100% Intake			
	Y	Z	AA	BB
0	10	10	10	10
1	10	10	10	10
2	10	10	10	10
3	10	10	10	10
4	10	10	10	10
5	10	10	10	10
6	10	10	10	10
7	10	10	10	10
A = Pan weight (mg) Tray color code:: cuby Analyst: JJB Date: 05-09-13	13.68	13.44	12.54	13.01
B = Pan + Larvae weight (mg) Analyst: JJB Date: 05-22-13	18.59	19.73	18.39	18.18
C = Larvae weight (mg) = B – A Hand calculated. Analyst: JJB	4.91	6.29	5.85	5.17
Weight per initial number of larvae (mg) = C / Initial number of larvae Hand calculated. Analyst: JJB	0.491	0.629	0.585	0.517
Average weight per initial number of larvae (mg)	0.556			
Percent reduction from control (%)	11.17.			

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:

Independent Review by Kelley E. Keenan Initial: KK

Independent Review by

Environmental Testing Solutions, Inc.

TVA / Sequoyah Nuclear Plant, Outfall 101
Non-treated
May 14-21, 2013

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

Project number: 8968

Concentration (%)	Replicate	Initial number of larvae	Final number of larvae	A = Pan weight (mg)	B = Pan + Larvae weight (mg)	Larvae weight (mg) = A - B	Not for Compliance Assessment, Internal Laboratory QC: 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 (Mean weight per initial number of larvae) (%)	Percent reduction from control (%)
Control	A	10	10	14.90	21.19	6.29	0.629	0.625	8.1	0.629	100.0	0.625	8.1	Not applicable
	B	10	10	14.50	21.37	6.87	0.687			0.687				
	C	10	10	12.53	18.16	5.63	0.563			0.563				
	D	10	10	13.80	20.00	6.20	0.620			0.620				
10.8%	E	10	10	13.19	19.45	6.26	0.626	0.624	7.3	0.626	100.0	0.624	7.3	0.1
	F	10	10	15.65	22.49	6.84	0.684			0.684				
	G	10	10	13.81	19.93	6.12	0.612			0.612				
	H	10	10	14.79	20.53	5.74	0.574			0.574				
21.6%	I	10	10	13.55	19.56	6.01	0.601	0.598	6.7	0.601	100.0	0.598	6.7	4.4
	J	10	10	13.78	20.20	6.42	0.642			0.642				
	K	10	10	12.53	18.55	6.02	0.602			0.602				
	L	10	10	13.49	18.94	5.45	0.545			0.545				
43.2%	M	10	10	13.44	18.94	5.50	0.550	0.599	7.0	0.550	100.0	0.599	7.0	4.1
	N	10	10	14.21	20.51	6.30	0.630			0.630				
	O	10	10	14.60	20.39	5.79	0.579			0.579				
	P	10	10	14.39	20.77	6.38	0.638			0.638				
86.4%	Q	10	10	14.59	20.19	5.60	0.560	0.595	4.2	0.560	100.0	0.595	4.2	4.8
	R	10	10	13.35	19.52	6.17	0.617			0.617				
	S	10	10	13.88	19.83	5.95	0.595			0.595				
	T	10	10	14.12	20.18	6.06	0.606			0.606				
100%	U	10	10	13.71	19.71	6.00	0.600	0.568	4.1	0.600	100.0	0.568	4.1	9.0
	V	10	10	15.01	20.61	5.60	0.560			0.560				
	W	10	10	13.90	19.35	5.45	0.545			0.545				
	X	10	10	14.38	20.06	5.68	0.568			0.568				
100% Intake	Y	10	10	13.68	18.59	4.91	0.491	0.556	11.3	0.491	100.0	0.556	11.3	11.1
	Z	10	10	13.44	19.73	6.29	0.629			0.629				
	AA	10	10	12.54	18.39	5.85	0.585			0.585				
	BB	10	10	13.01	18.18	5.17	0.517			0.517				

Outfall 101:
Dunnett's MSD value: 0.0666
PMSD: 10.7

Intake:
Dunnett's MSD value: 0.0786
PMSD: 12.6

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.

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.

File: sqn101_051413data.xlsx
Entered by: J. Sumner
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TVA / Sequoyah Nuclear Plant, Outfall 101
Non-treated
May 14-21, 2013

ETS Environmental Testing Solutions, Inc.

Statistical Analyses

Larval Fish Growth and Survival Test-7 Day Growth

Start Date:	5/14/2013	Test ID:	PpFRCR	Sample ID:	TVA / SQN 101	
End Date:	5/21/2013	Lab ID:	ETS-Envir. Testing Sol.	Sample Type:	DMR-Discharge Monitoring Report	
Sample Date:	May 2013	Protocol:	FWCHR-EPA-821-R-02-013	Test Species:	PP-Pimephales promelas	
Comments:	Non-treated					

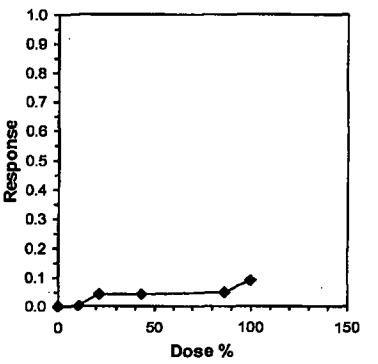
Conc-%	1	2	3	4
D-Control	0.6290	0.6870	0.5630	0.6200
10.8	0.6260	0.6840	0.6120	0.5740
21.6	0.6010	0.6420	0.6020	0.5450
43.2	0.5500	0.6300	0.5790	0.6380
86.4	0.5600	0.6170	0.5950	0.6060
100	0.6000	0.5600	0.5450	0.5680
Intake	0.4910	0.6290	0.5850	0.5170

			Transform: Untransformed						1-Tailed		Isotonic	
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Mean	N-Mean
D-Control	0.6248	1.0000	0.6248	0.5630	0.6870	8.124	4				0.6248	1.0000
10.8	0.6240	0.9988	0.6240	0.5740	0.6840	7.314	4	0.027	2.410	0.0666	0.6240	0.9988
21.6	0.5975	0.9564	0.5975	0.5450	0.6420	6.673	4	0.986	2.410	0.0666	0.5984	0.9578
43.2	0.5993	0.9592	0.5993	0.5500	0.6380	7.003	4	0.923	2.410	0.0666	0.5984	0.9578
86.4	0.5945	0.9516	0.5945	0.5600	0.6170	4.153	4	1.095	2.410	0.0666	0.5945	0.9516
100	0.5683	0.9096	0.5683	0.5450	0.6000	4.085	4	2.045	2.410	0.0666	0.5683	0.9096
Intake	0.5555	0.8892	0.5555	0.4910	0.6290	11.345	4					

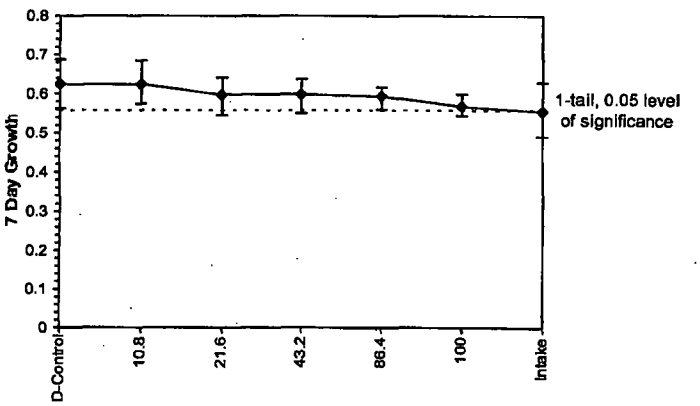
Auxiliary Tests					Statistic		Critical		Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)					0.96674		0.884		-0.0129	-0.5657
Bartlett's Test indicates equal variances (p = 0.78)					2.49894		15.0863			
Hypothesis Test (1-tail, 0.05)	**NOEC**	**LOEC**	**ChV**	**TU**	**MSDu**	**MSDp**	**MSB**	**MSE**	**F-Prob**	**df**
Dunnett's Test	100	>100		1	0.06658	0.10657	0.00178	0.00153	0.36414	5, 18
Treatments vs D-Control										

Linear Interpolation (200 Resamples)

Point	%	SD	95% CL(Exp)	Skew
IC05	86.912			
IC10	>100			
IC15	>100			
IC20	>100			
IC25	>100			
IC40	>100			
IC50	>100			



Dose-Response Plot



Independent Review by Kelley E. Keenan Initials:

File: sqn101_051413data.xlsx
Entered by: J. Sumner
Reviewed by:

TVA / Sequoyah Nuclear Plant, Outfall 101 - Intake
Non-treated
May 14-21, 2013

ETS Environmental Testing Solutions, Inc.

Statistical Analyses

Larval Fish Growth and Survival Test-7 Day Growth

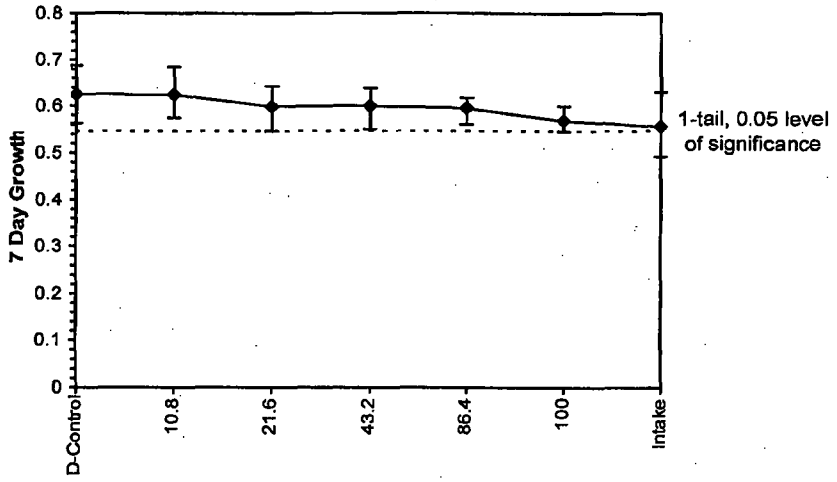
Start Date:	5/14/2013	Test ID:	PpFRCR	Sample ID:	TVA / SQN 101 - Intake
End Date:	5/21/2013	Lab ID:	ETS-Envir. Testing Sol.	Sample Type:	DMR-Discharge Monitoring Report
Sample Date:	May 2013	Protocol:	FWCHR-EPA-821-R-02-013	Test Species:	PP-Pimephales promelas
Comments:	Non-treated				

Conc-%	1	2	3	4
D-Control	0.6290	0.6870	0.5630	0.6200
10.8	0.6260	0.6840	0.6120	0.5740
21.6	0.6010	0.6420	0.6020	0.5450
43.2	0.5500	0.6300	0.5790	0.6380
86.4	0.5600	0.6170	0.5950	0.6060
100	0.6000	0.5600	0.5450	0.5680
Intake	0.4910	0.6290	0.5850	0.5170

			Transform: Untransformed					1-Tailed		
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
D-Control	0.6248	1.0000	0.6248	0.5630	0.6870	8.124	4			
10.8	0.6240	0.9988	0.6240	0.5740	0.6840	7.314	4			
21.6	0.5975	0.9564	0.5975	0.5450	0.6420	6.673	4			
43.2	0.5993	0.9592	0.5993	0.5500	0.6380	7.003	4			
86.4	0.5945	0.9516	0.5945	0.5600	0.6170	4.153	4			
100	0.5683	0.9096	0.5683	0.5450	0.6000	4.085	4			
Intake	0.5555	0.8892	0.5555	0.4910	0.6290	11.345	4	1.712	1.943	0.0786

Auxiliary Tests	Statistic		Critical		Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.92927		0.749		0.13206	-1.4604
F-Test indicates equal variances (p = 0.73)	1.54165		47.4683			
Hypothesis Test (1-tail, 0.05)	**MSDu**	**MSDp**	**MSB**	**MSE**	**F-Prob**	**df**
Homoscedastic t Test indicates no significant differences Treatments vs D-Control	0.07862	0.12584	0.00959	0.00327	0.13782	1, 6

Dose-Response Plot



Independent Review by Kelley E. Keenan Initials

File: sqn101_051413data.xlsx
Entered by: J. Sumner
Reviewed by:

Species: ***Pimephales promelas*** **Date:** 05.14.13

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

Daily Chemistry:

		Day (Analyst identified for each day, performed pH, D.O. and conductivity measurements only.)					
		0		1		2	
	Analyst	JSB	JJ/MF	JJ/MF	JSB	JSB	JSB
Concentration	Parameter						
CONTROL Non-treated	pH (S.U.)	7.93	7.78	7.93	7.72	7.97	7.75
	DO (mg/L)	7.7	7.8	7.8	7.5	7.7	7.3
	Conductivity (µmhos/cm)	313		309		307	
	*Alkalinity (mg $CaCO_3$/L)	61		[illegible]		62	
	*Hardness (mg $CaCO_3$/L)	84				88	
	*Temperature (°C)	24.8	24.6	24.8	24.7	24.8	24.5
10.8%	pH (S.U.)	7.96	7.77	7.93	7.66	7.95	7.75
	DO (mg/L)	7.9	7.9	7.8	7.5	7.8	7.3
	Conductivity (µmhos/cm)	290		285		287	
	*Temperature (°C)	24.8	24.5	24.8	24.4	24.8	24.8
21.6%	pH (S.U.)	7.97	7.71	7.93	7.66	7.95	7.67
	DO (mg/L)	7.9	7.9	7.8	7.4	7.8	7.3
	Conductivity (µmhos/cm)	272		270		268	
	*Temperature (°C)	24.8	24.5	24.8	24.7	24.8	24.7
43.2%	pH (S.U.)	7.96	7.70	7.92	7.66	7.90	7.67
	DO (mg/L)	7.9	7.9	7.8	7.4	7.8	7.3
	Conductivity (µmhos/cm)	234		236		231	
	*Temperature (°C)	24.8	24.7	24.8	24.6	24.8	24.7
86.4%	pH (S.U.)	7.88	7.64	7.86	7.63	7.83	7.67
	DO (mg/L)	7.9	7.9	7.9	7.4	7.8	7.2
	Conductivity (µmhos/cm)	157		157		155	
	*Temperature (°C)	24.9	24.7	24.9	24.6	24.9	24.6
100%	pH (S.U.)	7.85	7.65	7.84	7.63	7.79	7.61
	DO (mg/L)	8.0	8.0	7.9	7.3	8.0	7.2
	Conductivity (µmhos/cm)	128		126		128	
	*Alkalinity (mg $CaCO_3$/L)	51				52	
	*Hardness (mg $CaCO_3$/L)	52				56	
	*TR chlorine (mg/L)	<0.10				<0.10	
	*Temperature (°C)	25.0	24.6	25.0	24.6	25.0	24.6
100% Intake	pH (S.U.)	7.85	7.71	7.84	7.64	7.80	7.60
	DO (mg/L)	8.0	8.0	8.0	7.3	8.0	7.0
	Conductivity (µmhos/cm)	126		123		129	
	*Alkalinity (mg $CaCO_3$/L)	51				53	
	*Hardness (mg $CaCO_3$/L)	54				56	
	*TR chlorine (mg/L)	<0.10				<0.10	
	*Temperature (°C)	24.9	24.6	24.8	24.6	25.0	24.5
		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

Independent Review by Kelley E. Keenan Initials: KK

Species: *Pimephales promelas*

Client: TVA / Sequoyah Nuclear Plant, Outfall 101, Non-treated Date: 05.14.13

Concentration	Parameter	Day 3 Analyst	Day 3 Analyst	Day 4 Analyst	Day 4 Analyst	Day 5 Analyst	Day 5 Analyst	Day 6 Analyst	Day 6 Analyst
		JTB	JTB	JTB	JTB	JTB	JTB	JTB	JTB
CONTROL Non-treated	pH (S.U.)	7.97	7.64	7.89	7.69	8.00	7.79	7.93	7.81
	DO (mg/L)	7.7	7.2	7.6	7.3	7.7	7.6	7.7	7.5
	Conductivity (µmhos/cm)	310		308		311		314	
	*Alkalinity (mg $CaCO_3$/L)			61		61			
	*Hardness (mg $CaCO_3$/L)			88		88			
	*Temperature (°C)	24.8	24.6	24.8	24.4	24.7	24.7	24.7	24.3
10.8%	pH (S.U.)	7.97	7.67	7.90	7.68	7.97	7.75	7.94	7.75
	DO (mg/L)	7.7	7.2	7.7	7.3	7.7	7.6	7.7	7.5
	Conductivity (µmhos/cm)	283		286		284		285	
	*Temperature (°C)	24.8	24.6	24.8	24.4	24.8	24.4	24.7	24.3
21.6%	pH (S.U.)	7.98	7.66	7.90	7.63	7.96	7.76	7.94	7.77
	DO (mg/L)	7.8	7.2	7.7	7.3	7.7	7.6	7.7	7.5
	Conductivity (µmhos/cm)	267		269		270		271	
	*Temperature (°C)	24.8	24.4	24.8	24.5	24.8	24.4	24.7	24.2
43.2%	pH (S.U.)	7.98	7.60	7.90	7.59	7.90	7.76	7.94	7.76
	DO (mg/L)	7.8	7.3	7.8	7.3	7.7	7.6	7.7	7.6
	Conductivity (µmhos/cm)	232		235		237		235	
	*Temperature (°C)	24.8	24.4	24.9	24.3	24.8	24.6	24.7	24.2
86.4%	pH (S.U.)	7.97	7.60	7.83	7.61	7.83	7.73	7.91	7.71
	DO (mg/L)	7.8	7.3	7.8	7.3	7.8	7.6	7.8	7.6
	Conductivity (µmhos/cm)	154		163		166		168	
	*Temperature (°C)	24.8	24.4	24.9	24.4	24.8	24.6	24.8	24.2
100%	pH (S.U.)	7.88	7.59	7.81	7.60	7.79	7.72	7.89	7.66
	DO (mg/L)	7.8	7.4	7.8	7.2	7.9	7.7	7.9	7.6
	Conductivity (µmhos/cm)	128		133		136		137	
	*Alkalinity (mg $CaCO_3$/L)			55					
	*Hardness (mg $CaCO_3$/L)			58					
	*TR chlorine (mg/L)			<0.10					
	*Temperature (°C)	24.9	24.7	25.0	24.4	24.9	24.6	24.8	24.5
100% Intake	pH (S.U.)	7.87	7.63	7.84	7.59	7.81	7.74	7.89	7.73
	DO (mg/L)	7.8	7.4	8.0	7.2	8.0	7.6	7.9	7.6
	Conductivity (µmhos/cm)	127		136		136		138	
	*Alkalinity (mg $CaCO_3$/L)			56					
	*Hardness (mg $CaCO_3$/L)			58					
	*TR chlorine (mg/L)			<0.10					
	*Temperature (°C)	24.8	24.4	24.9	24.4	24.8	24.5	24.8	24.1
		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

Initial Review by Kelley Keenan Initials: KK

TVA / Sequoyah Nuclear Plant, Outfall 101 - Non-treated
May 14-21, 2013

ETS Environmental Testing Solutions, Inc.

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

Daily Chemical Analyses

Project number: 8968

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)	7.93	7.78	7.93	7.72	7.97	7.75	7.97	7.64	7.89	7.69	8.00	7.79	7.93	7.81
	DO (mg/L)	7.7	7.8	7.8	7.5	7.7	7.3	7.7	7.2	7.6	7.3	7.7	7.6	7.7	7.5
	Conductivity (µmhos/cm)	313		309		307		310		308		311		314	
	Alkalinity (mg/L $CaCO_3$)	61				62				61		61			
	Hardness (mg/L $CaCO_3$)	84				88				88		88			
	Temperature (°C)	24.8	24.6	24.8	24.7	24.8	24.5	24.8	24.6	24.8	24.4	24.7	24.7	24.7	24.3
10.8%	pH (SU)	7.96	7.72	7.93	7.66	7.95	7.75	7.97	7.67	7.90	7.68	7.97	7.75	7.94	7.75
	DO (mg/L)	7.9	7.9	7.8	7.5	7.8	7.3	7.7	7.2	7.7	7.3	7.7	7.6	7.7	7.5
	Conductivity (µmhos/cm)	290		285		287		283		286		284		285	
	Temperature (°C)	24.8	24.5	24.8	24.4	24.8	24.8	24.8	24.6	24.8	24.4	24.8	24.4	24.7	24.3
21.6%	pH (SU)	7.97	7.71	7.93	7.66	7.95	7.67	7.98	7.66	7.90	7.63	7.96	7.76	7.94	7.77
	DO (mg/L)	7.9	7.9	7.8	7.4	7.8	7.3	7.8	7.2	7.7	7.3	7.7	7.6	7.7	7.5
	Conductivity (µmhos/cm)	272		270		268		267		269		270		271	
	Temperature (°C)	24.8	24.5	24.8	24.7	24.8	24.7	24.8	24.4	24.8	24.5	24.8	24.4	24.7	24.2
43.2%	pH (SU)	7.96	7.70	7.92	7.66	7.90	7.67	7.98	7.60	7.90	7.59	7.90	7.76	7.94	7.76
	DO (mg/L)	7.9	7.9	7.8	7.4	7.8	7.3	7.8	7.3	7.8	7.3	7.7	7.6	7.7	7.6
	Conductivity (µmhos/cm)	234		236		231		232		235		237		235	
	Temperature (°C)	24.8	24.7	24.8	24.6	24.8	24.7	24.8	24.4	24.9	24.3	24.8	24.6	24.7	24.2
86.4%	pH (SU)	7.88	7.64	7.86	7.63	7.83	7.67	7.97	7.60	7.83	7.61	7.83	7.73	7.91	7.71
	DO (mg/L)	7.9	7.9	7.9	7.4	7.8	7.2	7.8	7.3	7.8	7.3	7.8	7.6	7.8	7.6
	Conductivity (µmhos/cm)	157		157		155		154		163		166		168	
	Temperature (°C)	24.9	24.7	24.9	24.6	24.9	24.6	24.8	24.4	24.9	24.4	24.8	24.6	24.8	24.2
100%	pH (SU)	7.85	7.65	7.84	7.63	7.79	7.61	7.88	7.59	7.81	7.60	7.79	7.72	7.89	7.66
	DO (mg/L)	8.0	8.0	7.9	7.3	8.0	7.2	7.8	7.4	7.8	7.2	7.9	7.7	7.9	7.6
	Conductivity (µmhos/cm)	128		126		128		128		133		136		137	
	Alkalinity (mg/L $CaCO_3$)	51				52				55					
	Hardness (mg/L $CaCO_3$)	52				56				58					
	Total Residual Chlorine (mg/L)	<0.10				<0.10				<0.10					
	Temperature (°C)	25.0	24.6	25.0	24.6	25.0	24.6	24.9	24.7	25.0	24.4	24.9	24.6	24.8	24.5
100% Intake	pH (SU)	7.85	7.71	7.84	7.64	7.80	7.60	7.87	7.63	7.84	7.59	7.81	7.74	7.89	7.73
	DO (mg/L)	8.0	8.0	8.0	7.3	8.0	7.0	7.8	7.4	8.0	7.2	8.0	7.6	7.9	7.6
	Conductivity (µmhos/cm)	126		123		129		127		136		136		138	
	Alkalinity (mg/L $CaCO_3$)	51				53				56					
	Hardness (mg/L $CaCO_3$)	54				56				58					
	Total Residual Chlorine (mg/L)	<0.10				<0.10				<0.10					
	Temperature (°C)	24.9	24.6	24.8	24.6	25.0	24.5	24.8	24.4	24.9	24.4	24.8	24.5	24.8	24.1

File: sqn101_051413chem.xlsx
Entered by: J. Sumner
Reviewed by: _____

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 #: 8968

County: Hamilton
Outfall: 101

Dilution preparation information:						*Comments:*
Dilution prep (%)	10.8	21.6	43.2	86.4	100	
Effluent volume (mL)	270	540	1080	2160	2500	
Diluent volume (mL)	2230	1960	1420	340	0	
Total volume (mL)	2500	2500	2500	2500	2500	

Test organism source information:											*Test information:*	
Organism age:	< 24-hours old										Randomizing template color:	BLK
Date and times organisms were born between:	05-14-13 0525 TO 1085										Incubator number and shelf location:	2B1
Culture board:	05-07-13 A											
Replicate number:	1	2	3	4	5	6	7	8	9	10	YWT batch:	04-18-13
Culture board cup number:	1	2	3	4	6	7	9	11	12	14		
Transfer vessel information:	pH = 7.92 S.U. Temperature = 25.1 °C										*Selenastrum* batch:	04-29-13
Average transfer volume (mL):	0.0212 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	05-14-13	1045	05-11-13	130513.01	130513.02	JH
1	05-15-13	0945	05-11-13	130513.01	130513.02	JH
2	05-16-13	0947	05-13-13A	130515.08	130515.09	JH
3	05-17-13	0945	05-13-13A	130515.08	130515.09	JH
4	05-18-13	0945	05-15-13	130517.07	130517.08	JH
5	05-19-13	0948	05-17-13A	130517.07	130517.08	JH
6	05-20-13	0945	05-17-13A	130517.07	130517.08	JH
7	05-21-13	0947				JH

Control information:	Control-1	Control-2	Acceptance criteria	*Summary of test endpoints:*	
% of Male Adults:	0%	0%	≤ 20%	7-day LC_{50}	> 100%
% Adults having 3rd Broods:	100%	100%	≥ 80%	NOEC	100%
% Mortality:	0%	0%	≤ 20%	LOEC	> 100%
Mean Offspring/Female:	30.8	29.6	≥ 15.0 offspring/female	ChV	> 100%
% CV:	3.0%	6.6%	< 40.0 %	IC_{25}	> 100%

Independent Review by Kelley E. Keenan Initials: KK

Species: *Ceriodaphnia dubia*
Client: TVA / Sequoyah Nuclear Plant, Outfall 101 Date: 05.14.13

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	3	5	4	4	4	4	4
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	10	10	13	10	11	10	12	11	11	9
	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	14	18	16	15	15	17
Total young produced		31	30	32	31	30	32	32	30	30	30
Final Adult Mortality		L	L	L	L	L	L	L	L	L	L
X for 3rd 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:	0%
Mean Offspring/Female:	30.8

CONC: 10.8% ***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	4	4	4	5	4	5	5
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	10	12	12	10	12	13	10	11	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	18	14	14	19	17	16	17	15	17	17
Total young produced		33	30	31	33	33	33	32	30	33	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).

