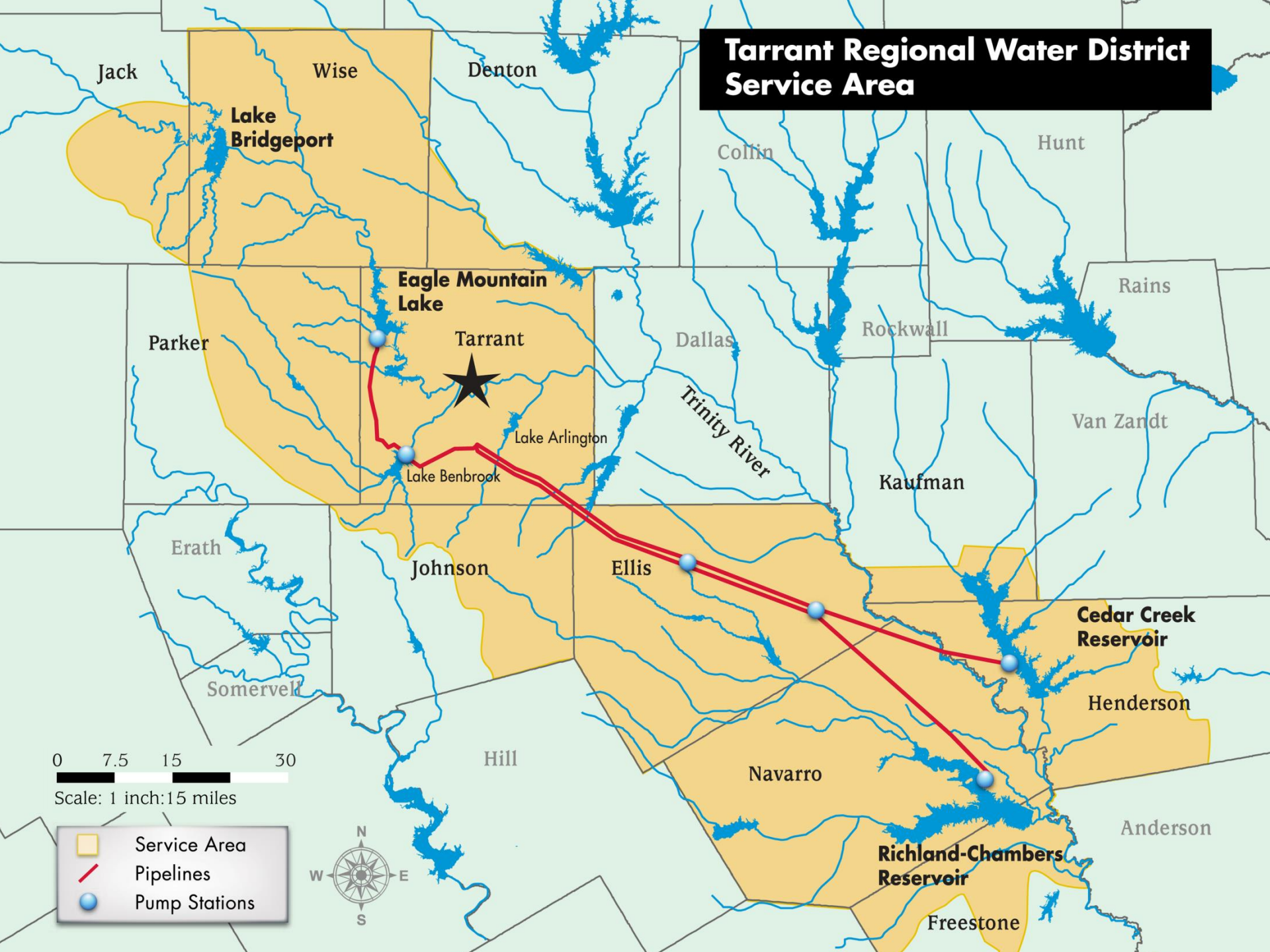
Algal Insight Into North Texas Reservoirs