Concentration:	
% Mortality:	0%
Mean Offspring/Female:	32.1
% Reduction from Control-1:	-4.27%

Independent Review by Kelley E. Keenan Initials: KK

Species: *Ceriodaphnia dubia*
Client: TVA / Sequoyah Nuclear Plant, Outfall 101 **Date:** 05.14.13
CONC: 21.6% ***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	4	4	4	5	4	5	4	6	6	4
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	12	12	10	12	12	12	11	13	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	15	18	17	19	16	17	15	15	17
Total young produced		34	31	32	34	35	33	32	34	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).

Concentration:	
% Mortality:	0%
Mean Offspring/Female:	33.2
% Reduction from Control-1:	-7.8%

CONC: 43.2% ***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	4	5	6	5	5	4	5	5	5	5
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	13	13	12	10	13	11	13	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	19	16	18	18	15	19	17	17	16	16
Total young produced		36	34	36	33	33	34	35	34	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).

Concentration:	
% Mortality:	0%
Mean Offspring/Female:	34.2
% Reduction from Control-1:	-11.0%

Independent Review by Kelley E. Keenan Initials: KK

Species: *Ceriodaphnia dubia*
Client: TVA / Sequoyah Nuclear Plant, Outfall 101 **Date:** 05.14.13

CONC: **86.4%** ***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	5	4	5	5	5	5	6	4	4	5
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	13	12	14	11	14	12	13	12	13	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	19	15	15	18	19	19	17	18	15	18
Total young produced		37	31	34	34	38	36	36	34	32	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).

Concentration:	
% Mortality:	0%
Mean Offspring/Female:	34.8
% Reduction from Control-1:	-13.0%

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	5	5	5	4	6	4	5	6	6	4
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	12	13	13	13	14	12	12	14	12	14
	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	20	19	17	16	19	19	18	18	19
Total young produced		35	36	37	34	36	35	36	38	36	37
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:	0%
Mean Offspring/Female:	36.2
% Reduction from Control-1:	-17.5%

Independent Review by Kelley E. Keenan Initials: KK

Species: *Ceriodaphnia dubia*
Client: TVA / Sequoyah Nuclear Plant, Outfall 101 Date: 05.14.13

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	4	4	5	5	5	4	5	4	4	3
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	12	10	10	10	10	9	10	13	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	15	15	13	16	14	14	14	17	15	16
Total young produced		31	29	28	31	29	27	29	34	29	29
Final Adult Mortality		L	L	L	L	L	L	L	L	L	L
X for 3rd 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:	0%
Mean Offspring/Female:	29.6

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	6	4	6	5	5	5	4	5	5	5
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	12	13	14	12	12	14	12	12	13	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	16	18	19	19	20	17	21	16	18	17
Total young produced		34	35	39	36	37	36	37	35	36	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).

Concentration:	
% Mortality:	0%
Mean Offspring/Female:	35.9
% Reduction from Control-2:	-21.3%

Independent Review by Kelley F. Keenan Initials: KK

TVA / Sequoyah Nuclear Plant, Outfall 101 - Non-treated
May 14-21, 2013

ETS Environmental Testing Solutions, Inc.

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	3	5	4	4	4	4	4	42
5	10	10	13	10	11	10	12	11	11	9	107
6	0	0	0	0	0	0	0	0	0	0	0
7	16	15	15	18	14	18	16	15	15	17	159
Total	31	30	32	31	30	32	32	30	30	30	308

86.4%

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	5	4	5	5	5	5	6	4	4	5	48
5	13	12	14	11	14	12	13	12	13	13	127
6	0	0	0	0	0	0	0	0	0	0	0
7	19	15	15	18	19	19	17	18	15	18	173
Total	37	31	34	34	38	36	36	34	32	36	348

10.8%

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	4	4	4	5	4	5	5	45
5	10	12	12	10	12	13	10	11	11	11	112
6	0	0	0	0	0	0	0	0	0	0	0
7	18	14	14	19	17	16	17	15	17	17	164
Total	33	30	31	33	33	33	32	30	33	33	321

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	5	5	5	4	6	4	5	6	6	4	50
5	12	13	13	13	14	12	12	14	12	14	129
6	0	0	0	0	0	0	0	0	0	0	0
7	18	20	19	17	16	19	19	18	18	19	183
Total	35	38	37	34	36	35	36	38	36	37	362

21.6%

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	4	4	4	5	4	5	4	6	6	4	46
5	12	12	10	12	12	12	11	13	12	13	119
6	0	0	0	0	0	0	0	0	0	0	0
7	18	15	18	17	19	16	17	15	15	17	167
Total	34	31	32	34	35	33	32	34	33	34	332

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	4	4	5	5	5	4	5	4	4	3	43
5	12	10	10	10	10	9	10	13	10	10	104
6	0	0	0	0	0	0	0	0	0	0	0
7	15	15	13	16	14	14	14	17	15	16	149
Total	31	29	28	31	29	27	29	34	29	29	296

43.2%

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	4	5	6	5	5	4	5	5	5	5	49
5	13	13	12	10	13	11	13	12	12	13	122
6	0	0	0	0	0	0	0	0	0	0	0
7	19	16	18	18	15	19	17	17	16	16	171
Total	36	34	36	33	33	34	35	34	33	34	342

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	6	4	6	5	5	5	4	5	5	5	50
5	12	13	14	12	12	14	12	12	13	12	126
6	0	0	0	0	0	0	0	0	0	0	0
7	16	18	19	19	20	17	21	18	18	17	183
Total	34	35	39	36	37	36	37	35	36	34	359

File: sqn101_051413data.xlsx
Entered by: J. Sumner
Reviewed by:

TVA / Sequoyah Nuclear Plant, Outfall 101
Non-treated
May 14-21, 2013

Environmental Testing Solutions, Inc.

***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: 8968

Concentration (%)	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 - 1	31	30	32	31	30	32	32	30	30	30	100	30.8	3.0	Not applicable
10.8%	33	30	31	33	33	33	32	30	33	33	100	32.1	4.0	-4.2
21.6%	34	31	32	34	35	33	32	34	33	34	100	33.2	3.7	-7.8
43.2%	36	34	36	33	33	34	35	34	33	34	100	34.2	3.3	-11.0
86.4%	37	31	34	34	38	36	36	34	32	36	100	34.8	6.3	-13.0
100%	35	38	37	34	36	35	36	38	36	37	100	36.2	3.6	-17.5
Control - 2	31	29	28	31	29	27	29	34	29	29	100	29.6	6.6	Not applicable
100% Intake	34	35	39	36	37	36	37	35	36	34	100	35.9	4.2	-21.3

Outfall 101:
Dunnett's MSD value: 1.439
PMSD: 4.7

Intake:
Dunnett's MSD value: 1.359
PMSD: 4.6

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.

Lower PMSD bound determined by USEPA (10th percentile) = 13%.
Upper PMSD bound determined by USEPA (90th 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. 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.

File: sqn101_051413data.xlsx
Table populated from associated "Verification of Ceriodaphnia Reproduction Totals" spreadsheet.
Spreadsheet entered by: J. Sumner
Reviewed by:

TVA / Sequoyah Nuclear Plant, Outfall 101
Non-treated
May 14-21, 2013

ETS Environmental Testing Solutions, Inc.

Statistical Analyses

Ceriodaphnia Survival and Reproduction Test-Reproduction

Start Date:	5/14/2013	Test ID:	CdFRCR	Sample ID:	TVA / SQN 101
End Date:	5/21/2013	Lab ID:	ETS-Envir. Testing Sol.	Sample Type:	DMR-Discharge Monitoring Report
Sample Date:	May 2013	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	30.000	32.000	31.000	30.000	32.000	32.000	30.000	30.000	30.000
Control-2	31.000	29.000	28.000	31.000	29.000	27.000	29.000	34.000	29.000	29.000
10.8	33.000	30.000	31.000	33.000	33.000	33.000	32.000	30.000	33.000	33.000
21.6	34.000	31.000	32.000	34.000	35.000	33.000	32.000	34.000	33.000	34.000
43.2	36.000	34.000	36.000	33.000	33.000	34.000	35.000	34.000	33.000	34.000
86.4	37.000	31.000	34.000	34.000	38.000	36.000	36.000	34.000	32.000	36.000
100	35.000	38.000	37.000	34.000	36.000	35.000	36.000	38.000	36.000	37.000
Intake	34.000	35.000	39.000	36.000	37.000	36.000	37.000	35.000	36.000	34.000

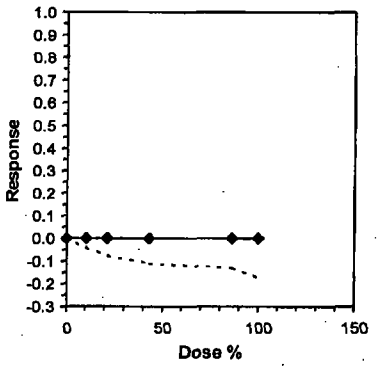
			Transform: Untransformed					Rank	1-Tailed	Isotonic	
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Sum	Critical	Mean	N-Mean
Control-1	30.800	1.0405	30.800	30.000	32.000	2.984	10	*		33.550	1.0000
Control-2	29.600	1.0000	29.600	27.000	34.000	6.605	10				
10.8	32.100	1.0845	32.100	30.000	33.000	4.008	10	134.50	75.00	33.550	1.0000
21.6	33.200	1.1216	33.200	31.000	35.000	3.703	10	148.00	75.00	33.550	1.0000
43.2	34.200	1.1554	34.200	33.000	36.000	3.320	10	155.00	75.00	33.550	1.0000
86.4	34.800	1.1757	34.800	31.000	38.000	6.325	10	149.50	75.00	33.550	1.0000
100	36.200	1.2230	36.200	34.000	38.000	3.637	10	155.00	75.00	33.550	1.0000
Intake	35.900	1.2128	35.900	34.000	39.000	4.245	10				

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Kolmogorov D Test indicates non-normal distribution (p <= 0.01)	1.23325	1.035	-0.3114	0.12786
Bartlett's Test indicates equal variances (p = 0.14)	8.35023	15.0863		
The control means are not significantly different (p = 0.10)	1.75662	2.10092		

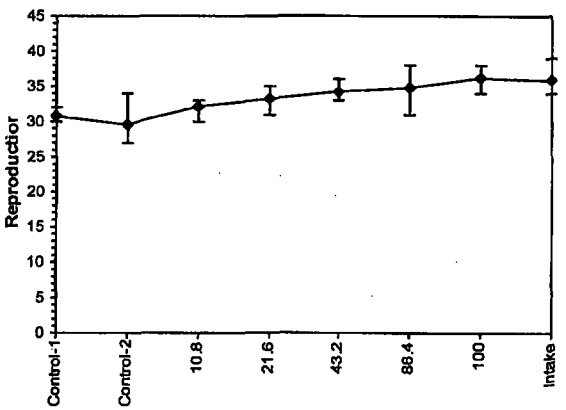
Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Steel's Many-One Rank Test	100	>100		1
Treatments vs Control-1				

Linear Interpolation (200 Resamples)

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



Dose-Response Plot



Independent Review by Kelley E. Keenan Initials:

File: sqn101_051413data.xlsx
Entered by: J. Sumner
Reviewed by:

ETS Environmental Testing Solutions, Inc.

Statistical Analyses

Statistics used for PMSD calculation only.

Ceriodaphnia Survival and Reproduction Test-Reproduction

Start Date:	5/14/2013	Test ID:	CdFRCR	Sample ID:	TVA / SQN 101
End Date:	5/21/2013	Lab ID:	ETS-Envir. Testing Sol.	Sample Type:	DMR-Discharge Monitoring Report
Sample Date:	May 2013	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	30.000	32.000	31.000	30.000	32.000	32.000	30.000	30.000	30.000
Control-2	31.000	29.000	28.000	31.000	29.000	27.000	29.000	34.000	29.000	29.000
10.8	33.000	30.000	31.000	33.000	33.000	33.000	32.000	30.000	33.000	33.000
21.6	34.000	31.000	32.000	34.000	35.000	33.000	32.000	34.000	33.000	34.000
43.2	36.000	34.000	36.000	33.000	33.000	34.000	35.000	34.000	33.000	34.000
86.4	37.000	31.000	34.000	34.000	38.000	36.000	36.000	34.000	32.000	36.000
100	35.000	38.000	37.000	34.000	36.000	35.000	36.000	38.000	36.000	37.000
Intake	34.000	35.000	39.000	36.000	37.000	36.000	37.000	35.000	36.000	34.000

			Transform: Untransformed						1-Tailed	
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
Control-1	30.800	1.0405	30.800	30.000	32.000	2.984	10	*		
Control-2	29.600	1.0000	29.600	27.000	34.000	6.605	10			
10.8	32.100	1.0845	32.100	30.000	33.000	4.008	10	-2.066	2.287	1.439
21.6	33.200	1.1216	33.200	31.000	35.000	3.703	10	-3.814	2.287	1.439
43.2	34.200	1.1554	34.200	33.000	36.000	3.320	10	-5.403	2.287	1.439
86.4	34.800	1.1757	34.800	31.000	38.000	6.325	10	-6.357	2.287	1.439
100	36.200	1.2230	36.200	34.000	38.000	3.637	10	-8.582	2.287	1.439
Intake	35.900	1.2128	35.900	34.000	39.000	4.245	10			

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Kolmogorov D Test indicates non-normal distribution (p <= 0.01)	1.23325	1.035	-0.3114	0.12786
Bartlett's Test indicates equal variances (p = 0.14)	8.35023	15.0863		
The control means are not significantly different (p = 0.10)	1.75662	2.10092		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test Treatments vs Control-1	100	>100		1	1.43883	0.04672	37.59	1.97963	7.5E-11	5, 54

Independent Review by Kelley E. Keenan Initials:

File: sqn101_051413data.xlsx
Entered by: J. Sumner
Reviewed by:

TVA / Sequoyah Nuclear Plant, Outfall 101 - Intake
Non-treated
May 14-21, 2013

ETS Environmental Testing Solutions, Inc.

Statistical Analyses

Ceriodaphnia Survival and Reproduction Test-Reproduction

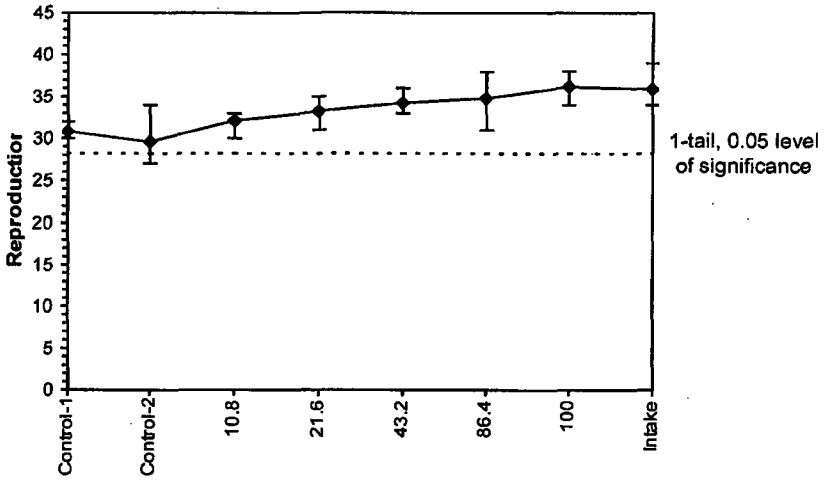
Start Date:	5/14/2013	Test ID:	CdFRCR	Sample ID:	TVA / SQN 101 - Intake
End Date:	5/21/2013	Lab ID:	ETS-Envir. Testing Sol.	Sample Type:	DMR-Discharge Monitoring Report
Sample Date:	May 2013	Protocol:	FWCHR-EPA-821-R-02-013	Test Species:	CD-Ceriodaphnia dubia
Comments:					

Conc-%	1	2	3	4	5	6	7	8	9	10
Control-1	31.000	30.000	32.000	31.000	30.000	32.000	32.000	30.000	30.000	30.000
Control-2	31.000	29.000	28.000	31.000	29.000	27.000	29.000	34.000	29.000	29.000
10.8	33.000	30.000	31.000	33.000	33.000	33.000	32.000	30.000	33.000	33.000
21.6	34.000	31.000	32.000	34.000	35.000	33.000	32.000	34.000	33.000	34.000
43.2	36.000	34.000	36.000	33.000	33.000	34.000	35.000	34.000	33.000	34.000
86.4	37.000	31.000	34.000	34.000	38.000	36.000	36.000	34.000	32.000	36.000
100	35.000	38.000	37.000	34.000	36.000	35.000	36.000	38.000	36.000	37.000
Intake	34.000	35.000	39.000	36.000	37.000	36.000	37.000	35.000	36.000	34.000

			Transform: Untransformed						1-Tailed	
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
Control-1	30.800	1.0405	30.800	30.000	32.000	2.984	10			
Control-2	29.600	1.0000	29.600	27.000	34.000	6.605	10	*		
10.8	32.100	1.0845	32.100	30.000	33.000	4.008	10			
21.6	33.200	1.1216	33.200	31.000	35.000	3.703	10			
43.2	34.200	1.1554	34.200	33.000	36.000	3.320	10			
86.4	34.800	1.1757	34.800	31.000	38.000	6.325	10			
100	36.200	1.2230	36.200	34.000	38.000	3.637	10			
Intake	35.900	1.2128	35.900	34.000	39.000	4.245	10	-8.037	1.734	1.359

Auxiliary Tests	Statistic		Critical		Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.92329		0.868		1.00343	1.21965
F-Test indicates equal variances (p = 0.47)	1.64593		6.54109			
The control means are not significantly different (p = 0.10)	1.75662		2.10092			
Hypothesis Test (1-tail, 0.05)	**MSDu**	**MSDp**	**MSB**	**MSE**	**F-Prob**	**df**
Homoscedastic t Test indicates no significant differences	1.35927	0.04592	198.45	3.07222	2.3E-07	1, 18
Treatments vs Control-2						

Dose-Response Plot



Independent Review by Kelley E. Keenan Initials:

File: sqn101_051413data.xlsx
Entered by: J. Sumner
Reviewed by:

Species: *Ceriodaphnia dubia* **Date:** 05-14-13

Client: TVA / Sequoyah Nuclear Plant, Outfall 101

Daily Chemistry:

		Day (Analyst identified for each day, performed pH, D.O. and conductivity measurements only.)					
		0		1		2	
	Analyst	JWB	JWB/mf	JWB/mf	JWB	JWB	JWB
Concentration	**Parameter**						
CONTROL	pH (S.U.)	7.93	7.89	7.93	7.94	7.97	7.95
	DO (mg/L)	7.7	7.9	7.8	8.0	7.7	7.8
	Conductivity (µmhos/cm)	313		309		307	
	*Alkalinity (mg $CaCO_3$/L)	61				62	
	*Hardness (mg $CaCO_3$/L)	84				88	
	*Temperature (°C)	24.9	25.1	24.8	25.2	24.8	25.1
10.8%	pH (S.U.)	7.96	7.89	7.93	7.95	7.95	7.96
	DO (mg/L)	7.9	7.9	7.8	8.0	7.8	7.8
	Conductivity (µmhos/cm)	290		285		287	
	*Temperature (°C)	25.0	24.9	24.9	25.0	24.8	24.8
21.6%	pH (S.U.)	7.97	7.88	7.93	7.94	7.95	7.96
	DO (mg/L)	7.9	7.9	7.8	8.0	7.8	7.8
	Conductivity (µmhos/cm)	272		270		268	
	*Temperature (°C)	25.0	24.9	24.9	25.0	24.8	24.8
43.2%	pH (S.U.)	7.96	7.88	7.92	7.94	7.90	7.97
	DO (mg/L)	7.9	8.0	7.8	8.0	7.8	7.9
	Conductivity (µmhos/cm)	234		236		231	
	*Temperature (°C)	25.0	24.9	25.0	24.9	24.9	24.8
86.4%	pH (S.U.)	7.88	7.83	7.86	7.90	7.83	7.97
	DO (mg/L)	7.9	8.0	7.9	8.0	7.8	7.9
	Conductivity (µmhos/cm)	157		157		155	
	*Temperature (°C)	25.1	25.0	25.0	24.9	24.9	24.8
100%	pH (S.U.)	7.85	7.83	7.84	7.88	7.79	7.93
	DO (mg/L)	8.0	8.0	7.9	8.0	8.0	7.9
	Conductivity (µmhos/cm)	128		126		128	
	*Alkalinity (mg $CaCO_3$/L)	51				52	
	*Hardness (mg $CaCO_3$/L)	52				56	
	*TR chlorine (mg/L)	<0.10				<0.10	
	*Temperature (°C)	25.3	24.8	25.0	24.9	25.2	24.9
100% Intake	pH (S.U.)	7.85	7.84	7.84	7.81	7.80	7.93
	DO (mg/L)	8.0	8.0	8.0	8.1	8.0	7.9
	Conductivity (µmhos/cm)	126		123		129	
	*Alkalinity (mg $CaCO_3$/L)	51				53	
	*Hardness (mg $CaCO_3$/L)	54				56	
	*TR chlorine (mg/L)	<0.10				<0.10	
	*Temperature (°C)	25.2	24.9	24.9	25.0	24.9	24.9
		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: JH.

Independent Review by Kelley E. Keenan Initials: KK

Species: *Ceriodaphnia dubia*

Client: TVA / Sequoyah Nuclear Plant, Outfall 101 **Date:** 05.14.13

		Day (Analyst identified for each day, performed pH, D.O. and conductivity measurements only.)							
		3		4		5		6	
	Analyst	JWB	JWB	JWB	JWB	JWB	JWB	JWB	JWB
Concentration	Parameter								
CONTROL	pH (S.U.)	7.97	7.93	7.89	7.96	8.00	7.95	7.93	7.87
	DO (mg/L)	7.7	7.8	7.6	7.8	7.7	7.8	7.7	7.8
	Conductivity (µmhos/cm)	310		308		311		314	
	*Alkalinity (mg $CaCO_3$/L)			61		61			
	*Hardness (mg $CaCO_3$/L)			88		88			
	*Temperature (°C)	24.9	24.8	24.8	25.0	24.7	24.9	24.7	25.1
10.8%	pH (S.U.)	7.97	7.94	7.90	7.98	7.97	7.96	7.94	7.88
	DO (mg/L)	7.7	7.8	7.7	7.8	7.7	7.8	7.7	7.8
	Conductivity (µmhos/cm)	283		286		284		285	
	*Temperature (°C)	25.0	25.0	24.8	24.9	24.7	25.1	24.7	25.3
21.6%	pH (S.U.)	7.98	7.94	7.90	7.99	7.96	7.96	7.94	7.89
	DO (mg/L)	7.8	7.9	7.7	7.8	7.7	7.8	7.7	7.8
	Conductivity (µmhos/cm)	267		269		270		271	
	*Temperature (°C)	25.0	25.0	24.8	24.9	24.7	25.1	24.7	25.0
43.2%	pH (S.U.)	7.98	7.94	7.90	8.00	7.90	7.97	7.94	7.90
	DO (mg/L)	7.8	7.9	7.8	7.9	7.7	7.8	7.7	7.8
	Conductivity (µmhos/cm)	232		235		237		235	
	*Temperature (°C)	25.0	25.0	24.8	24.9	24.7	24.9	24.8	25.0
86.4%	pH (S.U.)	7.97	7.94	7.83	7.97	7.83	7.97	7.91	7.87
	DO (mg/L)	7.8	7.9	7.8	7.9	7.8	7.8	7.8	7.8
	Conductivity (µmhos/cm)	154		163		166		168	
	*Temperature (°C)	25.0	25.1	24.8	25.1	24.8	24.9	24.8	24.9
100%	pH (S.U.)	7.88	7.90	7.81	7.98	7.79	7.94	7.89	7.87
	DO (mg/L)	7.8	8.0	7.8	7.9	7.9	7.9	7.9	7.8
	Conductivity (µmhos/cm)	128		133		136		137	
	*Alkalinity (mg $CaCO_3$/L)			55					
	*Hardness (mg $CaCO_3$/L)			58					
	*TR chlorine (mg/L)			<0.10					
	*Temperature (°C)	25.0	24.8	25.0	25.1	24.8	24.9	24.8	24.9
100% Intake	pH (S.U.)	7.87	7.91	7.84	7.97	7.81	7.93	7.89	7.86
	DO (mg/L)	7.8	8.0	8.0	8.0	8.0	7.9	7.9	7.9
	Conductivity (µmhos/cm)	127		136		136		138	
	*Alkalinity (mg $CaCO_3$/L)			56					
	*Hardness (mg $CaCO_3$/L)			58					
	*TR chlorine (mg/L)			<0.10					
	*Temperature (°C)	25.1	24.8	24.9	24.8	24.9	25.0	25.0	24.9
		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: ____.

Independent Review by Kelley E. Keenan Initials: KK

TVA / Sequoyah Nuclear Plant, Outfall 101 - Non-treated
May 14-21, 2013

Environmental Testing Solutions, Inc.

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

Daily Chemical Analyses

Project number: 8968

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)	7.93	7.89	7.93	7.94	7.97	7.95	7.97	7.93	7.89	7.96	8.00	7.95	7.93	7.87
	DO (mg/L)	7.7	7.9	7.8	8.0	7.7	7.8	7.7	7.8	7.6	7.8	7.7	7.8	7.7	7.8
	Conductivity (µmhos/cm)	313		309		307		310		308		311		314	
	Alkalinity (mg/L $CaCO_3$)	61				62				61		61			
	Hardness (mg/L $CaCO_3$)	84				88				88		88			
	Temperature (°C)	24.9	25.1	24.8	25.2	24.8	25.1	24.9	24.8	24.8	25.0	24.7	24.9	24.7	25.1
10.8%	pH (SU)	7.96	7.89	7.93	7.95	7.95	7.96	7.97	7.94	7.90	7.98	7.97	7.96	7.94	7.88
	DO (mg/L)	7.9	7.9	7.8	8.0	7.8	7.8	7.7	7.8	7.7	7.8	7.7	7.8	7.7	7.8
	Conductivity (µmhos/cm)	290		285		287		283		286		284		285	
	Temperature (°C)	25.0	24.9	24.9	25.0	24.8	24.8	25.0	25.0	24.8	24.9	24.7	25.1	24.7	25.3
21.6%	pH (SU)	7.97	7.88	7.93	7.94	7.95	7.96	7.98	7.94	7.90	7.99	7.96	7.96	7.94	7.89
	DO (mg/L)	7.9	7.9	7.8	8.0	7.8	7.8	7.8	7.9	7.7	7.8	7.7	7.8	7.7	7.8
	Conductivity (µmhos/cm)	272		270		268		267		269		270		271	
	Temperature (°C)	25.0	24.9	24.9	25.0	24.8	24.8	25.0	25.0	24.8	24.9	24.7	25.1	24.7	25.0
43.2%	pH (SU)	7.96	7.88	7.92	7.94	7.90	7.97	7.98	7.94	7.90	8.00	7.90	7.97	7.94	7.90
	DO (mg/L)	7.9	8.0	7.8	8.0	7.8	7.9	7.8	7.9	7.8	7.9	7.7	7.8	7.7	7.8
	Conductivity (µmhos/cm)	234		236		231		232		235		237		235	
	Temperature (°C)	25.0	24.9	25.0	24.7	24.9	24.8	25.0	25.0	24.8	24.9	24.7	24.9	24.8	25.0
86.4%	pH (SU)	7.88	7.83	7.86	7.90	7.83	7.97	7.97	7.94	7.83	7.97	7.83	7.97	7.91	7.87
	DO (mg/L)	7.9	8.0	7.9	8.0	7.8	7.9	7.8	7.9	7.8	7.9	7.8	7.8	7.8	7.8
	Conductivity (µmhos/cm)	157		157		155		154		163		166		168	
	Temperature (°C)	25.1	25.0	25.0	24.9	24.9	24.8	25.0	25.1	24.8	25.1	24.8	24.9	24.8	24.9
100%	pH (SU)	7.85	7.83	7.84	7.88	7.79	7.93	7.88	7.90	7.81	7.98	7.79	7.94	7.89	7.87
	DO (mg/L)	8.0	8.0	7.9	8.0	8.0	7.9	7.8	8.0	7.8	7.9	7.9	7.9	7.9	7.8
	Conductivity (µmhos/cm)	128		126		128		128		133		136		137	
	Alkalinity (mg/L $CaCO_3$)	51				52				55					
	Hardness (mg/L $CaCO_3$)	52				56				58					
	Total Residual Chlorine (mg/L)	<0.10				<0.10				<0.10					
	Temperature (°C)	25.3	24.8	25.0	24.9	25.2	24.9	25.0	24.8	25.0	25.1	24.8	24.9	24.8	24.9
100% Intake	pH (SU)	7.85	7.84	7.84	7.81	7.80	7.93	7.87	7.91	7.84	7.97	7.81	7.93	7.89	7.86
	DO (mg/L)	8.0	8.0	8.0	8.1	8.0	7.9	7.8	8.0	8.0	8.0	8.0	7.9	7.9	7.9
	Conductivity (µmhos/cm)	126		123		129		127		136		136		138	
	Alkalinity (mg/L $CaCO_3$)	51				53				56					
	Hardness (mg/L $CaCO_3$)	54				56				58					
	Total Residual Chlorine (mg/L)	<0.10				<0.10				<0.10					
	Temperature (°C)	25.2	24.9	24.9	25.0	24.9	24.9	25.1	24.8	24.9	24.8	24.9	25.0	25.0	24.9

File: sqn101_051413chem.xlsx
Entered by: J. Sumner
Reviewed by: _____

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 #: ~~TN0020168~~ TN 0026450
Project #: 8968

County: ~~Rhea~~ HAMILTON
Outfall: 101

Dilution preparation information:						*Comments:*
Dilution prep (%)	10.8	21.6	43.2	86.4	100	Each concentration was UV-treated
Effluent volume (mL)	270	540	1080	2160	2500	for 2 minutes to remove pathogenic
Diluent volume (mL)	2230	1960	1420	340	0	Interferences.
Total volume (mL)	2500	2500	2500	2500	2500	

Test organism information:		*Test information:*	
Organism age:	21.5 HOURS OLD	Randomizing template:	BLUE
Date and times organisms were born between:	05·13·13 1600	Incubator number and shelf location:	3B
Organism source:	ATOX BATCH Pp 05·13·13	*Artemia* CHM number:	CHM720
		Drying information for weight determination:	
Transfer bowl information:	pH = 7.75 S.U. Temperature = 24.7 °C	Date / Time in oven:	05·21·13 1440
		Initial oven temperature:	60°C
Average transfer volume:	1.1665 mL	Date / Time out of oven:	05·22·13 1440
		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	05·14·13			1545	JH	1330	JH	130513.01	130513.02	05·11·13
1	05·15·13	0800	JH	1415	JH	1232	JH	130513.01	130513.02	05·11·13
2	05·16·13	0830	JH	1430	JH	1230	JH	130515.08	130515.09	05·13·13A
3	05·17·13	0830	JH	1430	JH	1233	JH	130515.08	130515.09	05·13·13A
4	05·18·13	0830	JH	1430	JH	1230	JH	130517.07	130517.08	05·15·13
5	05·19·13	0815	JH	1415	JH	1230	JH	130517.07	130517.08	05·17·13A
6	05·20·13	0815	JH	1415	JH	1230	JH	130517.07	130517.08	05·17·13A
7	05·21·13					1230	JH			

Control information:		Acceptance criteria	*Summary of test endpoints:*	
% Mortality:	0%	≤ 20%	7-day LC_{50}	>100%
Average weight per initial larvae:	0.578		NOEC	100%
Average weight per surviving larvae:	0.578	≥ 0.25mg/larvae	LOEC	>100%
			ChV	>100%
			IC_{25}	>100%

Independent Review by Kelley E. Keenan

Species: ***Pimephales promelas***
Client: **TVA / Sequoyah Nuclear Plant, Outfall 101, UV-treated** **Date:** 05-14-13

Survival and Growth Data

Day	CONTROL				10.8%				21.6%			
	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:: forest green Analyst: JJB Date: 05-09-13	13.78	14.27	13.45	13.78	12.40	12.29	12.62	14.59	11.90	13.55	13.47	13.68
B = Pan + Larvae weight (mg) Analyst: JJB Date: 05-22-13	19.71	19.75	19.20	19.72	17.99	17.88	18.05	19.70	17.65	19.39	19.65	19.60
C = Larvae weight (mg) = B – A Hand calculated. Analyst:	5.93	5.48	5.75	5.94	5.59	5.59 5.43	5.43	5.11	5.75	5.84	6.18	5.92
Weight per initial number of larvae (mg) = C / Initial number of larvae Hand calculated. Analyst:	0.593	0.548	0.575	0.594	0.559	0.559	0.543	0.511	0.575	0.584	0.618	0.592
Average weight per initial number of larvae (mg)	0.578				0.543		6.07.		0.592		-2.67.	
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:

Independent Review by Kelley E. Keenan Initials: KK

Species: ***Pimephales promelas***
Client: TVA / Sequoyah Nuclear Plant, Outfall 101, UV-treated **Date:** 05.14.13

Survival and Growth Data

Day	43.2%				86.4%				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	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[16]	10	10	10	10	10
A = Pan weight (mg) Tray color code:: Forest green Analyst: JJB Date: 05.09.13	12.94	14.05	14.71	13.58	12.90	12.96	14.57	12.82	14.06	12.74	13.46	13.38
B = Pan + Larvae weight (mg) Analyst: JJB Date: 05.22.13	18.19	19.78	20.49	19.02 18 10 JJB 05-22-13	18.22	18.92	21.72	18.97	19.85	18.33	19.51	19.71
C = Larvae weight (mg) = B – A Hand calculated. Analyst:	5.25	5.73	5.78	5.44	5.32	5.96	7.15	6.15	5.79	5.59	6.05	6.33
Weight per initial number of larvae (mg) = C / Initial number of larvae Hand calculated. Analyst:	0.525	0.573	0.578	0.544	0.532	0.596	0.715	0.615	0.579	0.559	0.605	0.633
Average weight per initial number of larvae (mg)	0.555		3.97.		0.615		-6.47.		0.594		-2.97.	
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:

Independent Review by Kelley E. Keenan Initials:

Species: ***Pimephales promelas***
Client: TVA / Sequoyah Nuclear Plant, Outfall 101, UV-treated **Date:** 05-14-13

Survival and Growth Data

Day	100% Intake			
	Y	Z	AA	BB
0	10	10	10	10
1	10	10	10	10
2	10	10	10	10
3	10	10	10	10
4	10	10	10	10
5	10	10	10	10
6	10	10	10	10
7	10	10	10	10 (1sk)
A = Pan weight (mg) Tray color code:: forest green Analyst: JLB Date: 05.09.13	13.23	12.24	13.31	13.89
B = Pan + Larvae weight (mg) Analyst: JLB Date: 05.22.13	18.46	18.31	18.96	18.74
C = Larvae weight (mg) = B – A Hand calculated. Analyst: JLB	5.23	6.07	5.65	4.85
Weight per initial number of larvae (mg) = C / Initial number of larvae Hand calculated. Analyst: JLB	0.523	0.607	0.565	0.485
Average weight per initial number of larvae (mg)	0.545			
Percent reduction from control (%)	5.67			

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:

Independent Review by Kelley E. Keenan Initials: KK

Independent Review by Kelley E. Keenan 5/28/13

TVA / Sequoyah Nuclear Plant, Outfall 101
UV-treated
May 14-21, 2013

Environmental Testing Solutions, Inc.

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

Project number: 8968

Concentration (%)	Replicate	Initial number of larvae	Final number of larvae	A = Pan weight (mg)	B = Pan + Larvae weight (mg)	Larvae weight (mg) = A - B	Not for Compliance Assessment, Internal Laboratory QC: Weight / Surviving number of larvae (mg)	Not for Compliance Assessment, Internal Laboratory QC: Mean weight / Surviving number of larvae (mg)	Not for Compliance Assessment, Internal Laboratory QC: 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 (Mean weight per initial number of larvae) (%)	Percent reduction from control (%)
Control	A	10	10	13.78	19.71	5.93	0.593	0.578	3.7	0.593	100.0	0.578	3.7	Not applicable
	B	10	10	14.27	19.75	5.48	0.548			0.548				
	C	10	10	13.45	19.20	5.75	0.575			0.575				
	D	10	10	13.78	19.72	5.94	0.594			0.594				
10.8%	E	10	10	12.40	17.99	5.59	0.559	0.543	4.2	0.559	100.0	0.543	4.2	6.0
	F	10	10	12.29	17.88	5.59	0.559			0.559				
	G	10	10	12.62	18.05	5.43	0.543			0.543				
	H	10	10	14.59	19.70	5.11	0.511			0.511				
21.6%	I	10	10	11.90	17.65	5.75	0.575	0.592	3.1	0.575	100.0	0.592	3.1	-2.6
	J	10	10	13.55	19.39	5.84	0.584			0.584				
	K	10	10	13.47	19.65	6.18	0.618			0.618				
	L	10	10	13.68	19.60	5.92	0.592			0.592				
43.2%	M	10	10	12.94	18.19	5.25	0.525	0.555	4.5	0.525	100.0	0.555	4.5	3.9
	N	10	10	14.05	19.78	5.73	0.573			0.573				
	O	10	10	14.71	20.49	5.78	0.578			0.578				
	P	10	10	13.58	19.02	5.44	0.544			0.544				
86.4%	Q	10	10	12.90	18.22	5.32	0.532	0.615	12.3	0.532	100.0	0.615	12.3	-6.4
	R	10	10	12.96	18.92	5.96	0.596			0.596				
	S	10	10	14.57	21.72	7.15	0.715			0.715				
	T	10	10	12.82	18.97	6.15	0.615			0.615				
100%	U	10	10	14.06	19.85	5.79	0.579	0.594	5.4	0.579	100.0	0.594	5.4	-2.9
	V	10	10	12.74	18.33	5.59	0.559			0.559				
	W	10	10	13.46	19.51	6.05	0.605			0.605				
	X	10	10	13.38	19.71	6.33	0.633			0.633				
100% Intake	Y	10	10	13.23	18.46	5.23	0.523	0.545	9.7	0.523	100.0	0.545	9.7	5.6
	Z	10	10	12.24	18.31	6.07	0.607			0.607				
	AA	10	10	13.31	18.96	5.65	0.565			0.565				
	BB	10	10	13.89	18.74	4.85	0.485			0.485				

Outfall 101:
Dunnett's MSD value: 0.0650
PMSD: 11.3

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: 0.0553
PMSD: 9.6

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.

File: sqn101_051413data-uv.xlsx
Entered by: J. Sumner
Reviewed by: KK

TVA / Sequoyah Nuclear Plant, Outfall 101
UV-treated
May 14-21, 2013

ETS Environmental Testing Solutions, Inc.

Statistical Analyses

Larval Fish Growth and Survival Test-7 Day Growth

Start Date:	5/14/2013	Test ID:	PpFRCR	Sample ID:	TVA / SQN 101
End Date:	5/21/2013	Lab ID:	ETS-Envir. Testing Sol.	Sample Type:	DMR-Discharge Monitoring Report
Sample Date:	May 2013	Protocol:	FWCHR-EPA-821-R-02-013	Test Species:	PP-Pimephales promelas
Comments:	UV-treated				

Conc-%	1	2	3	4
D-Control	0.5930	0.5480	0.5750	0.5940
10.8	0.5590	0.5590	0.5430	0.5110
21.6	0.5750	0.5840	0.6180	0.5920
43.2	0.5250	0.5730	0.5780	0.5440
86.4	0.5320	0.5960	0.7150	0.6150
100	0.5790	0.5590	0.6050	0.6330
Intake	0.5230	0.6070	0.5650	0.4850

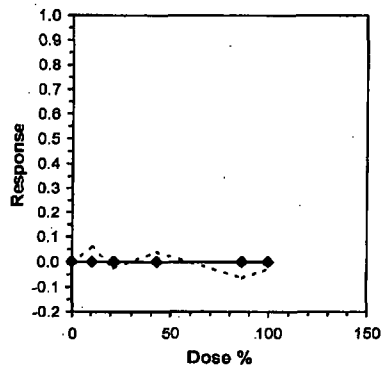
			Transform: Untransformed					1-Tailed			Isotonic	
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Mean	N-Mean
D-Control	0.5775	1.0000	0.5775	0.5480	0.5940	3.726	4				0.5794	1.0000
10.8	0.5430	0.9403	0.5430	0.5110	0.5590	4.167	4	1.280	2.410	0.0650	0.5794	1.0000
21.6	0.5923	1.0255	0.5923	0.5750	0.6180	3.127	4	-0.547	2.410	0.0650	0.5794	1.0000
43.2	0.5550	0.9610	0.5550	0.5250	0.5780	4.503	4	0.835	2.410	0.0650	0.5794	1.0000
86.4	0.6145	1.0641	0.6145	0.5320	0.7150	12.340	4	-1.372	2.410	0.0650	0.5794	1.0000
100	0.5940	1.0286	0.5940	0.5590	0.6330	5.405	4	-0.612	2.410	0.0650	0.5794	1.0000
Intake	0.5450	0.9437	0.5450	0.4850	0.6070	9.667	4					

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.92439	0.884	0.51985	3.37587
Bartlett's Test indicates equal variances (p = 0.10)	9.15189	15.0863		

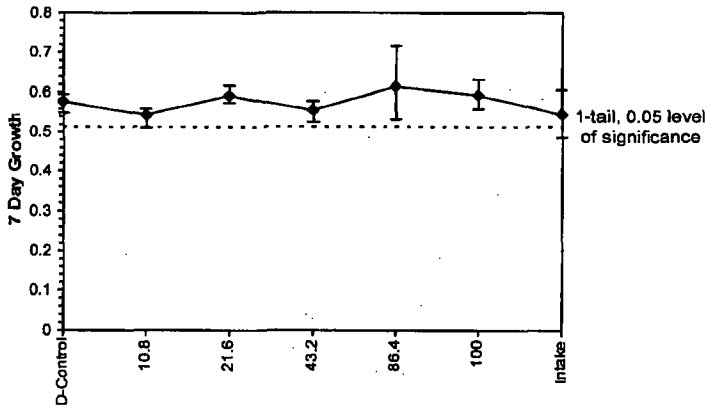
Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test Treatments vs D-Control	100	>100		1	0.06498	0.11251	0.00283	0.00145	0.1365	5, 18

Linear Interpolation (200 Resamples)

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



Dose-Response Plot



Independent Review by Kelley E. Keenan Initials:

File: sqn101_051413data-uv.xlsx
Entered by: J. Sumner
Reviewed by:

TVA / Sequoyah Nuclear Plant, Outfall 101 - Intake
UV-treated
May 14-21, 2013

ETS Environmental Testing Solutions, Inc.

Statistical Analyses

Larval Fish Growth and Survival Test-7 Day Growth

Start Date:	5/14/2013	Test ID:	PpFRCR	Sample ID:	TVA / SQN 101 - Intake
End Date:	5/21/2013	Lab ID:	ETS-Envir. Testing Sol.	Sample Type:	DMR-Discharge Monitoring Report
Sample Date:	May 2013	Protocol:	FWCHR-EPA-821-R-02-013	Test Species:	PP-Pimephales promelas
Comments:	UV-treated				

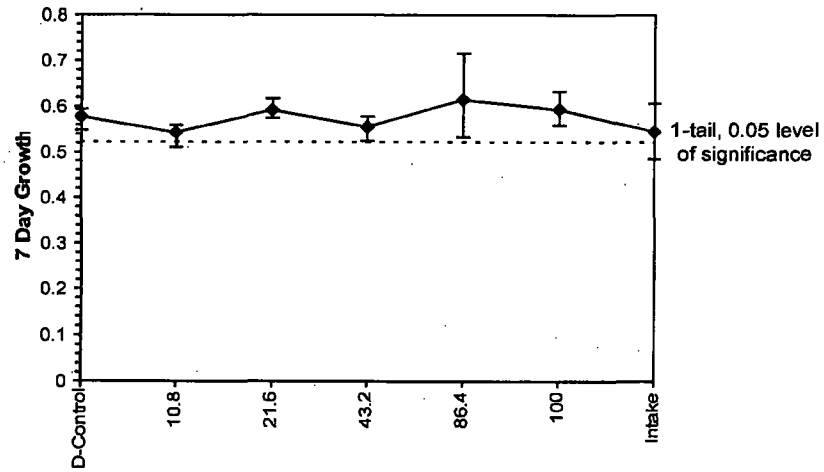
Conc-%	1	2	3	4
D-Control	0.5930	0.5480	0.5750	0.5940
10.8	0.5590	0.5590	0.5430	0.5110
21.6	0.5750	0.5840	0.6180	0.5920
43.2	0.5250	0.5730	0.5780	0.5440
86.4	0.5320	0.5960	0.7150	0.6150
100	0.5790	0.5590	0.6050	0.6330
Intake	0.5230	0.6070	0.5650	0.4850

			Transform: Untransformed					1-Tailed		
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
D-Control	0.5775	1.0000	0.5775	0.5480	0.5940	3.726	4			
10.8	0.5430	0.9403	0.5430	0.5110	0.5590	4.167	4			
21.6	0.5923	1.0255	0.5923	0.5750	0.6180	3.127	4			
43.2	0.5550	0.9610	0.5550	0.5250	0.5780	4.503	4			
86.4	0.6145	1.0641	0.6145	0.5320	0.7150	12.340	4			
100	0.5940	1.0286	0.5940	0.5590	0.6330	5.405	4			
Intake	0.5450	0.9437	0.5450	0.4850	0.6070	9.667	4	1.142	1.943	0.0553

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.97263	0.749	0.00813	0.26344
F-Test indicates equal variances (p = 0.18)	5.99568	47.4683		

Hypothesis Test (1-tail, 0.05)	MSDu	MSDp	MSB	MSE	F-Prob	df
Homoscedastic t Test indicates no significant differences Treatments vs D-Control	0.0553	0.09575	0.00211	0.00162	0.29693	1, 6

Dose-Response Plot



Independent Review by Kelley E. Keenan

File: sqn101_051413data-uv.xlsx
Entered by: J. Sumner
Reviewed by:

Species: *Pimephales promelas* **Date:** 05.14.13

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

Daily Chemistry:

		Day (Analyst identified for each day, performed pH, D.O. and conductivity measurements only.)					
		0		1		2	
	Analyst	JLB	JLB/MF	JLB/MF	JLB	JLB	JLB
Concentration	Parameter						
CONTROL UV-treated	pH (S.U.)	7.96	7.81	7.92	7.72	7.94	7.69
	DO (mg/L)	7.8	7.8	7.8	7.4	7.8	7.7
	Conductivity (µmhos/cm)	311		310		303	
	*Alkalinity (mg $CaCO_3$/L)	61				61	
	*Hardness (mg $CaCO_3$/L)	86				86	
	*Temperature (°C)	24.8	24.7	24.7	24.6	24.9	24.5
10.8%	pH (S.U.)	7.97	7.80	7.93	7.73	7.95	7.68
	DO (mg/L)	8.0	7.9	8.0	7.4	7.9	7.3
	Conductivity (µmhos/cm)	294		288		287	
	*Temperature (°C)	24.9	24.6	24.8	24.7	25.0	24.5
21.6%	pH (S.U.)	7.97	7.73	7.93	7.75	7.93	7.69
	DO (mg/L)	8.0	7.9	8.0	7.4	7.9	7.7
	Conductivity (µmhos/cm)	274		272		269	
	*Temperature (°C)	24.9	24.6	24.9	24.6	25.0	24.5
43.2%	pH (S.U.)	7.96	7.73	7.92	7.65	7.93	7.57
	DO (mg/L)	8.0	7.9	8.0	7.4	8.0	7.7
	Conductivity (µmhos/cm)	237		234		233	
	*Temperature (°C)	24.9	24.4	24.9	24.6	25.0	24.7
86.4%	pH (S.U.)	7.90	7.68	7.92	7.64	7.84	7.55
	DO (mg/L)	8.0	7.9	8.0	7.3	8.0	7.1
	Conductivity (µmhos/cm)	157		158		156	
	*Temperature (°C)	24.9	24.7	24.9	24.6	25.0	24.5
100%	pH (S.U.)	7.87	7.68	7.83	7.65	7.80	7.64
	DO (mg/L)	8.0	7.9	8.0	7.3	8.0	7.1
	Conductivity (µmhos/cm)	127		128		128	
	*Alkalinity (mg $CaCO_3$/L)	51				52	
	*Hardness (mg $CaCO_3$/L)	56				56	
	*TR chlorine (mg/L)	<0.10				<0.10	
	*Temperature (°C)	25.1	24.7	25.1	24.6	25.2	24.4
100% Intake	pH (S.U.)	7.86	7.67	7.82	7.65	7.80	7.65
	DO (mg/L)	8.1	7.9	8.1	7.7	8.1	7.0
	Conductivity (µmhos/cm)	125		125		128	
	*Alkalinity (mg $CaCO_3$/L)	50				54	
	*Hardness (mg $CaCO_3$/L)	54				56	
	*TR chlorine (mg/L)	<0.10				<0.10	
	*Temperature (°C)	25.2	24.5	25.0	24.6	25.1	24.5
		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.