OCLWA March 2016
Mark R. Ernst
Tarrant Regional Water District
Fort Worth, Texas

TARRANT REGIONAL WATER DISTRICT

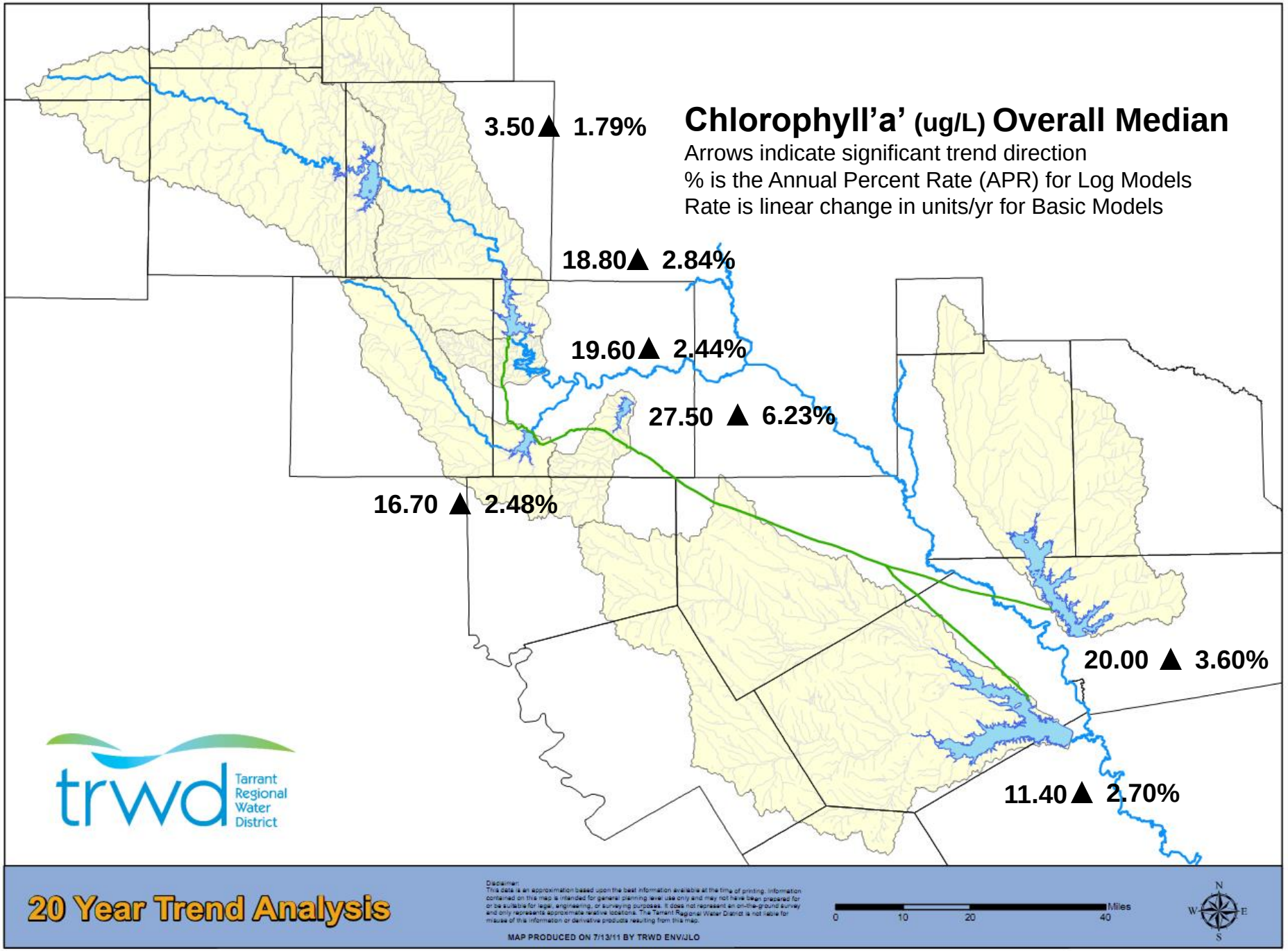
WATER SUPPLY FLOOD CONTROL WATER QUALITY RECREATION

trwd
Tarrant Regional Water District


Tarrant Regional Water District
Service Area
Jack
Wise
Denton
Lake
Bridgeport
Collin
Hunt
Eagle Mountain
Lake
Rains
Parker
Tarrant
Dallas
Rockwall
Trinity River
Van Zandt
Lake Arlington
Lake Benbrook
Kaufman
Erath
Johnson
Ellis
Cedar Creek
Reservoir
Somervell
Henderson
Hill
Navarro
Anderson
Richland-Chambers
Reservoir
Freestone
0 7.5 15 30
Scale: 1 inch:15 miles
Service Area
Pipelines
Pump Stations
N
W
E
S