Independent Review by: Kelley E. Keenan Initials: KK

Species: ***Pimephales promelas***

Client: TVA / Sequoyah Nuclear Plant, Outfall 101, UV-treated **Date:** 05-14-13

Concentration	Parameter	Day 3 (Analyst: JB)		Day 4 (Analyst: JB)		Day 5 (Analyst: JB)		Day 6 (Analyst: JB)	
		Initial	Final	Initial	Final	Initial	Final	Initial	Final
CONTROL UV-treated	pH (S.U.)	7.95	7.67	7.89	7.69	7.94	7.77	7.95	7.69
	DO (mg/L)	7.7	7.3	7.7	7.4	7.7	7.4	7.8	7.3
	Conductivity (µmhos/cm)	303		302		301		306	
	*Alkalinity (mg $CaCO_3$/L)			62		62			
	*Hardness (mg $CaCO_3$/L)			86		92			
	*Temperature (°C)	24.9	24.6	24.8	24.6	24.7	24.6	24.9	24.7
10.8%	pH (S.U.)	7.97	7.70	7.90	7.68	7.92	7.77	7.96	7.70
	DO (mg/L)	7.8	7.3	7.8	7.4	7.8	7.4	7.8	7.3
	Conductivity (µmhos/cm)	281		284		289		289	
	*Temperature (°C)	24.9	24.7	24.8	24.3	24.8	24.4	25.0	24.7
21.6%	pH (S.U.)	7.97	7.68	7.90	7.67	7.89	7.76	7.96	7.72
	DO (mg/L)	7.8	7.3	7.8	7.4	7.9	7.4	7.9	7.4
	Conductivity (µmhos/cm)	270		269		274		274	
	*Temperature (°C)	25.0	24.5	24.8	24.3	24.8	24.4	26.0	24.8
43.2%	pH (S.U.)	7.97	7.68	7.89	7.63	7.85	7.76	7.94	7.77
	DO (mg/L)	7.9	7.3	7.9	7.3	7.9	7.4	7.9	7.4
	Conductivity (µmhos/cm)	232		232		237		239	
	*Temperature (°C)	25.0	24.5	24.8	24.4	24.8	24.4	25.0	24.6
86.4%	pH (S.U.)	7.96	7.62	7.81	7.54	7.79	7.72	7.90	7.69
	DO (mg/L)	7.9	7.3	7.9	7.3	7.9	7.4	8.0	7.5
	Conductivity (µmhos/cm)	156		164		166		167	
	*Temperature (°C)	25.0	24.8	24.8	24.4	24.8	24.3	25.0	24.6
100%	pH (S.U.)	7.88	7.59	7.78	7.61	7.79	7.71	7.89	7.66
	DO (mg/L)	7.9	7.4	8.0	7.2	7.9	7.5	8.0	7.6
	Conductivity (µmhos/cm)	127		137		138		140	
	*Alkalinity (mg $CaCO_3$/L)			56					
	*Hardness (mg $CaCO_3$/L)			62					
	*TR chlorine (mg/L)			<0.10					
	*Temperature (°C)	25.0	24.6	25.0	24.4	24.8	24.3	25.2	24.7
100% Intake	pH (S.U.)	7.87	7.67	7.79	7.66	7.75	7.77	7.88	7.72
	DO (mg/L)	8.0	7.4	8.0	7.1	8.0	7.5	8.1	7.6
	Conductivity (µmhos/cm)	129		136		138		139	
	*Alkalinity (mg $CaCO_3$/L)			56					
	*Hardness (mg $CaCO_3$/L)			58					
	*TR chlorine (mg/L)			<0.10					
	*Temperature (°C)	25.0	24.6	25.1	24.4	24.8	24.5	24.9	24.7

*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.

Independent Review by Kelley Keenan

TVA / Sequoyah Nuclear Plant, Outfall 101 - UV-treated
May 14-21, 2013

Environmental Testing Solutions, Inc.

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

Daily Chemical Analyses

Project number: 8968

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)	7.96	7.81	7.92	7.72	7.94	7.69	7.95	7.67	7.89	7.69	7.94	7.77	7.95	7.69
	DO (mg/L)	7.8	7.8	7.8	7.4	7.8	7.2	7.7	7.3	7.7	7.4	7.7	7.4	7.8	7.3
	Conductivity (µmhos/cm)	311		310		303		303		302		301		306	
	Alkalinity (mg/L $CaCO_3$)	61				61				62		62			
	Hardness (mg/L $CaCO_3$)	86				86				86		92			
	Temperature (°C)	24.8	24.7	24.7	24.6	24.9	24.5	24.9	24.6	24.8	24.6	24.7	24.6	24.9	24.7
10.8%	pH (SU)	7.97	7.80	7.93	7.73	7.95	7.68	7.97	7.70	7.90	7.68	7.92	7.77	7.96	7.70
	DO (mg/L)	8.0	7.9	8.0	7.4	7.9	7.3	7.8	7.3	7.8	7.4	7.8	7.4	7.8	7.3
	Conductivity (µmhos/cm)	294		288		287		281		284		289		289	
	Temperature (°C)	24.9	24.6	24.8	24.7	25.0	24.5	24.9	24.7	24.8	24.3	24.8	24.4	25.0	24.7
21.6%	pH (SU)	7.97	7.73	7.93	7.75	7.93	7.69	7.97	7.68	7.90	7.67	7.89	7.76	7.96	7.72
	DO (mg/L)	8.0	7.9	8.0	7.4	7.9	7.2	7.8	7.3	7.8	7.4	7.9	7.4	7.9	7.4
	Conductivity (µmhos/cm)	274		272		269		270		269		274		274	
	Temperature (°C)	24.9	24.6	24.9	24.6	25.0	24.5	25.0	24.5	24.8	24.3	24.8	24.4	25.0	24.8
43.2%	pH (SU)	7.96	7.73	7.92	7.65	7.93	7.57	7.97	7.68	7.89	7.63	7.85	7.76	7.94	7.77
	DO (mg/L)	8.0	7.9	8.0	7.4	8.0	7.2	7.9	7.3	7.9	7.3	7.9	7.4	7.9	7.4
	Conductivity (µmhos/cm)	237		234		233		232		232		237		239	
	Temperature (°C)	24.9	24.4	24.9	24.6	25.0	24.7	25.0	24.5	24.8	24.4	24.8	24.4	25.0	24.6
86.4%	pH (SU)	7.90	7.68	7.92	7.64	7.84	7.55	7.96	7.62	7.81	7.54	7.79	7.72	7.90	7.69
	DO (mg/L)	8.0	7.9	8.0	7.3	8.0	7.1	7.9	7.3	7.9	7.3	7.9	7.4	8.0	7.5
	Conductivity (µmhos/cm)	157		158		156		156		164		166		167	
	Temperature (°C)	24.9	24.7	24.9	24.6	25.0	24.5	25.0	24.8	24.8	24.4	24.8	24.3	25.0	24.6
100%	pH (SU)	7.87	7.68	7.83	7.55	7.80	7.64	7.88	7.59	7.78	7.61	7.79	7.71	7.89	7.66
	DO (mg/L)	8.0	7.9	8.0	7.3	8.0	7.1	7.9	7.4	8.0	7.2	7.9	7.5	8.0	7.6
	Conductivity (µmhos/cm)	127		128		128		127		137		138		140	
	Alkalinity (mg/L $CaCO_3$)	51				52				56					
	Hardness (mg/L $CaCO_3$)	56				56				62					
	*Total Residual Chlorine (mg/L)	<0.10				<0.10				<0.10					
	Temperature (°C)	25.1	24.7	25.1	24.6	25.2	24.4	25.0	24.6	25.0	24.4	24.8	24.3	25.2	24.7
100% Intake	pH (SU)	7.86	7.67	7.82	7.65	7.80	7.65	7.87	7.67	7.79	7.66	7.75	7.77	7.88	7.72
	DO (mg/L)	8.1	7.9	8.1	7.2	8.1	7.0	8.0	7.4	8.0	7.1	8.0	7.5	8.1	7.6
	Conductivity (µmhos/cm)	125		125		128		129		136		138		139	
	Alkalinity (mg/L $CaCO_3$)	50				54				56					
	Hardness (mg/L $CaCO_3$)	54				56				58					
	*Total Residual Chlorine (mg/L)	<0.10				<0.10				<0.10					
	Temperature (°C)	25.2	24.5	25.0	24.6	25.1	24.5	25.0	24.6	25.1	24.4	24.8	24.5	24.9	24.7

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

File: sqn101_051413chem-UV.xls
Entered by: J. Sumner
Reviewed by: JA

ETS
Environmental Testing Solutions, Inc.

Total Residual Chlorine (ORION-1977)

Matrix: Water, RL = 0.10 mg/L
Meter: Accumet Model AR25 pH/Ion Meter

Analyst	JLB	Iodide reagent:	INR 568
Date analyzed	05.14.13	Acid reagent:	INR 563

Calibration:

	0.10 mg/L	1.00 mg/L	Slope
Reference standard number	INSS 1064	INSS 1064	-46.4%

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%)
INSS 1064	0.50	0.492	98.4%

Duplicate sample precision:

Sample number	Sample ID	Sample characteristics	Residual chlorine (mg/L)	%RPD = {(S - D) /[(S+D)/2]} x 100 (acceptable range = ± 10%)
130514.11	PINOVA	very pale yellow, clear, particles	S <0.00460	
↓	Duplicate		D <0.00213	JLB 05.14.13

Sample measurements:

Sample number	Sample ID	Sample characteristics	Residual chlorine (mg/L)
	Reagent Blank		<0.00637
130514.01	COLONIAL PIPELINE 002	pale yellow, clear	<0.00383
130514.02	003	pale yellow, clear	<0.00234
130514.03	004	pale yellow, clear, particles	<0.00162
130514.04	005	pale yellow, clear, particles	<0.00153
130514.05	006	pale yellow, clear	<0.00387
130514.06	007	pale yellow, clear, particles	<0.00251
130514.07	008	pale yellow, clear, particles	<0.00326
130514.08	009	pale yellow, clear	<0.00268
130514.09	↓ PNO 010	very pale yellow, clear	0.00621

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%)
INSS 1064	0.50	0.514	102.8%

Reviewed by	JG
Date reviewed	051413

ETS Environmental Testing Solutions, Inc.

Total Residual Chlorine (ORION-1977)

Matrix: Water, RL = 0.10 mg/L

Meter: Accumet Model AR25 pH/Ion Meter

Analyst	JVB
Date analyzed	05.14.13

Iodide reagent:	~~ING 5~~ JVB 05.14.13
Acid reagent:	

Calibration:

	0.10 mg/L	1.00 mg/L	Slope
~~Reference standard number~~			JVB 05.14.13

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%)
	~~0.50~~		JVB 05.14.13

Duplicate sample precision:

Sample number	Sample ID	Sample characteristics	Residual chlorine (mg/L)	%RPD = {(S - D) /[(S+D)/2]} x 100 (acceptable range = ± 10%)
130513.01	SQN 101	no color, clear	S <0.00438	
↓	Duplicate		D <0.00339	JVB 05.14.13

Sample measurements:

Sample number	Sample ID	Sample characteristics	Residual chlorine (mg/L)
	Reagent Blank		JVB 05.14.13
130513.02	SQN INTAKE	very pale yellow, clear, particles	<0.00269
130513.03	WBN 101	very pale yellow, clear, particles	<0.00275
130513.04	101 - INTAKE	very pale yellow, clear, particles	<0.00248
130513.05	113	no color, clear	<0.00167
130513.06	113 - INTAKE	very pale yellow clear, particles	<0.00112
			JVB 05.14.13

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%)
INGS 1064	0.50	0.492	98.4%

Reviewed by	KO
Date reviewed	051413

ETS
Environmental Testing Solutions, Inc.

Total Residual Chlorine (ORION-1977)

Matrix: Water, RL = 0.10 mg/L
Meter: Accumet Model AR25 pH/Ion Meter

Analyst	JB	Iodide reagent:	INR 568
Date analyzed	05.16.13	Acid reagent:	INR 563

Calibration:

	0.10 mg/L	1.00 mg/L	Slope
Reference standard number	INSS 1064	INSS 1064	-45.4%

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%)
INSS 1064	0.50	0.488	97.6%

Duplicate sample precision:

Sample number	Sample ID	Sample characteristics	Residual chlorine (mg/L)	%RPD = {(S - D) /[(S+D)/2]} x 100 (acceptable range = ± 10%)
130516.01	PINOVA	pale yellow clear, particles	S <0.00280	
↓	Duplicate		D <0.00217	JB 05.16.13

Sample measurements:

Sample number	Sample ID	Sample characteristics	Residual chlorine (mg/L)
	Reagent Blank		<0.00523
130515.08	TVA SQN101	no color, clear	<0.00193
130515.09	↓ INTAKE	no color, clear, particles	<0.00224
130515.10	TVA WBN 101	no color, clear	<0.00306
130515.11	↓ INTAKE	no color, clear, particles	<0.00251
130515.12	TVA WBN 113	no color, clear	<0.00168
130515.13	↓ INTAKE	no color, clear, particles	<0.00114
		05.16.13	

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%)
INSS 1064	0.50	0.502	100.4%

Reviewed by	
Date reviewed	05.16.13

ETS
Environmental Testing Solutions, Inc.

Total Residual Chlorine (ORION-1977)

Matrix: Water, RL = 0.10 mg/L
Meter: Accumet Model AR25 pH/Ion Meter

Analyst	JJB	Iodide reagent:	INR 568
Date analyzed	05.18.13	Acid reagent:	INR 563

Calibration:

	0.10 mg/L	1.00 mg/L	Slope
Reference standard number	INSS 1064	INSS 1064	-48.3%

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%)
INSS 1064	0.50	0.511	102.2%

Duplicate sample precision:

Sample number	Sample ID	Sample characteristics	Residual chlorine (mg/L)	%RPD = {(S - D) /[(S+D)/2]} x 100 (acceptable range = ± 10%)
130517.07	TJA SQN 101	pale yellow, clear	S <0.00198	
↓	Duplicate		D <0.00156	JJB 05.18.13

Sample measurements:

Sample number	Sample ID	Sample characteristics	Residual chlorine (mg/L)
	Reagent Blank		<0.00613
130517.08	TJA SQN INTake	pale yellow, clear	<0.00141
130517.09	WBN 101	pale yellow, clear	<0.00108
130517.10	101 INT	pale yellow, clear, particles	<0.00123
130517.11	113	pale yellow, clear	<0.00116
130517.12	113 INT	pale yellow, clear, particles	<0.00148
			JJB 05.18.13

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%)
INSS 1064	0.50	0.491	98.2%

Reviewed by	JJB
Date reviewed	05.18.13

ETS Environmental Testing Solutions, Inc.

Alkalinity (SM 2320 B-1997)

Matrix: Water, RL = 1.0 mg $CaCO_3$/L

Analyst	JSS
Date analyzed	05·12·13

Titrate samples to pH = 4.5 S.U.

Time initiated	1250
Time completed	1532

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_2SO_4 = (5 ml Na_2CO_3 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
5.8	INR 540	INSS 1117	0.2	12.4	12.2	0.0205	10.2

Blk correction: 0.0 - 0.2 : 0.2 mL

Laboratory control standard:

Reference standard number	True value (TV) (mg $CaCO_3$/L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (MV) (mg $CaCO_3$/L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
INSS 1146	100	100	12.4	21.4	9.0	10.2	92	92.0%

Duplicate sample precision:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg $CaCO_3$/L)	%RPD = {(S - D) /[(S+D)/2]} x 100 (acceptable range = ± 10%)
05.09.13	SSW	100	21.4	24.6	3.2	10.2	S 33	
↓	Duplicate (B)	↓	24.6	27.9	3.3	↓	D 34	3.0%

Matrix spike recovery:

Reference standard number	Spike value (SV) (mg $CaCO_3$/L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Spike alkalinity (A) (mg $CaCO_3$/L)
INSS 1146	50	100	24.6	32.4	7.8	10.2	80

Sample alkalinity (B) (mg $CaCO_3$/L)	Measured spike value (MV) MV = A - B (mg $CaCO_3$/L)	% R = MV / SV x 100 (acceptable range = 75 to 125%)
34	46	92.0%

Sample measurements:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg $CaCO_3$/L)
05.10.13	SSW	100	32.4	35.7	3.3	10.2	34
05.09.13	MHSW	↓	35.7	41.7	6.0	↓	61
05.10.13	↓	↓	41.7	47.9	6.2	↓	63
05.06.13	↓	↓	0.0	6.0	6.0	↓	61
05.09.13	SaltSW	↓	6.0	16.3	10.3	↓	100
05.10.13	↓	↓	16.3	25.0	8.7	↓	89
130502.01	Finished H2O	↓	25.0	27.8	2.8	↓	29
↓	26000 mg/L	5	27.8	33.4	5.6	(20)	1100
130509.10	Washington	25	33.4	38.4	5.0	(4) ↓	200

Reviewed by: [signature] Date reviewed: 05.12.13

ETS Environmental Testing Solutions, Inc.

Alkalinity (SM 2320 B-1997)

Matrix: Water, RL = 1.0 mg $CaCO_3$/L

Analyst	JSB
Date analyzed	05.12.13

Titrate samples to pH = 4.5 S.U.

Time initiated	
Time completed	900 05.12.13

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_2SO_4 = (5 ml Na_2CO_3 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
							JSB 05.12.13

Laboratory control standard:

Reference standard number	True value (TV) (mg $CaCO_3$/L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (MV) (mg $CaCO_3$/L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
INSS 1146	100	100	38.4	47.5	9.1	10.2	93	93.0%

Duplicate sample precision:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg $CaCO_3$/L)	%RPD = {(S - D) /[(S+D)/2]} x 100 (acceptable range = ± 10%)
105323	Ukwa	25	0.0	3.7	3.7	(4) 10.2	S 150	
↓	Duplicate (B)	↓	3.7	7.5	3.8	↓ ↓	D 160	6.4%

Matrix spike recovery:

Reference standard number	Spike value (SV) (mg $CaCO_3$/L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Spike alkalinity (A) (mg $CaCO_3$/L)
INSS 1146	200	25	3.7	11.7	8.0	(4) 10.2	330

Sample alkalinity (B) (mg $CaCO_3$/L)	Measured spike value (MV) MV = A - B (mg $CaCO_3$/L)	% R = MV / SV x 100 (acceptable range = 75 to 125%)
160	170	85.0%

Sample measurements:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg $CaCO_3$/L)
130507.03	Chattanooga 1	25	11.7	14.0	2.3	(4) 10.2	94
130509.02	↓ 2	↓	14.0	16.7	2.7	↓ ↓	110
130511.02	↓ 3	↓	16.7	20.2	3.5	↓ ↓	140
130507.04	Conn Ac 1	↓	20.2	23.8	3.6	↓ ↓	150
130509.03	↓ 2	↓	23.8	28.8	5.0	↓ ↓	200
130511.03	↓ 3	↓	28.8	33.6	4.8	↓ ↓	200
pH = 3.6 130507.02	Fluwood 1	100	33.6	33.6	0.0	↓ ↓	<1.0
130509.01	↓ 2	↓	33.6	38.2	4.6	↓ ↓	47
130511.01	↓ 3	↓	38.2	45.4	7.2	↓ ↓	73

Reviewed by: [signature] Date reviewed: 05.12.13

ETS Environmental Testing Solutions, Inc.

Alkalinity (SM 2320 B-1997)

Matrix: Water, RL = 1.0 mg $CaCO_3$/L

Analyst	JJS
Date analyzed	05.12.13

Titrate samples to pH = 4.5 S.U.

Time initiated	
Time completed	JJS 05.12.13

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_2SO_4 = (5 ml Na_2CO_3 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
							JJS 05.12.13

Laboratory control standard:

Reference standard number	True value (TV) (mg $CaCO_3$/L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (MV) (mg $CaCO_3$/L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
INSS 1146	100	100	0.0	9.0	9.0	10.2	92	92.0%

Duplicate sample precision:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg $CaCO_3$/L)	%RPD = {(S - D) /[(S+D)/2]} x 100 (acceptable range = ± 10%)
130507.12	Buckingham 1	25	9.6	11.2	2.2	(4) 10.2	S 90	
↓	Duplicate (B)	↓	11.2	13.5	2.3	↓ ↓	D 94	4.3%

Matrix spike recovery:

Reference standard number	Spike value (SV) (mg $CaCO_3$/L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Spike alkalinity (A) (mg $CaCO_3$/L)
INSS 1146	200	25	11.2	18.0	6.8	(4) 10.2	280

Sample alkalinity (B) (mg $CaCO_3$/L)	Measured spike value (MV) MV = A - B (mg $CaCO_3$/L)	% R = MV / SV x 100 (acceptable range = 75 to 125%)
94	186	93.0%

Sample measurements:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg $CaCO_3$/L)
130509.12	Buckingham 2	25	18.0	20.5	2.5	(4) 10.2	100
130511.09	↓ 3	25	20.5	22.9	2.4	↓	98
130507.01	S. Cary 1	100	22.9	28.2	5.3		54
130509.11	↓ 2	↓	28.2	32.6	4.4		45
130511.08	↓ 3	↓	32.6	36.9	4.3		44
130507.05	Buque Banks 1	5	36.9	42.6	5.7	(20)	1200
130509.04	↓ 2	↓	42.6	48.6	6.0	↓	1200
130511.04	↓ 3	↓	0.0	6.1	6.1		1200
130507.06	Engelhard 1	2	6.1	12.3	6.2	(50) ↓	3200

Reviewed by: [signature] Date reviewed: 05.12.13

ETS Environmental Testing Solutions, Inc.

Alkalinity (SM 2320 B-1997)

Matrix: Water, RL = 1.0 mg $CaCO_3$/L

Analyst	JB
Date analyzed	05.12.13

Titrate samples to pH = 4.5 S.U.

Time initiated	
Time completed	JB 05.12.13

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_2SO_4 = (5 ml Na_2CO_3 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
							JB 05.12.13

Laboratory control standard:

Reference standard number	True value (TV) (mg $CaCO_3$/L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (MV) (mg $CaCO_3$/L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
INSS 1146	100	100	12.3	21.4	9.1	10.2	93	93.0%

Duplicate sample precision:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg $CaCO_3$/L)	%RPD = {(S - D) /[(S+D)/2]} x 100 (acceptable range = ± 10%)
130509.05	Englehard 2	2	21.4	27.6	6.2	(50) 10.2	S 3200	
↓	Duplicate (B)	2	27.6	34.0	6.4	↓ ↓	D 3300	3.1%

Matrix spike recovery:

Reference standard number	Spike value (SV) (mg $CaCO_3$/L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Spike alkalinity (A) (mg $CaCO_3$/L)
INSS 1146	2500	2	27.6	38.6	11.0	(50) 10.2	5500

Sample alkalinity (B) (mg $CaCO_3$/L)	Measured spike value (MV) MV = A - B (mg $CaCO_3$/L)	% R = MV / SV x 100 (acceptable range = 75 to 125%)
3300	2300	92.0%

Sample measurements:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg $CaCO_3$/L)
130511.05	Engelmeel 3	2	38.6	45.0	6.4	(50) 10.2	3300
130507.07	Rascpatank 1	↓	0.0	3.9	3.9	↓ ↓	2000
130509.06	↓ 2	↓	3.9	7.9	4.0	↓	2000
130511.06	↓ 3	↓	7.9	11.8	3.9	↓	2000
05.11.13	MHSW	100	11.8	17.8	6.0		61
05.11.13	Sant SW	↓	17.8	26.9	9.1	↓	93
							JB 05.12.13

Reviewed by: [signature] Date reviewed: 05.12.13

ETS Environmental Testing Solutions, Inc.

Alkalinity (SM 2320 B-1997)

Matrix: Water, RL = 1.0 mg $CaCO_3$/L

Analyst	JB	Time initiated	1534
Date analyzed	05.12.13	Time completed	1542

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_2SO_4 = (5 ml Na_2CO_3 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
5.8	INR 540	INSS 1117	0.2	12.4	12.2	0.0205	10.2

Blk correction: 0.0-0.2=0.2 mL

Laboratory control standard:

Reference standard number	True value (TV) (mg $CaCO_3$/L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (MV) (mg $CaCO_3$/L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
INSS 1145	100	100	12.4	21.4	9.0	10.2	92	92.0%

Duplicate sample precision:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg $CaCO_3$/L)	%RPD = {(S - D) /[(S+D)/2]} x 100 (acceptable range = ± 10%)
							S	
	Duplicate (B)						D	

Matrix spike recovery:

Reference standard number	Spike value (SV) (mg $CaCO_3$/L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Spike alkalinity (A) (mg $CaCO_3$/L)

Sample alkalinity (B) (mg $CaCO_3$/L)	Measured spike value (MV) MV = A - B (mg $CaCO_3$/L)	% R = MV / SV x 100 (acceptable range = 75 to 125%)

JB 05.12.13

Sample measurements:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg $CaCO_3$/L)
	QC 1	100	26.9	30.0	3.1	10.2	32
	2		30.1	33.2	3.1		32
	3		33.2	36.3	3.1		32
	4		36.3	39.4	3.1		32

JB 05.12.13

Reviewed by: JL Date reviewed: 05-16-13

ETS Environmental Testing Solutions, Inc.

Alkalinity (SM 2320 B-1997)

Matrix: Water, RL = 1.0 mg $CaCO_3$/L

Analyst	JJB	Time initiated	1030
Date analyzed	05.19.13	Time completed	1242

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_2SO_4 = (5 ml Na_2CO_3 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
5.5	INR540	INSS 1117	0.2	12.5	12.3	0.0203	10.2

Blk correction: 0.0-0.2: 0.2 ml

Laboratory control standard:

Reference standard number	True value (TV) (mg $CaCO_3$/L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (MV) (mg $CaCO_3$/L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
INSS 1146	100	100	12.5	21.5	9.0	10.2	92	92.0%

Duplicate sample precision:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg $CaCO_3$/L)	%RPD = {(S - D) /[(S+D)/2]} x 100 (acceptable range = ± 10%)
05.13.13	SSW	100	21.5	24.7	3.2	10.2	S 33	
↓	Duplicate (B)	↓	24.7	27.9	3.2	↓	D 33	JJB 05.19.13

Matrix spike recovery:

Reference standard number	Spike value (SV) (mg $CaCO_3$/L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Spike alkalinity (A) (mg $CaCO_3$/L)
INSS 1146	50	100	24.7	32.5	7.8	10.2	80

Sample alkalinity (B) (mg $CaCO_3$/L)	Measured spike value (MV) MV = A - B (mg $CaCO_3$/L)	% R = MV / SV x 100 (acceptable range = 75 to 125%)
33	47	94.0%

Sample measurements:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg $CaCO_3$/L)
05.15.13	MHSW	100	32.5	38.5	6.0	10.2	61
05.17.13A	↓	↓	38.5	44.5	6.0	↓	61
05.17.13B	↓	↓	0.0	5.9	5.9	↓	60
05.15.13	SaltSW	↓	5.9	15.0	9.1	↓	93
05.13.13 A	MHSW	↓	15.0	21.1	6.1	↓	62
05.13.13 B	↓	↓	21.1	27.2	6.1	↓	62
105594	Lake Mere	25	27.2	30.2	3.0	(4)	120
05.13.13	SaltSW	100	30.2	39.9	9.7	↓	99
130511.01	Prova 1	25	39.9	43.4	3.5	(4) ↓	140

Reviewed by: [signature] Date reviewed: 052013

ETS Environmental Testing Solutions, Inc.

Alkalinity (SM 2320 B-1997)

Matrix: Water, RL = 1.0 mg $CaCO_3$/L

Analyst	JJB
Date analyzed	05.19.13

Titrate samples to pH = 4.5 S.U.

Time initiated	
Time completed	JJB 05.19.13

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_2SO_4 = (5 ml Na_2CO_3 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
							JJB 05.19.13

Laboratory control standard:

Reference standard number	True value (TV) (mg $CaCO_3$/L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (MV) (mg $CaCO_3$/L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
INSS 1146	100	100	0.0	9.1	9.1	10.2	93	93.0%

Duplicate sample precision:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg $CaCO_3$/L)	%RPD = {(S - D) /[(S+D)/2]} x 100 (acceptable range = ± 10%)
130514.11	Pinava 2	25	9.1	12.5	3.4	(4) 10.2	S 140	
↓	Duplicate (B)	↓	12.5	15.9	3.4	↓ ↓	D 140	JJB 05.19.13

Matrix spike recovery:

Reference standard number	Spike value (SV) (mg $CaCO_3$/L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Spike alkalinity (A) (mg $CaCO_3$/L)
INSS 1146	200	25	12.5	20.5	8.0	(4) 10.2	330

Sample alkalinity (B) (mg $CaCO_3$/L)	Measured spike value (MV) MV = A - B (mg $CaCO_3$/L)	% R = MV / SV x 100 (acceptable range = 75 to 125%)
140	190	95.0%

Sample measurements:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg $CaCO_3$/L)
130516.01	Pinava 3	25	20.5	24.0	3.5	(4) 10.2	140
130513.01	TVA SBW 101 1	100	24.0	29.0	5.0		51
130515.08	↓ 2		29.0	34.1	5.1		52
130517.07	↓ 3		34.1	39.5	5.4		55
130513.02	TVA SBW INT 1		39.5	44.5	5.0		51
130515.09	↓ 2		44.5	49.7	5.2		53
130517.08	↓ 3		0.0	5.5	5.5		56
130513.03	TVA WBW 101 1	↓	5.5	13.2	7.7		74 * 10 052013
130515.10	↓ 2	50	13.2	17.4	4.2	(2) ↓	86

Reviewed by: [signature] Date reviewed: 052013

ETS Environmental Testing Solutions, Inc.

Alkalinity (SM 2320 B-1997)

Matrix: Water, RL = 1.0 mg $CaCO_3$/L

Analyst	JB
Date analyzed	05·19·13

Titrate samples to pH = 4.5 S.U.

Time initiated	
Time completed	JB 05·19·13

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_2SO_4 = (5 ml Na_2CO_3 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
							JB 05·19·13

Laboratory control standard:

Reference standard number	True value (TV) (mg $CaCO_3$/L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (MV) (mg $CaCO_3$/L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
INSS 1146	100	100	17.4	26.5	9.1	10.2	93	93.0%

Duplicate sample precision:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg $CaCO_3$/L)	%RPD = {(S - D) /[(S+D)/2]} x 100 (acceptable range = ± 10%)
130517.09	TVAWBN101 3	50	26.5	30.9	4.4	(E) 10.2	S 90	
↓	Duplicate (B)	↓	30.9	35.4	4.5	↓ ↓	D 92	2.2%

Matrix spike recovery:

Reference standard number	Spike value (SV) (mg $CaCO_3$/L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Spike alkalinity (A) (mg $CaCO_3$/L) 052013
INSS 1146	100	50	30.9	39.9	9.0	(E) 10.2	184 JB 100

Sample alkalinity (B) (mg $CaCO_3$/L)	Measured spike value (MV) MV = A - B (mg $CaCO_3$/L)	% R = MV / SV x 100 (acceptable range = 75 to 125%) 052013
92	052013 ~~92~~ JB 88	~~92.0%~~ JB 88.0%

Sample measurements:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg $CaCO_3$/L)
130513.04	TVAWBN101INT 1	50	39.9	42.8	2.9	(E) 10.2	59
130515.11	↓ 2	↓	42.8	45.9	3.1	↓ ↓	63
130517.10	↓ 3	↓	45.9	49.3	3.4	↓ ↓	69
130513.05	TVA WBN 113 1	↓	0.0	3.1	3.1	↓ ↓	63
130515.12	↓ 2	↓	3.1	6.0	2.9	↓ ↓	59
130517.11	↓ 3	↓	6.0	9.1	3.1	↓ ↓	05·19·13 JB 63
130513.06	TVA WBN113 INT 1	100	9.1	14.8	5.7	↓ ↓	58
130515.13	↓ 2	↓	14.8	20.8	6.0	↓ ↓	61
130517.12	↓ 3	↓	20.8	26.9	6.1	↓ ↓	62

Reviewed by: JL Date reviewed: 052013

ETS Environmental Testing Solutions, Inc.

Alkalinity (SM 2320 B-1997)

Matrix: Water, RL = 1.0 mg $CaCO_3$/L

Analyst	JJB
Date analyzed	05.19.13

Titrate samples to pH = 4.5 S.U.

Time initiated	
Time completed	JJB 05.19.13

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_2SO_4 = (5 ml Na_2CO_3 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
							JJB 05.19.13

Laboratory control standard:

Reference standard number	True value (TV) (mg $CaCO_3$/L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (MV) (mg $CaCO_3$/L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
INSS 1146	100	100	26.9	36.0	9.1	10.2	93	93.0%

Duplicate sample precision:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg $CaCO_3$/L)	%RPD = {(S - D) /[(S+D)/2]} x 100 (acceptable range = ± 10%)
130513.01	TVASQN101W1	100	36.0	41.0	5.0	10.2	S 51	
↓	Duplicate (B)	↓	0.0	5.0	5.0	↓	D 51	JJB 05.19.13

Matrix spike recovery:

Reference standard number	Spike value (SV) (mg $CaCO_3$/L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Spike alkalinity (A) (mg $CaCO_3$/L)
INSS 1146	50	100	0.0	9.6	9.6	10.2	98

Sample alkalinity (B) (mg $CaCO_3$/L)	Measured spike value (MV) MV = A - B (mg $CaCO_3$/L)	% R = MV / SV x 100 (acceptable range = 75 to 125%)
51	47	94.0%

Sample measurements:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg $CaCO_3$/L)
130515.08	TVASQN101UV 2	100	9.6	14.7	5.1	10.2	52
130517.07	↓ 3	↓	14.7	20.2	5.5	↓	56
130513.02	TVASQN1NTW1		20.2	25.1	4.9		50
130515.09	↓ 2		25.1	30.4	5.3		54
130517.08	↓ 3		30.4	35.9	5.5		56
05-11-13	MHSW VV 1		35.9	41.9	6.0		61
05.13.13 A	↓ 2		41.9	47.9	6.0		61
05-15-13	↓ 3		0.0	6.1	6.1		62
05-17-13A	↓ 4	↓	6.1	12.2	6.1	↓	62

Reviewed by: JL Date reviewed: 052013

ETS Environmental Testing Solutions, Inc.

Alkalinity (SM 2320 B-1997)

Matrix: Water, RL = 1.0 mg $CaCO_3$/L

Analyst	JJB
Date analyzed	05.19.13

Titrate samples to pH = 4.5 S.U.

Time initiated	
Time completed	JJB 05.19.13

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_2SO_4 = (5 ml Na_2CO_3 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
							JJB 05.19.13

Laboratory control standard:

Reference standard number	True value (TV) (mg $CaCO_3$/L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (MV) (mg $CaCO_3$/L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
ISS 1146	100	100	12.2	21.3	9.1	10.2	93	93.0%

Duplicate sample precision:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg $CaCO_3$/L)	%RPD = {(S - D) /[(S+D)/2]} x 100 (acceptable range = ± 10%)
							S	
	Duplicate (B)						D	

Matrix spike recovery:

Reference standard number	Spike value (SV) (mg $CaCO_3$/L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Spike alkalinity (A) (mg $CaCO_3$/L)

Sample alkalinity (B) (mg $CaCO_3$/L)	Measured spike value (MV) MV = A - B (mg $CaCO_3$/L)	% R = MV / SV x 100 (acceptable range = 75 to 125%)

JJB 05.19.13

Sample measurements:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Alkalinity (mg $CaCO_3$/L)
130508.23	F.Coty Finished	100	21.3	24.0	2.7	10.2	28
↓	Rosehead 20000mg/L	5	24.2	05.19.13 ~~28.33~~ (29.1)	4.9	(20) ↓	1000
							JJB 05.19.13

Reviewed by: IL Date reviewed: 05.20.13

ETS Environmental Testing Solutions, Inc.

Hardness (SM 2340 C-1997)

RL = 1.0 mg $CaCO_3$/L

Analyst		Time initiated	1302
Date analyzed	05.11.13	Time completed	1340

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
INR537	INSS1048	0.0	10.0	10.0	0.0200	20.0

Laboratory control standard:

Reference standard number	True value (TV) (mg $CaCO_3$/L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (MV) (mg $CaCO_3$/L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
INSS1129	40	50	10.0	12.0	2.0	20.0	40	100.0%

Duplicate sample precision:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (mg $CaCO_3$/L)	%RPD = {(S - D) /[(S+D)/2]} x 100
05.08.13	SSW	50	12.0	14.1	2.1	20.0	S 42	
↓	Duplicate (B)	↓	14.1	16.2	2.1	↓	D 42	0

Matrix spike recovery:

Reference standard number	Spike value (SV) (mg $CaCO_3$/L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Spike hardness (A) (mg $CaCO_3$/L)
INSS1129	40	50	14.1	18.2	4.1	20.0	82

Sample hardness (B) (mg $CaCO_3$/L)	Measured spike value (MV) MV = A - B (mg $CaCO_3$/L)	% R = MV / SV x 100 (acceptable range = 75 to 125%)
42	40	100.0%

Sample measurements:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (mg $CaCO_3$/L)
TV = ND	Blank (should be = 0 mg $CaCO_3$/L)	50	0.0	0.0	0.0	20.0	ND
05.10.13	SSW		18.2	20.3	2.1		42
05.09.13	MHSW		20.3	24.7	4.4		88
05.10.13	↓		24.7	29.2	4.5		90
05.06.13	↓		29.2	33.5	4.4		88
130502.01	Finish H2O	↓	33.5	34.6	1.1		22
↓	260000mg/L	0.5	34.6	37.0	2.4	(100)	4800
130509.10	Washington	50	37.0	42.5	5.5		110
130507.03	Chattanooga 1	25	42.5	45.2	2.7	(50)	110
130509.02	↓ 2	1	45.2	48.3	3.1	1 ↓	120

Note: If >15ml of titrant is used, sample must be diluted. Reviewed by: [signature] Date reviewed 05.11.13

ETS Environmental Testing Solutions, Inc.

Hardness (SM 2340 C-1997)

RL = 1.0 mg $CaCO_3$/L

Analyst	K
Date analyzed	05.11.13

Time initiated	
Time completed	05/11/13

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
						05/11/13

Laboratory control standard:

Reference standard number	True value (TV) (mg $CaCO_3$/L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (MV) (mg $CaCO_3$/L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
INSS1129	40	50	0.0	2.0	2.0	20.0	40	100.0 %

Duplicate sample precision:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (mg $CaCO_3$/L)	%RPD = {(S - D) /[(S+D)/2]} x 100
130511.02	Chattanooga 3	25	2.0	6.0	4.0	(2) 20.0	S 160	
↓	Duplicate (B)	↓	6.0	10.0	4.0	↓ ↓	D 160	05/11/13

Matrix spike recovery:

Reference standard number	Spike value (SV) (mg $CaCO_3$/L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Spike hardness (A) (mg $CaCO_3$/L)
INSS1129	80	25	6.0	12.0	6.0	(6) 20.0	240

Sample hardness (B) (mg $CaCO_3$/L)	Measured spike value (MV) MV = A - B (mg $CaCO_3$/L)	% R = MV / SV x 100 (acceptable range = 75 to 125%)
160	80	100.0 %

Sample measurements:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (mg $CaCO_3$/L)
TV = ND	Blank (should be = 0 mg $CaCO_3$/L)					05/11/13	
130507.04	COLN AC 1	25	12.0	15.5	3.5	(2) 20.0	140
130509.03	↓ 2	↓	15.5	20.4	4.9	↓ ↓	200
130511.03	3	↓	20.4	25.1	4.7	↓ ↓	190
130507.02	FLWOOD 1	50	25.1	26.1	1.0	↓ ↓	20
130509.01	↓ 2	↓	26.1	29.3	3.2	↓ ↓	64
130511.01	↓ 3	↓	29.3	34.5	5.2	↓ ↓	100
130507.12	Rocking horn 1	25	34.5	38.0	3.5	(2)	140
130509.12	↓ 2	↓	38.0	41.8	3.8	↓ ↓	150
130511.09	↓ 3	↓	41.8	45.3	3.5	↓ ↓	140

Note: If >15ml of titrant is used, sample must be diluted. Reviewed by: [signature] Date reviewed 05.11.13

ETS Environmental Testing Solutions, Inc.

Hardness (SM 2340 C-1997)

RL = 1.0 mg $CaCO_3$/L

Analyst: W
Date analyzed: 05.11.13

Time initiated: 0511 3
Time completed: W

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
						W 05 11 13

Laboratory control standard:

Reference standard number	True value (TV) (mg $CaCO_3$/L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (MV) (mg $CaCO_3$/L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
INSS1129	40	50	45.3	47.2	1.9	20.0	38	95.0%

Duplicate sample precision:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (mg $CaCO_3$/L)	%RPD = {(S - D) /[(S+D)/2]} x 100
130509.01	3 Cany 1	50	22.6	25.6	3.0	20.0	S 60	
↓	Duplicate (B)	↓	25.6	28.6	3.0	↓	D 60	W 05 13

Matrix spike recovery:

Reference standard number	Spike value (SV) (mg $CaCO_3$/L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Spike hardness (A) (mg $CaCO_3$/L)
INSS1129	40	50	25.6	30.6	5.0	20.0	100

Sample hardness (B) (mg $CaCO_3$/L)	Measured spike value (MV) MV = A - B (mg $CaCO_3$/L)	% R = MV / SV x 100 (acceptable range = 75 to 125%)
60	40	100.0%

Sample measurements:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (mg $CaCO_3$/L)
TV = ~~ND~~	Blank (should be = 0 mg $CaCO_3$/L)						W 05 13
130509.11	Scany 2	50	30.6	33.3	2.7	20.0	54
130511.08	↓ 3	↓	33.3	36.1	2.8	↓	56
05.11.13	MHSW	↓	36.1	40.3	4.2	↓	84
							W 05 11 13

Note: If >15ml of titrant is used, sample must be diluted. Reviewed by: [signature] Date reviewed: 05.11.13

ETS Environmental Testing Solutions, Inc.

Hardness (SM 2340 C-1997)

RL = 1.0 mg $CaCO_3$/L

Analyst	JJ	Time initiated	1346
Date analyzed	05.18.13	Time completed	1544

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
INR 537	INSS 1048	0.0	10.0	10.0	0.0200	20.0

Laboratory control standard:

Reference standard number	True value (TV) (mg $CaCO_3$/L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (MV) (mg $CaCO_3$/L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
INSS 1129	40	50	10.0	12.0	2.0	20.0	40	100.0%

Duplicate sample precision:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (mg $CaCO_3$/L)	%RPD = {(S - D) /[(S+D)/2]} x 100
051313	SSW	50	12.0	14.0	2.0	20.0	S 40	
↓	Duplicate (B)	↓	14.0	16.0	2.0	↓	D 40	JJJ 05.18.13

Matrix spike recovery:

Reference standard number	Spike value (SV) (mg $CaCO_3$/L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Spike hardness (A) (mg $CaCO_3$/L)
INSS 1129	40	50	14.0	18.0	4.0	20.0	80

Sample hardness (B) (mg $CaCO_3$/L)	Measured spike value (MV) MV = A - B (mg $CaCO_3$/L)	% R = MV / SV x 100 (acceptable range = 75 to 125%)
40	40	100.0%

Sample measurements:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (mg $CaCO_3$/L)
TV = ND	Blank (should be = 0 mg $CaCO_3$/L)	50	0.0	0.0	0.0	20.0	ND
05.15.13	MHSW		18.0	22.4	4.4		88
05.17.13A			22.4	26.8	4.4		88
05.17.13B			26.8	31.2	4.4		88
05.13.13A			31.2	35.6	4.4		88
05.13.13B			35.6	40.0	4.4		88
05.11.13	MHSW VV 1		40.0	44.3	4.3		86
05.13.13A	2		44.3	48.6	4.3		86
05.15.13	3		0.0	4.3	4.3		86
05.17.13A	4	↓	4.3	8.9	4.6	↓	92

Note: If >15ml of titrant is used, sample must be diluted. Reviewed by: JJ Date reviewed 05.18.13

ETS Environmental Testing Solutions, Inc.

Hardness (SM 2340 C-1997)

RL = 1.0 mg $CaCO_3$/L

Analyst	JJB
Date analyzed	05.18.13

Time initiated	
Time completed	JJB 05.18.13

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
						JJB 05.18.13

Laboratory control standard:

Reference standard number	True value (TV) (mg $CaCO_3$/L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (MV) (mg $CaCO_3$/L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
INSS 1129	40	50	8.9	10.9	2.0	20.0	40	100.0%

Duplicate sample precision:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (mg $CaCO_3$/L)	%RPD = {(S - D) /[(S+D)/2]} x 100
130513.01	TVASQNIOI 1	50	10.9	13.5	2.6	20.0	S 52	
↓	Duplicate (B)	↓	13.5	16.1	2.6	↓	D 52	JJB 05.18.13

Matrix spike recovery:

Reference standard number	Spike value (SV) (mg $CaCO_3$/L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Spike hardness (A) (mg $CaCO_3$/L)
INSS 1129	40	50	13.5	18.1	4.6	20.0	92

Sample hardness (B) (mg $CaCO_3$/L)	Measured spike value (MV) MV = A - B (mg $CaCO_3$/L)	% R = MV / SV x 100 (acceptable range = 75 to 125%)
52	40	100.0%

Sample measurements:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (mg $CaCO_3$/L)
TV = ND	Blank (should be = 0 mg $CaCO_3$/L)						JJB 05.18.13
130515.08	TVA SQN 101 2	50	18.1	20.9	2.8	20.0	56
130517.07	↓ 3	↓	20.9	23.8	2.9	↓	58
130513.02	TVA SQN INT 1		23.8	26.5	2.7		54
130515.09	↓ 2		26.5	29.3	2.8		56
130517.08	↓ 3		29.3	32.2	2.9		58
130513.01	TVASQNIOIUU 1		32.2	35.0	2.8		56
130515.08	↓ 2		35.0	37.8	2.8		56
130517.07	↓ 3		37.8	40.9	3.1		62
130513.02	TVA SQN INT UU 1	↓	40.9	43.6	2.7	↓	54

Note: If >15ml of titrant is used, sample must be diluted. Reviewed by: JJ Date reviewed 05.18.13

ETS Environmental Testing Solutions, Inc.

Hardness (SM 2340 C-1997)

RL = 1.0 mg $CaCO_3$/L

Analyst	JB
Date analyzed	05·18·13

Time initiated

Time completed JB 05-18-13

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
						JB 05·18·13

Laboratory control standard:

Reference standard number	True value (TV) (mg $CaCO_3$/L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (MV) (mg $CaCO_3$/L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
INSS 1129	40	50	43.6	45.5	1.9	20.0	38	95.0%

Duplicate sample precision:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (mg $CaCO_3$/L)	%RPD = {(S - D) /[(S+D)/2]} x 100
130515.09	TVASSWINTUV 2	50	45.5	48.3	2.8	20.0	S 56	
↓	Duplicate (B)	↓	0.0	2.8	2.8	↓	D 56	JB 05·18·13

Matrix spike recovery:

Reference standard number	Spike value (SV) (mg $CaCO_3$/L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Spike hardness (A) (mg $CaCO_3$/L)
INSS 1129	40	50	0.0	4.7	4.7	20.0	94

Sample hardness (B) (mg $CaCO_3$/L)	Measured spike value (MV) MV = A - B (mg $CaCO_3$/L)	% R = MV / SV x 100 (acceptable range = 75 to 125%)
56	38	95.0%

Sample measurements:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (mg $CaCO_3$/L)
TV = ND	Blank (should be = 0 mg $CaCO_3$/L)						JB 05·18·13
130517.08	TVASSWINTUV 3	50	4.7	7.6	2.9	20.0	58
130513.03	TVAWBN 101 1	↓	7.6	11.9	4.3	↓	86
130515.10	↓ 2		11.9	16.4	4.5		90
130517.09	↓ 3		16.4	21.3	4.9		98
130513.04	TVAWBN 101 INT 1		21.3	24.4	3.1		62
130515.11	↓ 2		24.4	27.8	3.4		68
130517.10	↓ 3		27.8	31.5	3.7		74
130513.05	TVAWBN 113 1		31.5	35.0	3.5		70
130515.12	↓ 2	↓	35.0	38.5	3.5	↓	70

Note: If >15ml of titrant is used, sample must be diluted. Reviewed by: [signature] Date reviewed 05·18·13

ETS Environmental Testing Solutions, Inc.