Reservoirs in the TRWD Raw Water System

Reservoir	Owner	Constructed	Conservation Pool (ft)	Surface Area (acres)	Volume (ac-ft.)	Watershed Size (mi²)
LAKE						
BRIDGEPORT	TRWD	1930	836	11,654	366,236	1,111
EAGLE						
MOUNTAIN	TRWD	1932	649	8,694	179,880	859
LAKE						
WORTH	Fort Worth	1914	594	3,458	33,495	94
LAKE						
BENBROOK	USCOE	1987	694	3,635	85,648	429
LAKE						
ARLINGTON	Arlington	1956	550	1,926	40,188	143
CEDAR						
CREEK	TRWD	1964	322	32,873	644,785	1,009
RICHLAND						
CHAMBERS	TRWD	1983	315	43,384	1,112,763	1,957


Chlorophyll'a' (ug/L) Overall Median
Arrows indicate significant trend direction
% is the Annual Percent Rate (APR) for Log Models
Rate is linear change in units/yr for Basic Models
3.50 ▲ 1.79%
18.80 ▲ 2.84%
19.60 ▲ 2.44%
27.50 ▲ 6.23%
16.70 ▲ 2.48%
20.00 ▲ 3.60%
11.40 ▲ 2.70%
trwd
Tarrant Regional Water District
20 Year Trend Analysis
Disclaimer:
This data is an approximation based upon the best information available at the time of printing. Information contained on this map is intended for general planning level use only and may not have been prepared for or be suitable for legal, engineering, or surveying purposes. It does not represent an on-the-ground survey and only represents approximate relative locations. The Tarrant Regional Water District is not liable for misuse of this information or derivative products resulting from this map.
MAP PRODUCED ON 7/13/11 BY TRWD ENV/JLO
0 10 20 40 Miles
N
W
E
S

USGS
science for a changing world

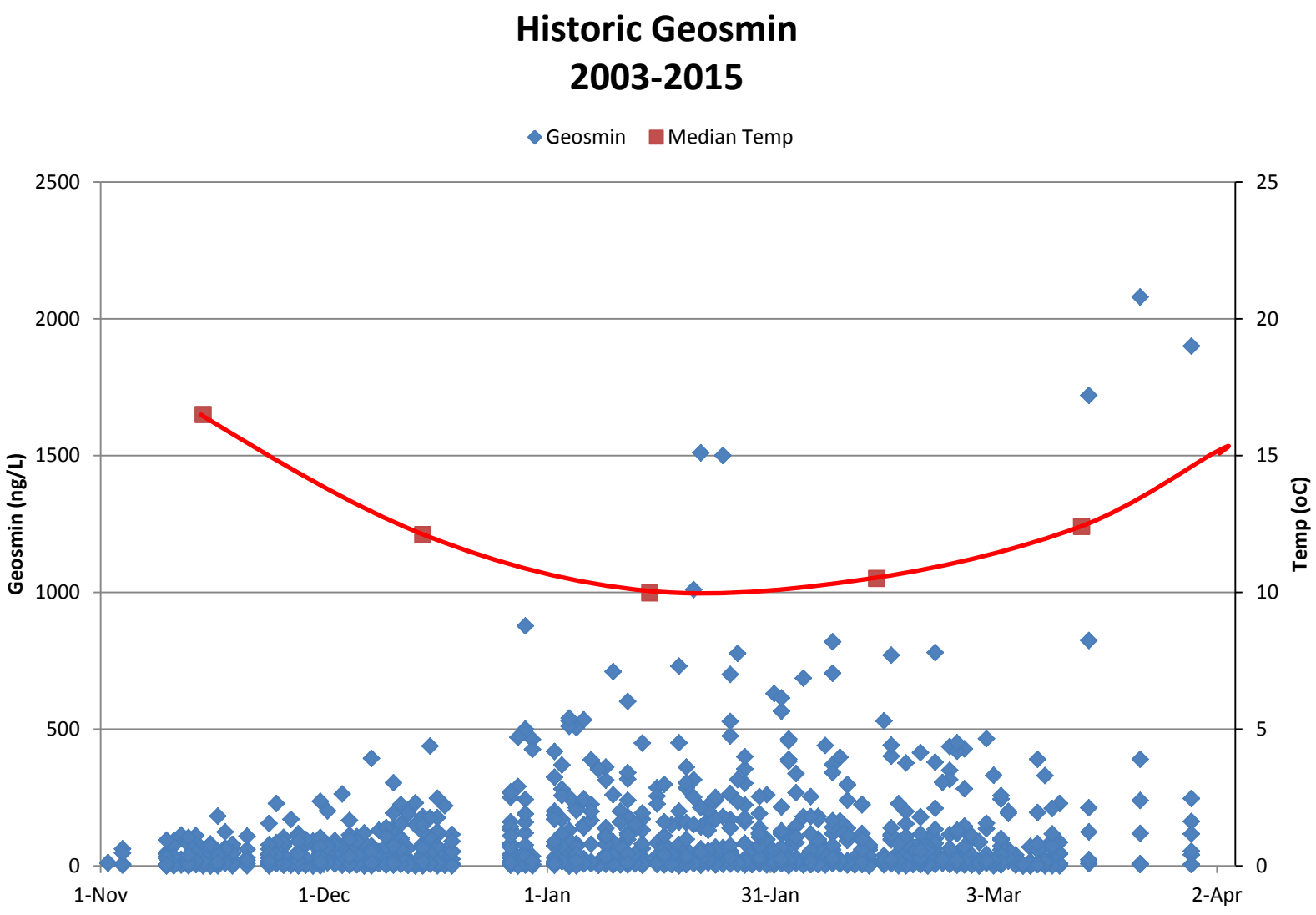
Cyanobacterial Blooms: Tastes, Odors, and Toxins