Hardness (SM 2340 C-1997)

RL = 1.0 mg $CaCO_3$/L

Analyst: JJB
Date analyzed: 05.18.13

Time initiated:
Time completed: JJB 05.18.13

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
						JJB 05.18.13

Laboratory control standard:

Reference standard number	True value (TV) (mg $CaCO_3$/L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (MV) (mg $CaCO_3$/L)	% RS = MV / TV x 100 (acceptable range = 90 to 110%)
INSS 1129	40	50	38.5	40.5	2.0	20.0	40	100.0%

Duplicate sample precision:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (mg $CaCO_3$/L)	%RPD = {(S - D) /[(S+D)/2]} x 100
130517.11	TVAWBN113B 3	50	40.5	44.0	3.5	20.0	S 70	
↓	Duplicate (B)	↓	44.0	47.5	3.5	↓	D 70	JJB 05.18.13

Matrix spike recovery:

Reference standard number	Spike value (SV) (mg $CaCO_3$/L)	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Spike hardness (A) (mg $CaCO_3$/L)
INSS 1129	40	50	44.0	49.5	5.5	20.0	110

Sample hardness (B) (mg $CaCO_3$/L)	Measured spike value (MV) MV = A - B (mg $CaCO_3$/L)	% R = MV / SV x 100 (acceptable range = 75 to 125%)
70	40	100.0%

Sample measurements:

Sample number	Sample ID	Sample volume (ml)	Begin ml	End ml	Total ml	Multiplier	Hardness (mg $CaCO_3$/L)
TV = ND	Blank (should be = 0 mg $CaCO_3$/L)						JJB 05.18.13
130513.06	TVAWBN113WT1	50	0.0	3.1	3.1	20.0	62
130515.13	2	↓	3.1	6.3	3.2	↓	64
130517.12	3	↓	6.3	9.7	3.4	↓	68
130508.23	F.City - Finished	↓	9.7	10.8	1.1	↓	22
↓	Horsehead 2000mg/L	0.5	10.8	13.2	2.4	(100) ↓	4800
							JJB 05.18.13

Note: If >15ml of titrant is used, sample must be diluted. Reviewed by: JJ Date reviewed: 05.18.13

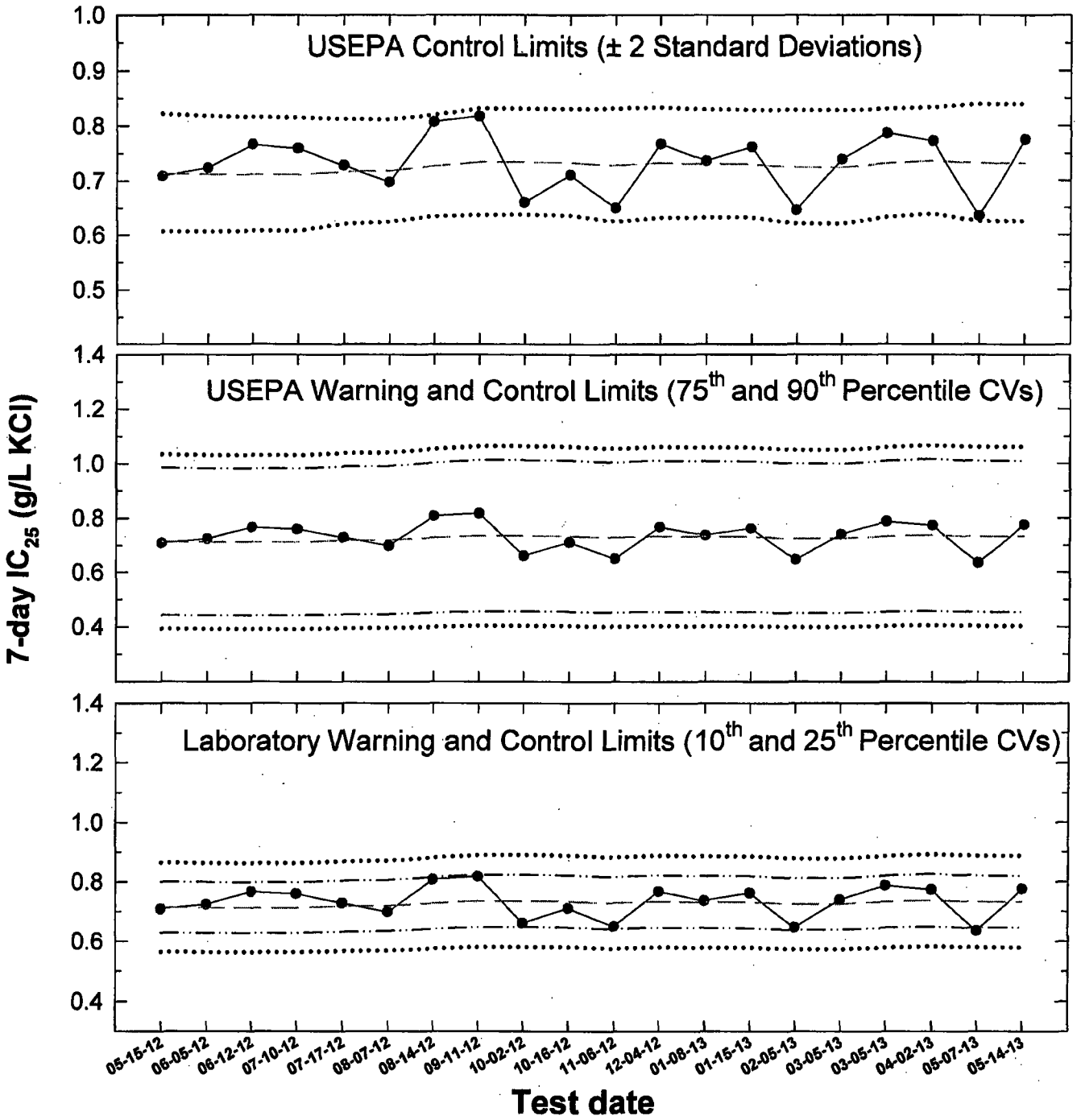
Sequoyah Nuclear Plant Biomonitoring
May 14 – 21, 2013

Appendix D

Reference Toxicant Test and
Control Chart

Environmental Testing Solutions, Inc.

Pimephales promelas
Chronic Reference Toxicant Control Chart
Organism Source: Aquatox, Inc.



—●— **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)

Graphs generated from associated excel spreadsheet.
Excel spreadsheet entered by: J. Sumner
Reviewed by: _____

Independent Review by Kelley E. Keenan Initials: KK

Independent Review by Kelley E. Keenan Initials:

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 CT - 2S	State and USEPA Control Limits CT + 2S	$S_{A.10}$	Laboratory Warning Limits CT - $S_{A.10}$	Laboratory Warning Limits CT + $S_{A.10}$	$S_{A.25}$	Laboratory Control Limits CT - $S_{A.25}$	Laboratory Control Limits CT + $S_{A.25}$	$S_{A.75}$	USEPA Warning Limits CT - $S_{A.75}$	USEPA Warning Limits CT + $S_{A.75}$	$S_{A.90}$	USEPA Control Limits CT - $S_{A.90}$	USEPA Control Limits CT + $S_{A.90}$	CV
1	05-15-12	0.71	0.71	0.05	0.61	0.82	0.09	0.63	0.80	0.15	0.56	0.86	0.27	0.44	0.99	0.32	0.39	1.04	0.08
2	06-05-12	0.72	0.71	0.05	0.61	0.82	0.09	0.63	0.80	0.15	0.56	0.86	0.27	0.44	0.98	0.32	0.39	1.03	0.07
3	06-12-12	0.77	0.71	0.05	0.61	0.82	0.09	0.63	0.80	0.15	0.56	0.86	0.27	0.44	0.98	0.32	0.39	1.03	0.07
4	07-10-12	0.76	0.71	0.05	0.61	0.82	0.09	0.63	0.80	0.15	0.56	0.86	0.27	0.44	0.98	0.32	0.39	1.03	0.07
5	07-17-12	0.73	0.72	0.05	0.62	0.81	0.09	0.63	0.80	0.15	0.57	0.87	0.27	0.44	0.99	0.32	0.39	1.04	0.07
6	08-07-12	0.70	0.72	0.05	0.62	0.81	0.09	0.63	0.80	0.15	0.57	0.87	0.27	0.45	0.99	0.32	0.40	1.04	0.07
7	08-14-12	0.81	0.73	0.05	0.63	0.82	0.09	0.64	0.81	0.15	0.57	0.88	0.28	0.45	1.00	0.33	0.40	1.05	0.06
8	09-11-12	0.82	0.73	0.05	0.64	0.83	0.09	0.65	0.82	0.15	0.58	0.89	0.28	0.46	1.01	0.33	0.40	1.06	0.07
9	10-02-12	0.66	0.73	0.05	0.64	0.83	0.09	0.65	0.82	0.15	0.58	0.89	0.28	0.46	1.01	0.33	0.40	1.06	0.07
10	10-16-12	0.71	0.73	0.05	0.64	0.83	0.09	0.65	0.82	0.15	0.58	0.89	0.28	0.45	1.01	0.33	0.40	1.06	0.07
11	11-06-12	0.65	0.73	0.05	0.62	0.83	0.09	0.64	0.82	0.15	0.57	0.88	0.28	0.45	1.00	0.33	0.40	1.06	0.07
12	12-04-12	0.77	0.73	0.05	0.63	0.83	0.09	0.64	0.82	0.15	0.58	0.89	0.28	0.45	1.01	0.33	0.40	1.06	0.07
13	01-08-13	0.74	0.73	0.05	0.63	0.83	0.09	0.64	0.82	0.15	0.58	0.88	0.28	0.45	1.01	0.33	0.40	1.06	0.07
14	01-15-13	0.76	0.73	0.05	0.63	0.83	0.09	0.64	0.82	0.15	0.58	0.88	0.28	0.45	1.01	0.33	0.40	1.06	0.07
15	02-05-13	0.65	0.72	0.05	0.62	0.83	0.09	0.64	0.81	0.15	0.57	0.88	0.28	0.45	1.00	0.33	0.40	1.05	0.07
16	03-05-13	0.74	0.72	0.05	0.62	0.83	0.09	0.64	0.81	0.15	0.57	0.88	0.28	0.45	1.00	0.33	0.40	1.05	0.07
17	03-05-13	0.79	0.73	0.05	0.63	0.83	0.09	0.64	0.82	0.15	0.58	0.89	0.28	0.45	1.01	0.33	0.40	1.06	0.07
18	04-02-13	0.77	0.74	0.05	0.64	0.83	0.09	0.65	0.82	0.15	0.58	0.89	0.28	0.46	1.02	0.33	0.40	1.07	0.07
19	05-07-13	0.63	0.73	0.05	0.62	0.84	0.09	0.64	0.82	0.15	0.58	0.89	0.28	0.45	1.01	0.33	0.40	1.06	0.07
20	05-14-13	0.78	0.73	0.05	0.62	0.84	0.09	0.64	0.82	0.15	0.58	0.89	0.28	0.45	1.01	0.33	0.40	1.06	0.07

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^{th} percentile CV. ($S_{A.10}$ = 0.12)

$S_{A.25}$ = Standard deviation corresponding to the 25^{th} percentile CV. ($S_{A.25}$ = 0.21)

USEPA Control and Warning Limits

$S_{A.75}$ = Standard deviation corresponding to the 75^{th} percentile CV. ($S_{A.75}$ = 0.38)

$S_{A.90}$ = Standard deviation corresponding to the 90^{th} percentile CV. ($S_{A.90}$ = 0.45)

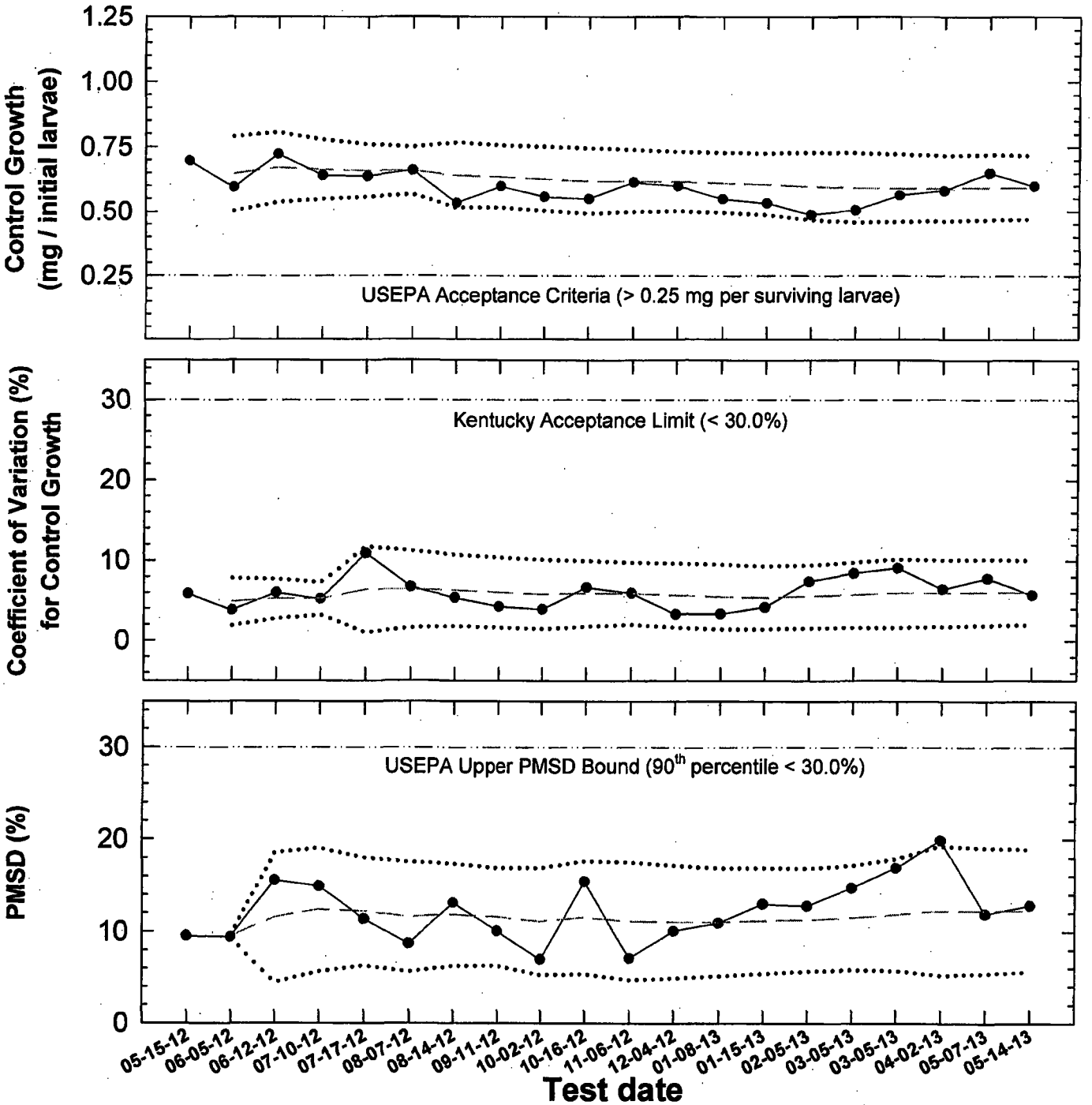
CV = Coefficient of variation of the IC_{25} values.

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.

File: ppkclcr_051413.xlsx
Entered by: J. Sumner
Reviewed by: JH

Environmental Testing Solutions, Inc.

Pimephales promelas
Chronic Reference Toxicant Control Chart
Precision of Endpoint Measurements
Organism Source: Aquatox, Inc.



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 ± 2 Standard Deviations)

Independent Review by Kelley E. Keenan Initials:

Graphs generated from associated excel spreadsheet.
Excel spreadsheet entered by: J. Sumner
Reviewed by: _____

ETS Environmental Testing Solutions, Inc.

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	05-15-12	100	0.697		5.9		0.07	9.5	
2	06-05-12	97.5	0.596	0.647	3.8	4.9	0.06	9.4	9.5
3	06-12-12	100	0.723	0.672	6.0	5.2	0.11	15.6	11.5
4	07-10-12	100	0.641	0.664	5.2	5.2	0.10	14.9	12.4
5	07-17-12	100	0.638	0.659	10.9	6.4	0.07	11.4	12.2
6	08-07-12	97.5	0.660	0.659	6.7	6.4	0.06	8.7	11.6
7	08-14-12	100	0.533	0.641	5.4	6.3	0.07	13.1	11.8
8	09-11-12	100	0.599	0.636	4.2	6.0	0.06	10.1	11.6
9	10-02-12	100	0.558	0.627	3.9	5.8	0.04	7.0	11.1
10	10-16-12	97.5	0.550	0.620	6.7	5.9	0.09	15.5	11.5
11	11-06-12	100	0.615	0.619	5.9	5.9	0.04	7.1	11.1
12	12-04-12	100	0.601	0.618	3.3	5.7	0.06	10.1	11.0
13	01-08-13	100	0.549	0.612	3.3	5.5	0.06	11.0	11.0
14	01-15-13	100	0.532	0.607	4.2	5.4	0.07	13.0	11.2
15	02-05-13	100	0.487	0.599	7.4	5.5	0.06	12.8	11.3
16	03-05-13	100	0.504	0.593	8.5	5.7	0.07	14.7	11.5
17	03-05-13	100	0.564	0.591	9.1	5.9	0.10	16.9	11.8
18	04-02-13	100	0.582	0.590	6.5	5.9	0.12	19.9	12.3
19	05-07-13	100	0.651	0.594	7.8	6.0	0.08	11.9	12.2
20	05-14-13	100	0.599	0.594	5.7	6.0	0.08	12.8	12.3

Note:

CV = Coefficient of variation for control growth.
Lower CV bound determined by USEPA (10th percentile) = 3.5%.
Upper CV bound determined by USEPA (90th 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 (10th percentile) = 12%.
Upper PMSD bound determined by USEPA (90th percentile) = 30%.

CT = Central Tendancy (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.

Independent Review by Kelley E. Keenan Initials:

File: ppkclcr_051413.xlsx
Entered by: J. Sumner
Reviewed by:

ETS Environmental Testing Solutions, Inc.

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

PpKClCR Test Number: 268

Dilution preparation information:							*Comments:*
KCl Stock INSS number:			INSS 1172				
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 age:	23 HOURS OLD	Randomizing template:	GREEN
Date and times organisms were born between:	05-13-13 1600	Incubator number and shelf location:	3D
Organism source:	ATOX BATCH Pp 05-13-13	*Artemia* CHM number:	CHM720
		Drying information for weight determination:	
Transfer vessel information:	pH = 7.75 S.U. Temperature = 24.7 °C	Date / Time in oven:	05-21-13 1440
		Initial oven temperature:	60 °C
Average transfer volume:	1.165 mL	Date / Time out of oven:	05-22-13 1440
		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		MHSW batch used
		Time	Analyst	Time	Analyst	Time	Analyst	
0	05-14-13			1540	JH	1500	JH	05-11-13
1	05-15-13	0800	JH	1415	JH	1400	JH	06-11-13
2	05-16-13	0830	JH	1430	JH	1400	JH	05-13-13 A
3	05-17-13	0830	JH	1430	JH	1405	JH	05-13-13 A
4	05-18-13	0830	JH	1430	JH	1400	JH	05-15-13
5	05-19-13	0815	JH	1415	JH	1400	JH	05-17-13 A
6	05-20-13	0815	JH	1415	JH	1402	JH	05-17-13 A
7	05-21-13					1436	JH	

Control information:		Acceptance criteria	*Summary of test endpoints:*	
% Mortality:	01.	≤20%	7-day LC_{50}	828.2
Average weight per initial larvae:	0.599		NOEC	600
Average weight per surviving larvae:	0.599	≥ 0.25 mg/larvae	LOEC	750
			ChV	670.8
			IC_{25}	775.4

Independent Review by Kelley E. Keenan Initial: KK

ETS Environmental Testing Solutions, Inc.

Species: ***Pimephales promelas***

PpKClCR Test Number: 268

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:: magenta Analyst: JLB Date: 05.09.13	13.22	13.19	13.57	14.07	13.97	12.60	13.15	12.88	13.02	14.27	14.20	14.03
B = Pan + Larvae weight (mg) Analyst: JLB Date: 05.22.13	19.01	19.19	19.27	20.53	20.39	18.66	19.19	19.26	19.11	21.13	19.87	19.84
C = Larvae weight (mg) = B – A Hand calculated. Analyst:	5.79	6.00	5.70	6.46	6.42	6.06	6.04	6.38	6.09	6.86	5.67	5.81
Weight per initial number of larvae (mg) = C / Initial number of larvae Hand calculated. Analyst:	0.579	0.600	0.570	0.646	0.642	0.606	0.604	0.638	0.609	0.686	0.567	0.581
Average weight per initial number of larvae (mg)	0.599				0.623		-4.07.		0.611		-2.07.	
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:

Independent Review by Kelley E. Keenan Initials: KK

ETS Environmental Testing Solutions, Inc.

Species: ***Pimephales promelas*** PpKClCR Test Number: 268

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	9[1d]	9[1d]	9[1d]	10	6[4d]	5[5d]	5[5d]	6[4d]
2	10	10	10	10	9	8[1d]	9	10	6	5	5	5[1d]
3	9[1d]	9[1d]	10	9[1d]	9	8	9	9[1d]	6	5	5	5
4	9	9	10	9	9	8	9	8[1d]	6	5	5	5
5	9	9	10	9	9	8	8[1d]	8	4[2d]	3[2d]	3[2d]	4[1d]
6	9	8[1d]	10	9	9	8	8	8	4	3	3	4
7	9	8	10	9	8[1d]	6[2d]	7[1d]	8	4	3	3[1fg]	4
A = Pan weight (mg) Tray color code:: magenta Analyst: JCB Date: 05-09-13	13.96	13.40	13.39	13.13	13.15	13.54	13.81	12.93	15.64	14.72	12.97	13.26
B = Pan + Larvae weight (mg) Analyst: JCB Date: 05-22-13	19.99	17.92	19.18	18.28	17.96	17.97	18.52	19.01	18.40	16.94	15.73	15.45
C = Larvae weight (mg) = B – A Hand calculated. Analyst: JL	6.03	4.52	5.79	5.15	4.81	4.43	4.71	6.08	2.76	2.22	2.76	2.19
Weight per initial number of larvae (mg) = C / Initial number of larvae Hand calculated. Analyst: JL	0.603	0.452	0.579	0.515	0.481	0.443	0.471	0.608	0.276	0.222	0.276	0.219
Average weight per initial number of larvae (mg)	0.537		0.501		0.248							
Percent reduction from control (%)	10.37.		16.47.		68.57.							

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:

Independent Review by Kelley E. Keenan Initials: KK

ETS Environmental Testing Solutions, Inc.

Species: ***Pimephales promelas*** PpKClCR Test Number: 268

Survival and Growth Data

Day	1050 mg KCl/L			
	Y	Z	AA	BB
0	10	10	10	10
1	5 Sd	5 Sd	4 Sd	5 Sd
2	3 1d	5	3 1d	4 1d
3	3	4 1d	2 1d	3 1d
4	3	2 2d	2	3
5	3	2	2	3
6	2 1d	1 1d	2	2 1d
7	2 SM	1	1 1d Lb	1 1d SM
A = Pan weight (mg) Tray color code:: magenta Analyst: JLB Date: 05-09-13	13.75	13.49	12.95	14.11
B = Pan + Larvae weight (mg) Analyst: JLB Date: 05-22-13	14.68	14.23	13.97	14.53
C = Larvae weight (mg) = B – A Hand calculated. Analyst:	0.93	0.74	1.02	0.42
Weight per initial number of larvae (mg) = C / Initial number of larvae Hand calculated. Analyst:	0.093	0.074	0.102	0.042
Average weight per initial number of larvae (mg)	0.078			
Percent reduction from control (%)	87.07			

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 1000.0

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

Test number: 268
Test dates: May 14-21, 2013

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) = A - B	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	13.22	19.01	5.79	0.579	0.599	5.7	0.579	100.0	0.599	5.7	Not applicable
	B	10	10	13.19	19.19	6.00	0.600			0.600				
	C	10	10	13.57	19.27	5.70	0.570			0.570				
	D	10	10	14.07	20.53	6.46	0.646			0.646				
300	E	10	10	13.97	20.39	6.42	0.642	0.623	3.3	0.642	100.0	0.623	3.3	-4.0
	F	10	10	12.60	18.66	6.06	0.606			0.606				
	G	10	10	13.15	19.19	6.04	0.604			0.604				
	H	10	10	12.88	19.26	6.38	0.638			0.638				
450	I	10	10	13.02	19.11	6.09	0.609	0.611	8.7	0.609	100.0	0.611	8.7	-2.0
	J	10	10	14.27	21.13	6.86	0.686			0.686				
	K	10	10	14.20	19.87	5.67	0.567			0.567				
	L	10	10	14.03	19.84	5.81	0.581			0.581				
600	M	10	9	13.96	19.99	6.03	0.670	0.597	8.3	0.603	90.0	0.537	12.6	10.3
	N	10	8	13.40	17.92	4.52	0.565			0.452				
	O	10	10	13.39	19.18	5.79	0.579			0.579				
	P	10	9	13.13	18.28	5.15	0.572			0.515				
750	Q	10	8	13.15	17.96	4.81	0.601	0.693	10.3	0.481	72.5	0.501	14.6	16.4
	R	10	6	13.54	17.97	4.43	0.738			0.443				
	S	10	7	13.81	18.52	4.71	0.673			0.471				
	T	10	8	12.93	19.01	6.08	0.760			0.608				
900	U	10	4	15.64	18.40	2.76	0.690	0.724	21.2	0.276	35.0	0.248	12.9	58.5
	V	10	3	14.72	16.94	2.22	0.740			0.222				
	W	10	3	12.97	15.73	2.76	0.920			0.276				
	X	10	4	13.26	15.45	2.19	0.548			0.219				
1050	Y	10	2	13.75	14.68	0.93	0.465	0.661	42.0	0.093	12.5	0.078	34.1	87.0
	Z	10	1	13.49	14.23	0.74	0.740			0.074				
	AA	10	1	12.95	13.97	1.02	1.020			0.102				
	BB	10	1	14.11	14.53	0.42	0.420			0.042				

Dunnett's MSD value: 0.0768 MSD = Minimum Significant Difference
PMSD: 12.8 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 (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.

File: ppkclcr_051413.xlsx
Entered by: J. Sumner
Reviewed by: JS

Larval Fish Growth and Survival Test-7 Day Survival

Start Date:	5/14/2013	Test ID:	PpKClCR	Sample ID:	REF-Ref Toxicant
End Date:	5/21/2013	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	0.9000	0.8000	1.0000	0.9000
750	0.8000	0.6000	0.7000	0.8000
900	0.4000	0.3000	0.3000	0.4000
1050	0.2000	0.1000	0.1000	0.1000

			Transform: Arcsin Square Root					Rank	1-Tailed	Number	Total
Conc-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	0.9000	0.9000	1.2543	1.1071	1.4120	9.935	4	12.00	10.00	4	40
*750	0.7250	0.7250	1.0229	0.8861	1.1071	10.398	4	10.00	10.00	11	40
*900	0.3500	0.3500	0.6322	0.5796	0.6847	9.597	4	10.00	10.00	26	40
*1050	0.1250	0.1250	0.3572	0.3218	0.4636	19.861	4	10.00	10.00	35	40

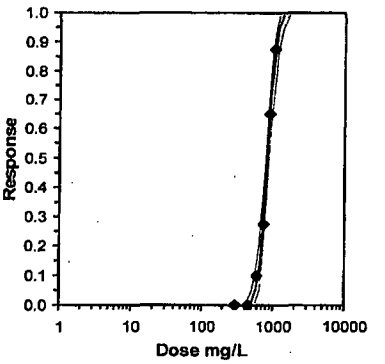
Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.89176	0.896	0.06591	1.68612
Equality of variance cannot be confirmed				

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Steel's Many-One Rank Test	600	750	670.82	
Treatments vs D-Control				

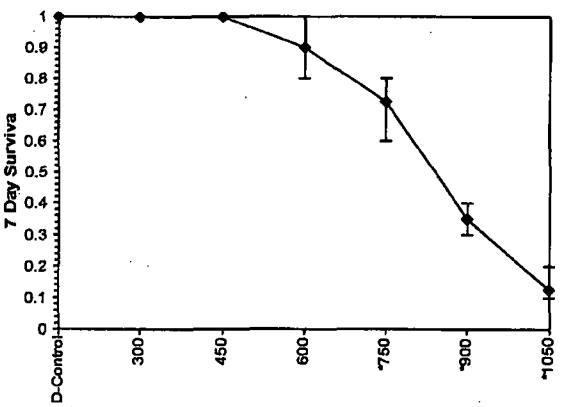
Maximum Likelihood-Probit

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	10.5215	1.36357	7.84887	13.1941	0	1.16914	9.48773	0.88315	2.91814	0.09504	3
Intercept	-25.703	3.97572	-33.498	-17.911							
TSCR											

Point	Probits	mg/L	95% Fiducial Limits	
EC01	2.674	497.782	415.931	555.987
EC05	3.355	577.845	506.211	628.394
EC10	3.718	625.664	561.398	671.607
EC15	3.964	660.143	601.448	703.066
EC20	4.158	688.896	634.794	729.704
EC25	4.326	714.56	664.335	753.969
EC40	4.747	783.548	741.183	822.982
EC50	5.000	828.218	787.641	871.902
EC60	5.253	875.434	833.371	927.764
EC75	5.674	959.954	908.252	1036.68
EC80	5.842	995.716	938.1	1085.33
EC85	6.036	1039.09	973.331	1145.88
EC90	6.282	1096.35	1018.64	1227.96
EC95	6.645	1187.07	1088.41	1362.18
EC99	7.326	1378	1229.87	1658.24



Dose-Response Plot



Independent Review by Kelley E. Keenan Initials:

File: ppkclcr_051413.xlsx
Entered by: J. Sumner
Reviewed by:

Larval Fish Growth and Survival Test-7 Day Growth

Start Date:	5/14/2013	Test ID:	PpKClCR	Sample ID:	REF-Ref Toxicant
End Date:	5/21/2013	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:					

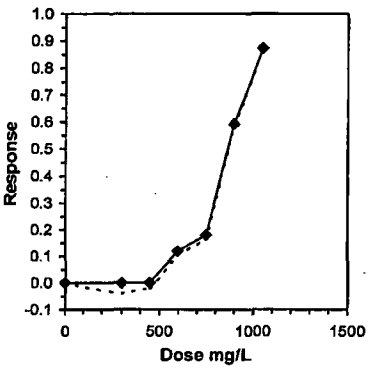
Conc-mg/L	1	2	3	4
D-Control	0.5790	0.6000	0.5700	0.6460
300	0.6420	0.6060	0.6040	0.6380
450	0.6090	0.6860	0.5670	0.5810
600	0.6030	0.4520	0.5790	0.5150
750	0.4810	0.4430	0.4710	0.6080
900	0.2760	0.2220	0.2760	0.2190
1050	0.0930	0.0740	0.1020	0.0420

			Transform: Untransformed					1-Tailed			Isotonic	
Conc-mg/L	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Mean	N-Mean
D-Control	0.5988	1.0000	0.5988	0.5700	0.6460	5.664	4				0.6107	1.0000
300	0.6225	1.0397	0.6225	0.6040	0.6420	3.259	4	-0.708	2.290	0.0768	0.6107	1.0000
450	0.6108	1.0200	0.6108	0.5670	0.6860	8.697	4	-0.358	2.290	0.0768	0.6107	1.0000
600	0.5373	0.8973	0.5373	0.4520	0.6030	12.637	4	1.834	2.290	0.0768	0.5373	0.8798
750	0.5008	0.8363	0.5008	0.4430	0.6080	14.635	4				0.5008	0.8200
900	0.2483	0.4146	0.2483	0.2190	0.2760	12.917	4				0.2483	0.4065
1050	0.0778	0.1299	0.0778	0.0420	0.1020	34.132	4				0.0778	0.1273

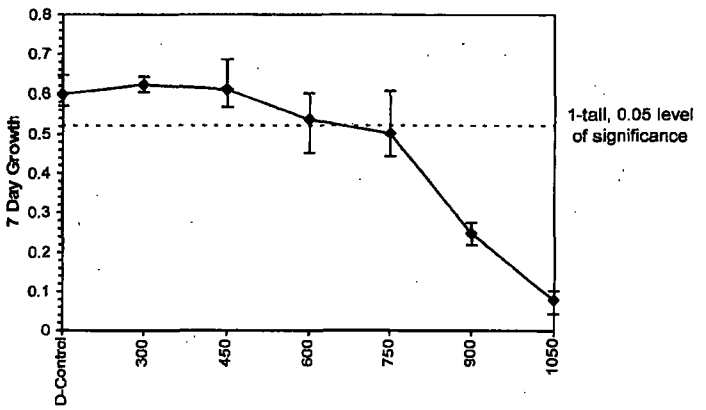
Auxiliary Tests					Statistic		Critical		Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)					0.96436		0.844		0.11667	-0.0895
Bartlett's Test indicates equal variances (p = 0.29)					3.74779		11.3449			
Hypothesis Test (1-tail, 0.05)	**NOEC**	**LOEC**	**ChV**	**TU**	**MSDu**	**MSDp**	**MSB**	**MSE**	**F-Prob**	**df**
Dunnett's Test Treatments vs D-Control	600	>600			0.07678	0.12823	0.00577	0.00225	0.10344	3, 12

Linear Interpolation (200 Resamples)

Point	mg/L	SD	95% CL(Exp)		Skew
IC05	512.38	48.38	346.57	683.57	0.9162
IC10	574.77	57.18	449.28	858.61	1.1978
IC15	674.73	69.11	470.86	823.64	-0.0055
IC20	757.26	52.65	485.54	796.15	-1.5179
IC25	775.40	20.36	692.50	809.44	-1.6735
IC40	829.81	10.01	792.62	850.94	-0.2375
IC50	866.09	8.39	837.29	890.11	-0.0572



Dose-Response Plot



Independent review by Kelley E. Keenan Initials:

File: ppkclcr_051413.xlsx
Entered by: J. Sumner
Reviewed by:

ETS Environmental Testing Solutions, Inc.

Species: ***Pimephales promelas*** PpKClCR Test Number: 768

Daily Chemistry:

		Day (Analyst identified for each day, performed pH, D.O. and conductivity measurements only.)					
		0		1		2	
	Analyst	JB	JB/mf	JB/mf	JB	JB	JB
Concentration	Parameter						
CONTROL	pH (S.U.)	7.93	7.81	7.93	7.81	7.97	7.78
	DO (mg/L)	7.7	7.7		7.6	7.7	7.4
	Conductivity (µmhos/cm)	313		309		307	
	*Alkalinity (mg $CaCO_3$/L)	61				62	
	*Hardness (mg $CaCO_3$/L)	84				88	
	*Temperature (°C)	24.7	24.3	24.8	24.5	24.7	24.3
300 mg KCl/L	pH (S.U.)	7.95	7.80	7.91	7.79	7.93	7.78
	DO (mg/L)	7.7	7.8	7.9	7.6	7.9	7.4
	Conductivity (µmhos/cm)	851		834		830	
	*Temperature (°C)	24.8	24.5	24.8	24.3	24.7	24.2
450 mg KCl/L	pH (S.U.)	7.95	7.78	7.92	7.80	7.94	7.78
	DO (mg/L)	7.7	7.8	7.9	7.6	7.8	7.4
	Conductivity (µmhos/cm)	1120		1090		1100	
	*Temperature (°C)	24.8	24.5	24.8	24.3	24.7	24.2
600 mg KCl/L	pH (S.U.)	7.94	7.80	7.91	7.77	7.93	7.78
	DO (mg/L)	7.7	7.8	7.9	7.5	7.9	7.4
	Conductivity (µmhos/cm)	1880		1340		1370	
	*Temperature (°C)	24.8	24.6	24.8	24.2	24.7	24.4
750 mg KCl/L	pH (S.U.)	7.95	7.79	7.91	7.76	7.93	7.79
	DO (mg/L)	7.7	7.8	7.9	7.5	7.9	7.4
	Conductivity (µmhos/cm)	1630		1590		1590	
	*Temperature (°C)	24.9	24.3	24.8	24.4	24.7	24.4
900 mg KCl/L	pH (S.U.)	7.94	7.80	7.90	7.76	7.93	7.76
	DO (mg/L)	7.8	7.8	7.9	7.5	7.9	7.4
	Conductivity (µmhos/cm)	1880		1800		1860	
	*Temperature (°C)	24.9	24.3	24.8	24.2	24.8	24.4
1050 mg KCl/L	pH (S.U.)	7.94	7.79	7.90	7.74	7.92	7.79
	DO (mg/L)	7.8	7.8	7.9	7.5	7.9	7.4
	Conductivity (µmhos/cm)	2150		2020		2090	
	*Temperature (°C)	24.8	24.3	24.7	24.3	24.8	24.3
STOCK	Conductivity (µmhos/cm)	66400					
		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: JB.

Independent Review by Kelley E. Keenan Initials

ETS Environmental Testing Solutions, Inc.

Species: ***Pimephales promelas***

PpKClCR Test Number: 268

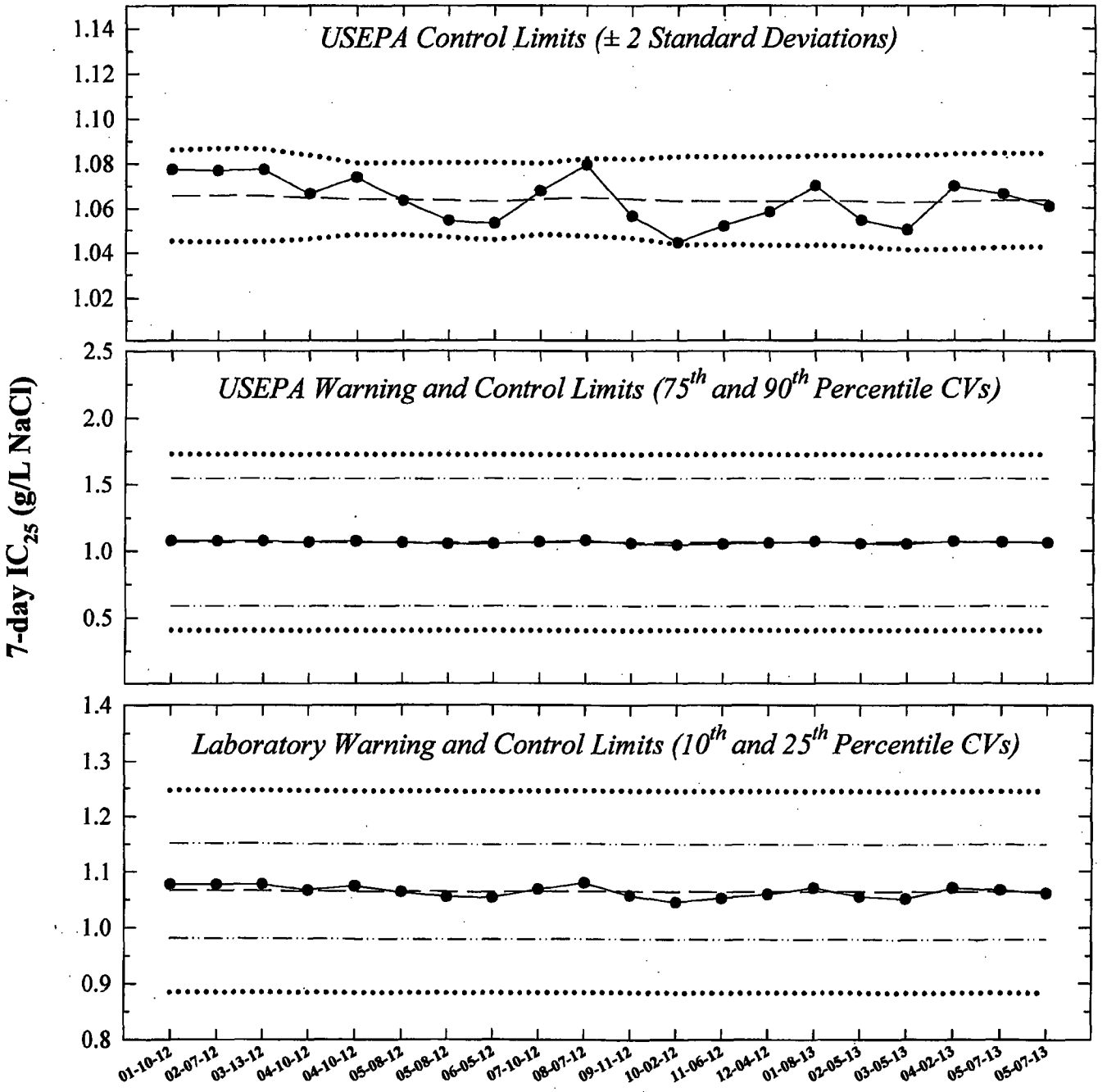
		Day (Analyst identified for each day, performed pH, D.O. and conductivity measurements only.)							
		3		4		5		6	
	Analyst	JJB	JJB	JJB	JJB	JJB	JJB	JJB	JJB
Concentration	**Parameter**								
CONTROL	pH (S.U.)	7.97	7.77	7.89	7.77	8.00	7.80	7.93	7.71
	DO (mg/L)	7.7	7.5	7.6	7.4	7.7	7.6	7.7	7.5
	Conductivity (µmhos/cm)	310		308		311		314	
	*Alkalinity (mg $CaCO_3$/L)	~~JJB~~		61		61		~~JJB~~	
	*Hardness (mg $CaCO_3$/L)	~~JJB~~		88		88		~~JJB~~	
	*Temperature (°C)	24.7	24.5	24.8	24.2	24.9	24.4	24.7	24.3
300 mg KCl/L	pH (S.U.)	7.96	7.72	7.97	7.68	7.92	7.77	7.94	7.71
	DO (mg/L)	7.8	7.5	7.9	7.4	8.0	7.6	8.0	7.5
	Conductivity (µmhos/cm)	807		816		824		834	
	*Temperature (°C)	24.7	24.7	24.7	24.3	24.8	24.4	24.6	24.2
450 mg KCl/L	pH (S.U.)	7.97	7.75	7.96	7.74	7.92	7.75	7.93	7.68
	DO (mg/L)	7.8	7.4	7.9	7.4	8.0	7.6	8.0	7.5
	Conductivity (µmhos/cm)	1060		1080		1070		1080	
	*Temperature (°C)	24.8	24.4	24.7	24.3	24.8	24.2	24.6	24.3
600 mg KCl/L	pH (S.U.)	7.97	7.75	7.97	7.73	7.92	7.75	7.93	7.75
	DO (mg/L)	7.8	7.4	7.9	7.4	8.0	7.6	8.0	7.5
	Conductivity (µmhos/cm)	1310		1330		1320		1330	
	*Temperature (°C)	24.8	24.4	24.7	24.4	24.8	24.2	24.7	24.3
750 mg KCl/L	pH (S.U.)	7.97	7.72	7.96	7.71	7.92	7.75	7.93	7.74
	DO (mg/L)	7.9	7.4	7.9	7.4	8.0	7.7	8.0	7.5
	Conductivity (µmhos/cm)	1540		1560		1570		1570	
	*Temperature (°C)	24.8	24.6	24.7	24.1	24.8	24.2	24.7	24.1
900 mg KCl/L	pH (S.U.)	7.97	7.66	7.96	7.66	7.92	7.74	7.93	7.70
	DO (mg/L)	7.9	7.4	7.9	7.3	8.0	7.7	8.0	7.5
	Conductivity (µmhos/cm)	1830		1830		1840		1800	
	*Temperature (°C)	24.8	24.3	24.7	24.3	24.9	24.3	24.7	24.4
1050 mg KCl/L	pH (S.U.)	7.96	7.76	7.96	7.65	7.91	7.77	7.92	7.76
	DO (mg/L)	7.9	7.4	7.9	7.3	8.0	7.7	8.1	7.5
	Conductivity (µmhos/cm)	2050		2070		2080		2050	
	*Temperature (°C)	24.7	24.4	24.7	24.3	24.9	24.4	24.7	24.2
		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 and hardness performed by the analyst identified on the bench sheet specific for each analysis and transcribed to this bench sheet by: JJB.

Independent Review by Kelley E. Keenan Initials: KK

Environmental Testing Solutions, Inc.

Ceriodaphnia dubia
Chronic Reference Toxicant Control Chart



Test date

—●— **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)

Independent Review by Kelley E. Keenan

Graphs generated from associated excel spreadsheet.
Excel spreadsheet entered by: J. Sumner
Reviewed by:

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 CT - 2S	CT + 2S	$S_{A.10}$	Laboratory Warning Limits CT - $S_{A.10}$	CT + $S_{A.10}$	$S_{A.25}$	Laboratory Control Limits CT - $S_{A.25}$	CT + $S_{A.25}$	$S_{A.75}$	USEPA Warning Limits CT - $S_{A.75}$	CT + $S_{A.75}$	$S_{A.90}$	USEPA Control Limits CT - $S_{A.90}$	CT + $S_{A.90}$	CV
1	01-10-12	1.08	1.07	0.01	1.04	1.09	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
2	02-07-12	1.08	1.07	0.01	1.04	1.09	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
3	03-13-12	1.08	1.07	0.01	1.04	1.09	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
4	04-10-12	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
5	04-10-12	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
6	05-08-12	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
7	05-08-12	1.05	1.06	0.01	1.05	1.08	0.09	0.98	1.15	0.18	0.88	1.24	0.48	0.58	1.54	0.66	0.40	1.72	0.01
8	06-05-12	1.05	1.06	0.01	1.05	1.08	0.09	0.98	1.15	0.18	0.88	1.24	0.48	0.58	1.54	0.66	0.40	1.72	0.01
9	07-10-12	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
10	08-07-12	1.08	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
11	09-11-12	1.06	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
12	10-02-12	1.04	1.06	0.01	1.04	1.08	0.09	0.98	1.15	0.18	0.88	1.24	0.48	0.58	1.54	0.66	0.40	1.72	0.01
13	11-06-12	1.05	1.06	0.01	1.04	1.08	0.09	0.98	1.15	0.18	0.88	1.24	0.48	0.58	1.54	0.66	0.40	1.72	0.01
14	12-04-12	1.06	1.06	0.01	1.04	1.08	0.09	0.98	1.15	0.18	0.88	1.24	0.48	0.58	1.54	0.66	0.40	1.72	0.01
15	01-08-13	1.07	1.06	0.01	1.04	1.08	0.09	0.98	1.15	0.18	0.88	1.24	0.48	0.58	1.54	0.66	0.40	1.72	0.01
16	02-05-13	1.05	1.06	0.01	1.04	1.08	0.09	0.98	1.15	0.18	0.88	1.24	0.48	0.58	1.54	0.66	0.40	1.72	0.01
17	03-05-13	1.05	1.06	0.01	1.04	1.08	0.08	0.98	1.15	0.18	0.88	1.24	0.48	0.58	1.54	0.66	0.40	1.72	0.01
18	04-02-13	1.07	1.06	0.01	1.04	1.08	0.09	0.98	1.15	0.18	0.88	1.24	0.48	0.58	1.54	0.66	0.40	1.72	0.01
19	05-07-13	1.07	1.06	0.01	1.04	1.08	0.09	0.98	1.15	0.18	0.88	1.24	0.48	0.58	1.54	0.66	0.40	1.72	0.01
20	05-07-13	1.06	1.06	0.01	1.04	1.08	0.09	0.98	1.15	0.18	0.88	1.24	0.48	0.58	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.