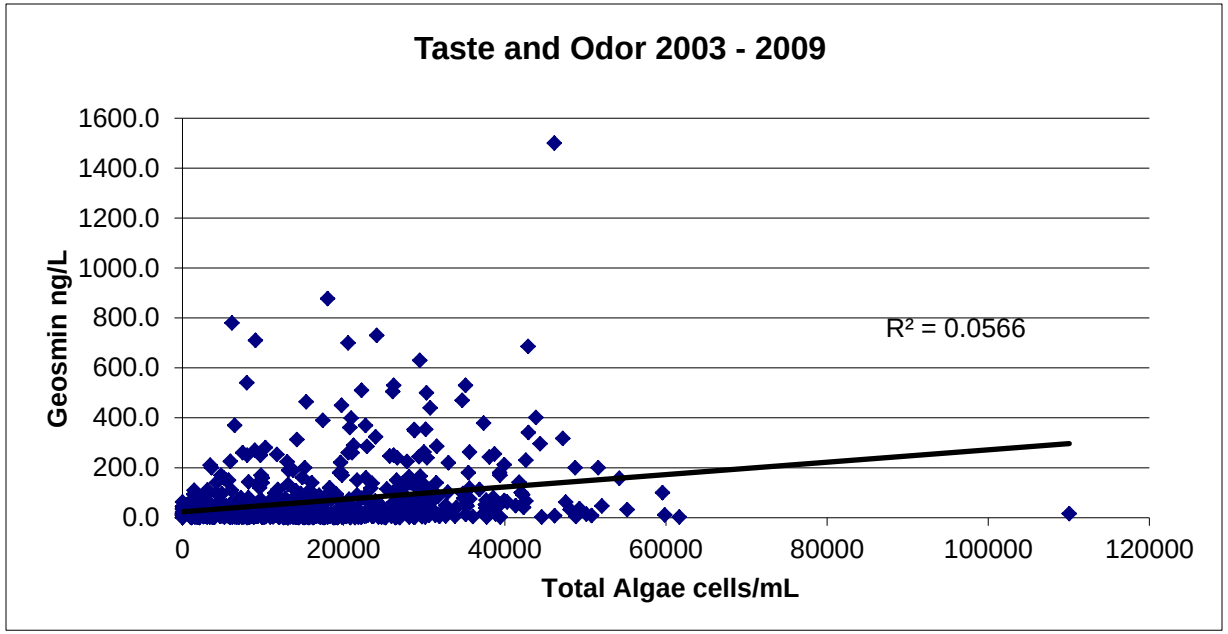
Jennifer L. Graham and Keith A. Loftin

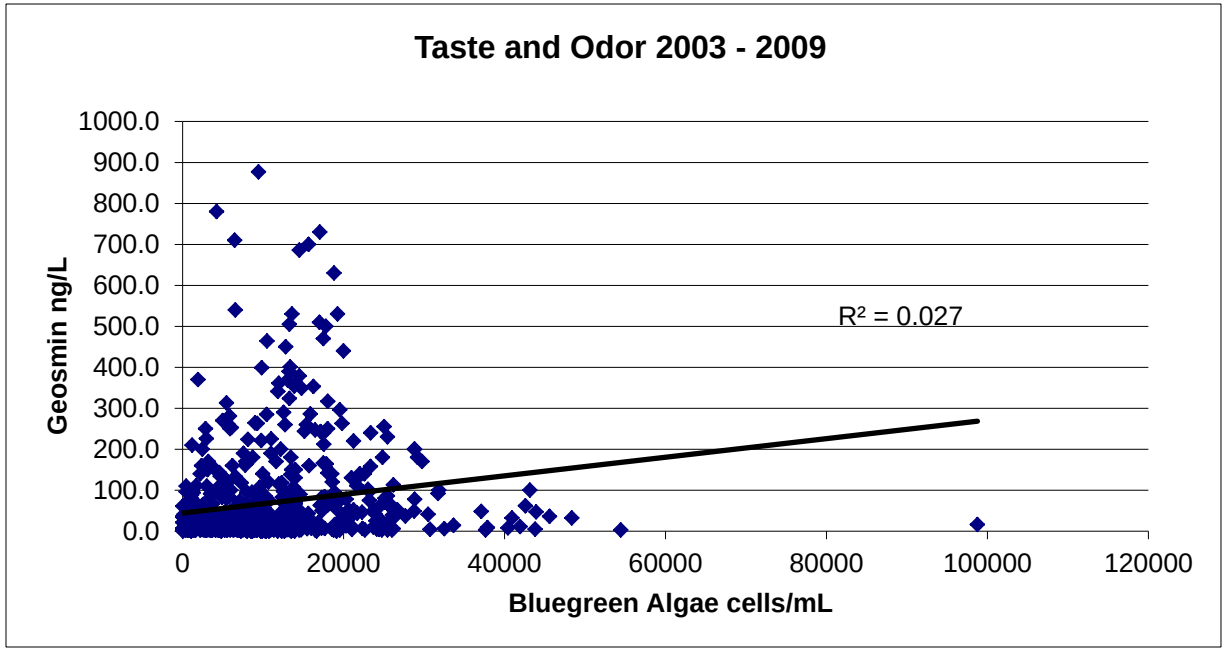
U.S. Geological Survey

Oklahoma Clean Lakes and Watershed Association Meeting

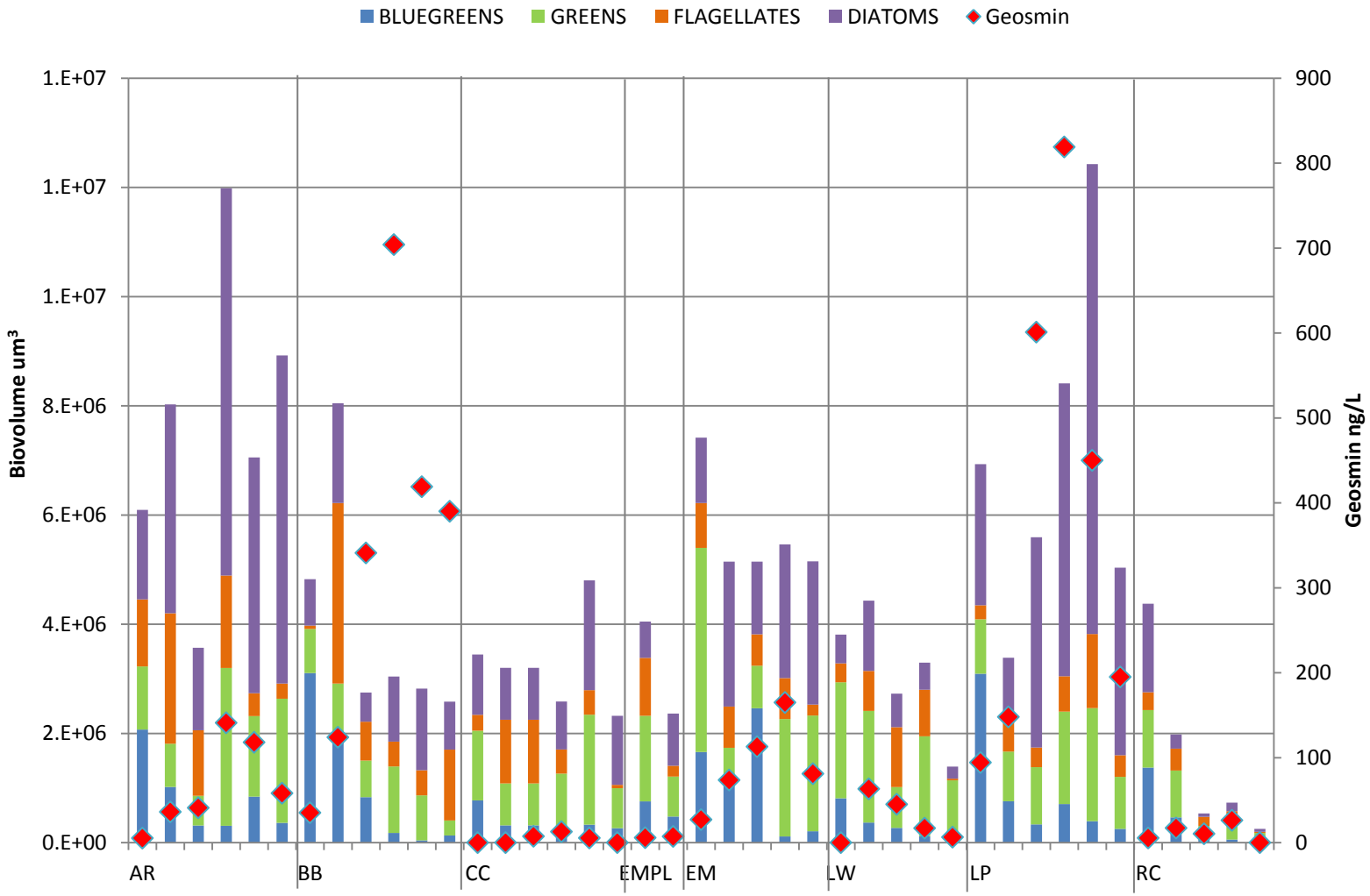
April 12, 2012


Historic Geosmin
2003-2015
Geosmin
Median Temp
2500
2000
1500
1000
500
0
25
20
15
10
5
0
Geosmin (ng/L)
Temp (oC)
1-Nov
1-Dec
1-Jan
31-Jan
3-Mar
2-Apr


Taste and Odor 2003 - 2009
Geosmin ng/L