$S_{A.10}$ = Standard deviation corresponding to the 10th percentile CV. ($S_{A.10}$ = 0.08)

$S_{A.25}$ = Standard deviation corresponding to the 25th percentile CV. ($S_{A.25}$ = 0.17)

USEPA Control and Warning Limits

$S_{A.75}$ = Standard deviation corresponding to the 75th percentile CV. ($S_{A.75}$ = 0.45)

$S_{A.90}$ = Standard deviation corresponding to the 90th percentile CV. ($S_{A.90}$ = 0.62)

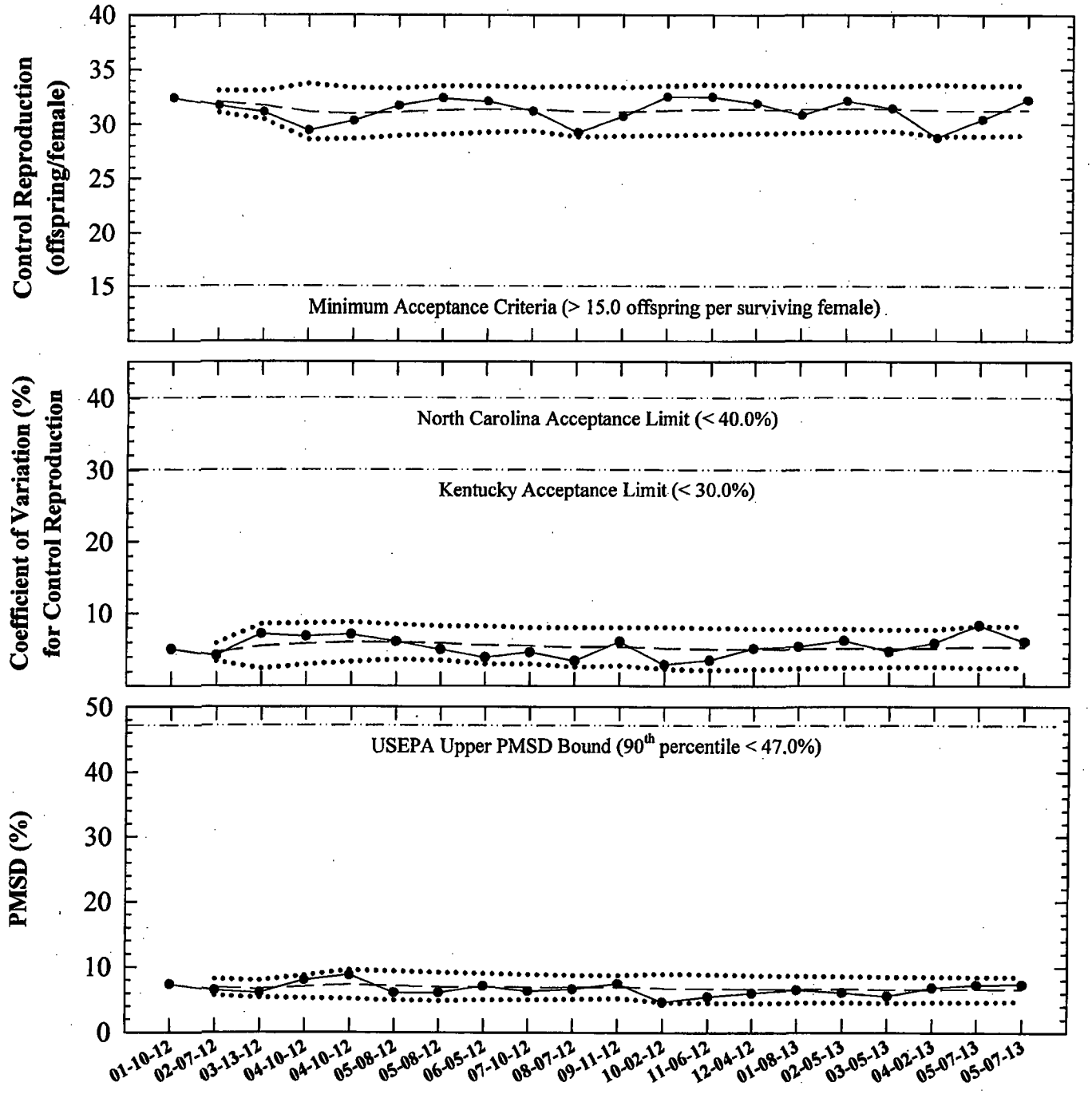
CV = Coefficient of variation of the IC_{25} values.

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.

File: CdNaClCR_050713new-ywt.xlsx
Entered by: J. Sumner
Reviewed by:

ETS
Environmental Testing Solutions, Inc.

Ceriodaphnia dubia
Chronic Reference Toxicant Control Chart
Precision of Endpoint Measurements



Test date

—●— **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 ± 2 Standard Deviations)

Independent Review by Kelley E. Keenan Initials: KK

Graphs generated from associated excel spreadsheet.
Excel spreadsheet entered by: J. Sumner
Reviewed by: KK

Environmental Testing Solutions, Inc.

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	01-10-12	100	32.4		5.1		2.4	7.4	
2	02-07-12	100	31.7	32.1	4.2	4.7	2.1	6.5	6.9
3	03-13-12	100	31.1	31.7	7.2	5.5	1.9	6.1	6.6
4	04-10-12	100	29.4	31.2	6.8	5.8	2.4	8.0	7.0
5	04-10-12	100	30.3	31.0	7.1	6.1	2.7	8.8	7.3
6	05-08-12	100	31.7	31.1	6.1	6.1	1.9	6.1	7.1
7	05-08-12	100	32.4	31.3	5.1	6.0	2.0	6.1	7.0
8	06-05-12	100	32.1	31.4	4.0	5.7	2.3	7.1	7.0
9	07-10-12	100	31.2	31.4	4.7	5.6	2.0	6.3	6.9
10	08-07-12	100	29.2	31.2	3.5	5.4	1.9	6.6	6.9
11	09-11-12	100	30.7	31.1	6.2	5.5	2.3	7.4	6.9
12	10-02-12	100	32.5	31.2	3.0	5.3	1.5	4.6	6.7
13	11-06-12	100	32.5	31.3	3.6	5.1	1.8	5.4	6.6
14	12-04-12	100	31.9	31.4	5.2	5.1	1.9	6.0	6.6
15	01-08-13	100	30.8	31.3	5.5	5.2	2.0	6.5	6.6
16	02-05-13	100	32.1	31.4	6.3	5.2	2.0	6.1	6.6
17	03-05-13	100	31.4	31.4	4.8	5.2	1.7	5.6	6.5
18	04-02-13	100	28.7	31.2	5.9	5.2	1.9	6.8	6.5
19	05-07-13	100	30.4	31.2	8.4	5.4	2.2	7.3	6.6
20	05-07-13	100	32.2	31.2	6.2	5.5	2.4	7.3	6.6

Note:

CV = Coefficient of variation for control reproduction.
Lower CV bound determined by USEPA (10th percentile) = 8.9%.
Upper CV bound determined by USEPA (90th 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 (10th percentile) = 13%.
Upper PMSD bound determined by USEPA (90th percentile) = 47%.

CT = Central Tendancy (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.

Independent Review by Kelley E. Keenan

File: CdNaClCR_050713new-ywt.xlsx
Entered by: J. Sumner
Reviewed by:

ETS Environmental Testing Solutions, Inc.

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

CdNaClCR #: 148
NEW YWT LOT

Dilution preparation information:						*Comments:*
NaCl Stock INSS number:		INSS 1160				
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:	ORANGE
Date and times organisms were born between:		05-07-13 0706 TO 0942									Incubator number and shelf location:	2B2
Culture board:	04-30-13 A											
Replicate number:	1	2	3	4	5	6	7	8	9	10	YWT batch:	04-18-13
Culture board cup number:	1	2	8	12	13	19	20	21	22	23		
Transfer vessel information:	pH = 7.93 S.U. Temperature = 24.6 °C										*Selenastrum* batch:	04-24-13
Average transfer volume (mL):	0.0212 mL											

Daily renewal information:

Day	Date	Test initiation and feeding, renewal and feeding, or termination time	MHSW batch used	Analyst
0	05-07-13	1014	05-01-13 B	JH
1	05-08-13	0915	05-01-13 B	JH
2	05-09-13	0915	05-01-13 B	JH
3	05-10-13	0918	05-06-13	JH
4	05-11-13	0914	05-09-13	JH
5	05-12-13	0915	05-09-13	JH
6	05-13-13	0915	05-09-13	JH
7	05-14-13	0920		JH

Control information:		Acceptance criteria	*Summary of test endpoints:*	
% of Male Adults:	0%	≤ 20%	7-day LC_{50}	>1400
% Adults having 3rd Broods:	100%	≥ 80%	NOEC	800
% Mortality:	0%	≤ 20%	LOEC	1000
Mean Offspring/Female:	32.2	≥ 15.0 offspring/female	ChV	894.4
% CV:	6.27%	< 40.0 %	IC_{25}	1060.6

Independent Review by Kelley E. Keenan (Initials: KK)

Species: ***Ceriodaphnia dubia*** **CdNaClCR #:** 148

CONTROL ***Survival and Reproduction Data*** NEW YWT LOT

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	4	6	4	5	5	4	5	3
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	12	11	12	13	12	12	12	11	13	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	17	15	15	18	16	15	15	15	15	17
Total young produced		33	30	31	37	32	32	32	30	33	32
Final Adult Mortality		L	L	L	L	L	L	L	L	L	L
X for 3rd 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:	0%
Mean Offspring/Female:	32.2

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	5	3	5	5	4	4	5	4	4	4
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	12	10	10	13	11	14	12	12	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	15	18	17	15	15	17	16	17	13	16
Total young produced		32	31	35	33	30	35	33	33	29	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).

Concentration:	
% Mortality:	0%
Mean Offspring/Female:	32.3
% Reduction from Control:	-0.37%

Species: *Ceriodaphnia dubia* CdNaClCR #: 148

800 mg NaCl/L *Survival and Reproduction Data* New YWT LOT

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	5	5	4	4	4
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	11	13	13	12	12	10	12	13	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	15	19	15	17	16	15	18	14	17	17
Total young produced		30	35	32	34	32	30	35	31	31	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).

Concentration:	
% Mortality:	0%
Mean Offspring/Female:	32.1
% Reduction from Control:	0.3%

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	5	4	4	3	3	3	4	4	3
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	10	11	12	10	10	10	13	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	14	16	16	13	16	14	17	17	13
Total young produced		30	30	32	30	26	29	30	31	32	27
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:	0%
Mean Offspring/Female:	29.7
% Reduction from Control:	7.8%

Independent Review by Kelley E. Keenan

Species: ***Ceriodaphnia dubia*** CdNaClCR #: 148

1200 mg NaCl/L ***Survival and Reproduction Data*** New 4WT LOT

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	2	4	3	3	4	4	3	4	2	2
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	10	6	5	8	5	9	4	4	6	3
	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	2	6	0	0	3	5	2	5	1	0
Total young produced		14	16	8	11	12	18	9	13	9	5
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:	0%
Mean Offspring/Female:	11.5
% Reduction from Control:	64.3%

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	2	0	0	0	1	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
5	Young produced	2	0	1	4	1	0	2	1	3	3
	Adult mortality	L	L	L	L	L	L	L	L	L	L
6	Young produced	0	0	0	0	0	2	0	0	0	0
	Adult mortality	L	L	L	L	L	L	L	L	L	L
7	Young produced	0	1	0	0	0	0	0	0	0	0
Total young produced		2	3	1	4	1	3	2	1	3	3
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:	0%
Mean Offspring/Female:	2.3
% Reduction from Control:	92.9%

Independent Review by Kelsey E. Keenan Initials: KK

ETS
Environmental Testing Solutions, Inc.

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	4	6	4	5	5	4	5	3	44
5	12	11	12	13	12	12	12	11	13	12	120
6	0	0	0	0	0	0	0	0	0	0	0
7	17	15	15	18	16	15	15	15	15	17	158
Total	33	30	31	37	32	32	32	30	33	32	322

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	5	4	4	3	3	3	4	4	3	37
5	10	11	12	10	10	10	13	10	11	11	108
6	0	0	0	0	0	0	0	0	0	0	0
7	16	14	16	16	13	16	14	17	17	13	152
Total	30	30	32	30	26	29	30	31	32	27	297

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	5	3	5	5	4	4	5	4	4	4	43
5	12	10	13	13	11	14	12	12	12	12	121
6	0	0	0	0	0	0	0	0	0	0	0
7	15	18	17	15	15	17	16	17	13	16	159
Total	32	31	35	33	30	35	33	33	29	32	323

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	2	4	3	3	4	4	3	4	2	2	31
5	10	6	5	8	5	9	4	4	6	3	60
6	0	0	0	0	0	0	0	0	0	0	0
7	2	6	0	0	3	5	2	5	1	0	24
Total	14	16	8	11	12	18	9	13	9	5	115

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	4	3	4	5	4	5	5	4	4	4	42
5	11	13	13	12	12	10	12	13	10	10	116
6	0	0	0	0	0	0	0	0	0	0	0
7	15	19	15	17	16	15	18	14	17	17	163
Total	30	35	32	34	32	30	35	31	31	31	321

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	2	0	0	0	1	0	0	0	0	3
5	2	0	1	4	1	0	2	1	3	3	17
6	0	0	0	0	0	2	0	0	0	0	2
7	0	1	0	0	0	0	0	0	0	0	1
Total	2	3	1	4	1	3	2	1	3	3	23

File: CdNaClCR_050713new-ywt.xlsx
Entered by: J. Sumner
Reviewed by: JF

Independent Review by Kelley E. Keenan Initials:

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 #148

Test dates: May 07-14, 2013

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	33	30	31	37	32	32	32	30	33	32	100	32.2	6.2	Not applicable
600	32	31	35	33	30	35	33	33	29	32	100	32.3	6.0	-0.3
800	30	35	32	34	32	30	35	31	31	31	100	32.1	6.0	0.3
1000	30	30	32	30	26	29	30	31	32	27	100	29.7	6.6	7.8
1200	14	16	8	11	12	18	9	13	9	5	100	11.5	34.1	64.3
1400	2	3	1	4	1	3	2	1	3	3	100	2.3	46.1	92.9

Dunnett's MSD value: 2.351
PMSD: 7.3

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^{th} percentile) = 13%.

Upper PMSD bound determined by USEPA (90^{th} 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.

File: CdNaClCR_050713new-ywt.xlsx
Table populated from associated "Verification of *Ceriodaphnia* Reproduction Totals" spreadsheet.
Spreadsheet entered by: J. Sumner
Reviewed by: JH

ETS
Environmental Testing Solutions, Inc.

Statistical Analyses

Ceriodaphnia Survival and Reproduction Test-Reproduction

Start Date:	5/7/2013	Test ID:	CdNaClCR	Sample ID:	REF-Ref Toxicant
End Date:	5/14/2013	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	33.000	30.000	31.000	37.000	32.000	32.000	32.000	30.000	33.000	32.000
600	32.000	31.000	35.000	33.000	30.000	35.000	33.000	33.000	29.000	32.000
800	30.000	35.000	32.000	34.000	32.000	30.000	35.000	31.000	31.000	31.000
1000	30.000	30.000	32.000	30.000	26.000	29.000	30.000	31.000	32.000	27.000
1200	14.000	16.000	8.000	11.000	12.000	18.000	9.000	13.000	9.000	5.000
1400	2.000	3.000	1.000	4.000	1.000	3.000	2.000	1.000	3.000	3.000

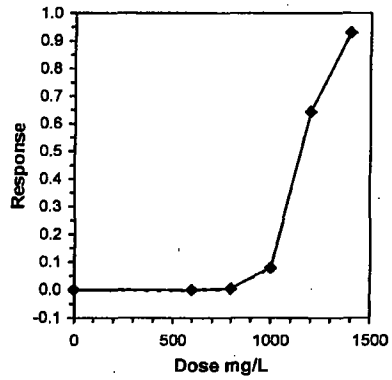
			Transform: Untransformed					Rank	1-Tailed	Isotonic	
Conc-mg/L	Mean	N-Mean	Mean	Min	Max	CV%	N	Sum	Critical	Mean	N-Mean
D-Control	32.200	1.0000	32.200	30.000	37.000	6.177	10			32.250	1.0000
600	32.300	1.0031	32.300	29.000	35.000	6.026	10	110.50	75.00	32.250	1.0000
800	32.100	0.9969	32.100	30.000	35.000	5.956	10	101.50	75.00	32.100	0.9953
*1000	29.700	0.9224	29.700	26.000	32.000	6.554	10	71.50	75.00	29.700	0.9209
*1200	11.500	0.3571	11.500	5.000	18.000	34.112	10	55.00	75.00	11.500	0.3566
*1400	2.300	0.0714	2.300	1.000	4.000	46.059	10	55.00	75.00	2.300	0.0713

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Kolmogorov D Test indicates normal distribution (p > 0.01)	0.97812	1.035	0.17037	1.33902
Bartlett's Test indicates unequal variances (p = 8.24E-03)	15.5538	15.0863		

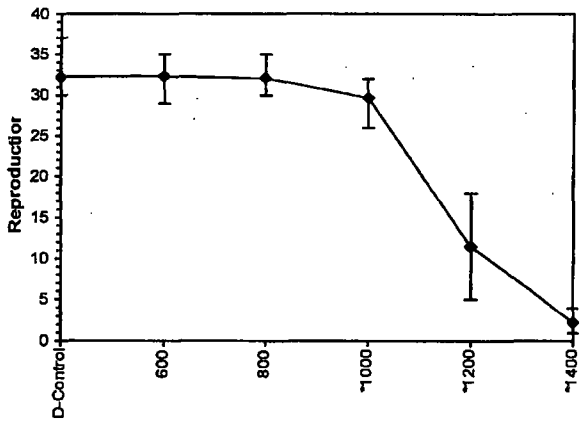
Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Steel's Many-One Rank Test	800	1000	894.427	
Treatments vs D-Control				

Linear Interpolation (200 Resamples)

Point	mg/L	SD	95% CL		Skew
IC05	921.875	64.1655	787.455	1002.89	-1.6172
IC10	1007.42	21.4035	936.218	1020.21	-2.6078
IC15	1025.14	7.97486	1006.95	1037.62	-0.6579
IC20	1042.86	7.40439	1026.9	1055.34	-0.3184
IC25	1060.58	7.23559	1045.83	1072.68	-0.1999
IC40	1113.74	8.15735	1098.11	1128.27	-0.0270
IC50	1149.18	9.69551	1130.03	1169.33	0.0275



Dose-Response Plot



Independent Review by Kelley E. Keenan Initials:

File: CdNaClCR_050713new-ywt.xlsx
Entered by: J. Sumner
Reviewed by:

ETS Environmental Testing Solutions, Inc.

Statistical Analyses

Used for PMSD calculation only.

Ceriodaphnia Survival and Reproduction Test-Reproduction

Start Date:	5/7/2013	Test ID:	CdNaClCR	Sample ID:	REF-Ref Toxicant
End Date:	5/14/2013	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	33.000	30.000	31.000	37.000	32.000	32.000	32.000	30.000	33.000	32.000
600	32.000	31.000	35.000	33.000	30.000	35.000	33.000	33.000	29.000	32.000
800	30.000	35.000	32.000	34.000	32.000	30.000	35.000	31.000	31.000	31.000
1000	30.000	30.000	32.000	30.000	26.000	29.000	30.000	31.000	32.000	27.000
1200	14.000	16.000	8.000	11.000	12.000	18.000	9.000	13.000	9.000	5.000
1400	2.000	3.000	1.000	4.000	1.000	3.000	2.000	1.000	3.000	3.000

			Transform: Untransformed						1-Tailed	
Conc-mg/L	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
D-Control	32.200	1.0000	32.200	30.000	37.000	6.177	10			
600	32.300	1.0031	32.300	29.000	35.000	6.026	10	-0.097	2.287	2.351
800	32.100	0.9969	32.100	30.000	35.000	5.956	10	0.097	2.287	2.351
*1000	29.700	0.9224	29.700	26.000	32.000	6.554	10	2.432	2.287	2.351
*1200	11.500	0.3571	11.500	5.000	18.000	34.112	10	20.137	2.287	2.351
*1400	2.300	0.0714	2.300	1.000	4.000	46.059	10	29.087	2.287	2.351

Auxiliary Tests					Statistic		Critical		Skew	Kurt
Kolmogorov D Test indicates normal distribution (p > 0.01)					0.97812		1.035		0.17037	1.33902
Bartlett's Test indicates unequal variances (p = 8.24E-03)					15.5538		15.0863			
Hypothesis Test (1-tail, 0.05)	**NOEC**	**LOEC**	**ChV**	**TU**	**MSDu**	**MSDp**	**MSB**	**MSE**	**F-Prob**	**df**
Dunnett's Test Treatments vs D-Control	800	1000	894.427		2.35056	0.073	1717.67	5.28333	5.3E-39	5, 54

Independent Review by Kelley T. Keenan Initials:

File: CdNaClCR_050713new-ywt.xlsx
Entered by: J. Sumner
Reviewed by:

Species: ***Ceriodaphnia dubia***

CdNaClCR #: 148
New 4WT LOT

Daily Chemistry:

		Day (Analyst identified for each day, performed pH, D.O. and conductivity measurements only.)					
		0		1		2	
	Analyst	JB	JB/MF	JB/MF	JB	JB	W
Concentration	**Parameter**						
CONTROL	pH (S.U.)	8.01	7.99	7.95	8.01	8.02	7.96
	DO (mg/L)	7.6	7.6	7.8	7.7	7.7	7.7
	Conductivity (µmhos/cm)	304		312		315	
	*Alkalinity (mg $CaCO_3$/L)	63		[illegible]		[illegible]	
	*Hardness (mg $CaCO_3$/L)	92		[illegible]		[illegible]	
	*Temperature (°C)	24.9	25.2	24.8	25.0	24.7	24.8
600 mg NaCl/L	pH (S.U.)	8.01	7.93	7.95	7.94	7.96	7.92
	DO (mg/L)	7.6	7.6	7.8	7.7	7.6	7.7
	Conductivity (µmhos/cm)	1330		1360		1350	
	*Temperature (°C)	24.9	25.0	24.8	24.8	24.8	24.9
800 mg NaCl/L	pH (S.U.)	8.01	7.92	7.95	7.93	7.97	7.92
	DO (mg/L)	7.6	7.6	7.8	7.7	7.6	7.8
	Conductivity (µmhos/cm)	1710		1730		1740	
	*Temperature (°C)	24.9	24.9	24.8	24.8	24.8	24.7
1000 mg NaCl/L	pH (S.U.)	8.00	7.92	7.94	7.92	7.96	7.91
	DO (mg/L)	7.6	7.7	7.8	7.7	7.7	7.8
	Conductivity (µmhos/cm)	2040		2050		2060	
	*Temperature (°C)	24.9	24.9	24.8	24.8	24.8	24.7
1200 mg NaCl/L	pH (S.U.)	7.99	7.91	7.94	7.93	7.95	7.90
	DO (mg/L)	7.6	7.7	7.8	7.8	7.7	7.9
	Conductivity (µmhos/cm)	2390		2440		2430	
	*Temperature (°C)	24.9	24.8	24.8	24.8	24.8	24.7
1400 mg NaCl/L	pH (S.U.)	7.98	7.90	7.93	7.92	7.95	7.89
	DO (mg/L)	7.7	7.7	7.8	7.8	7.7	7.8
	Conductivity (µmhos/cm)	2950		2800		2740	
	*Temperature (°C)	24.9	25.0	24.8	25.0	24.8	24.7
STOCK	Conductivity (µmhos/cm)	110 000					
		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: JF.

Independent Review by Kelley E. Keenan Initials: K

Species: ***Ceriodaphnia dubia***

CdNaClCR #: 148
New YWT LOT

Concentration	Parameter	Day 3 Analyst	Day 3 Analyst	Day 4 Analyst	Day 4 Analyst	Day 5 Analyst	Day 5 Analyst	Day 6 Analyst	Day 6 Analyst
		(Analyst identified for each day, performed pH, D.O. and conductivity measurements only.)							
		3		4		5		6	
		W	K	K	JB	JB	JB	JB	JB
CONTROL	pH (S.U.)	7.99	8.08	8.18	8.06	8.00	8.02	8.01	7.99
	DO (mg/L)	7.0	8.1	7.8	8.1	7.8	7.9	7.7	7.8
	Conductivity (µmhos/cm)	305		320		314		312	
	*Alkalinity (mg $CaCO_3$/L)	61		61					
	*Hardness (mg $CaCO_3$/L)	88		88					
	*Temperature (°C)	24.7	25.0	24.9	24.9	24.6	25.0	24.9	25.1
600 mg NaCl/L	pH (S.U.)	7.98	8.02	8.04	8.00	8.03	7.93	7.98	7.90
	DO (mg/L)	7.7	8.1	8.2	8.1	7.8	7.9	7.7	7.8
	Conductivity (µmhos/cm)	1360		1370		1380		1410	
	*Temperature (°C)	24.7	24.8	24.9	25.0	24.6	24.8	24.9	25.0
800 mg NaCl/L	pH (S.U.)	7.98	8.03	8.04	7.99	8.03	7.93	7.99	7.89
	DO (mg/L)	7.7	8.1	8.2	8.2	7.9	7.9	7.7	7.8
	Conductivity (µmhos/cm)	1740		1760		1760		1800	
	*Temperature (°C)	24.8	24.8	24.9	25.0	24.7	24.8	24.9	25.3
1000 mg NaCl/L	pH (S.U.)	7.96	8.01	8.03	7.99	8.03	7.92	7.98	7.89
	DO (mg/L)	7.7	8.0	8.2	8.2	7.9	7.9	7.7	7.8
	Conductivity (µmhos/cm)	2080		2080		2100		2140	
	*Temperature (°C)	24.8	24.8	24.9	24.8	24.8	24.7	25.0	25.1
1200 mg NaCl/L	pH (S.U.)	7.90	8.01	8.02	7.98	8.02	7.94	7.98	7.88
	DO (mg/L)	7.7	7.9	8.2	8.3	7.9	8.0	7.8	7.8
	Conductivity (µmhos/cm)	2450		2460		2490		2540	
	*Temperature (°C)	24.8	24.8	24.9	24.8	24.6	24.7	24.8	25.1
1400 mg NaCl/L	pH (S.U.)	7.96	8.00	8.03	7.97	8.01	7.92	7.97	7.87
	DO (mg/L)	7.7	7.9	8.1	8.3	8.0	8.0	7.8	7.8
	Conductivity (µmhos/cm)	2730		2720		2780		2810	
	*Temperature (°C)	24.8	24.8	24.9	24.8	24.6	24.7	24.8	25.1
		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: K.

Independent Review by Kelley E. Keenan Initials