1600.0
1400.0
1200.0
1000.0
800.0
600.0
400.0
200.0
0.0
R² = 0.0566
0
20000
40000
60000
80000
100000
120000
Total Algae cells/mL


Taste and Odor 2003 - 2009
Geosmin ng/L
1000.0
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
R² = 0.027
0
20000
40000
60000
80000
100000
120000
Bluegreen Algae cells/mL

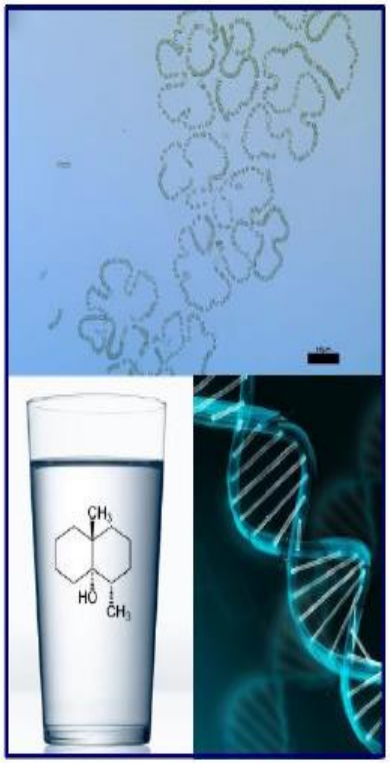
2014-2105 T&O Algae Biovolume



Genetic Study to Identify Sources of Geosmin Production

- Oregon State University
- Samples from CC, AR, PAL and BB on Feb 26 and Mar 23.
- Task 1: Identify which algae are capable of geosmin,MIB and toxin biosynthesis
- Task 2: Verify unicellular bluegreen algae are *Aphanocapsa* and not *Microsystis*.
- $12,540

Deep sequencing shotgun metagenomics to identify the microbial source(s) of geosmin production in Tarrant Regional Water District reservoirs



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Study Conclusions

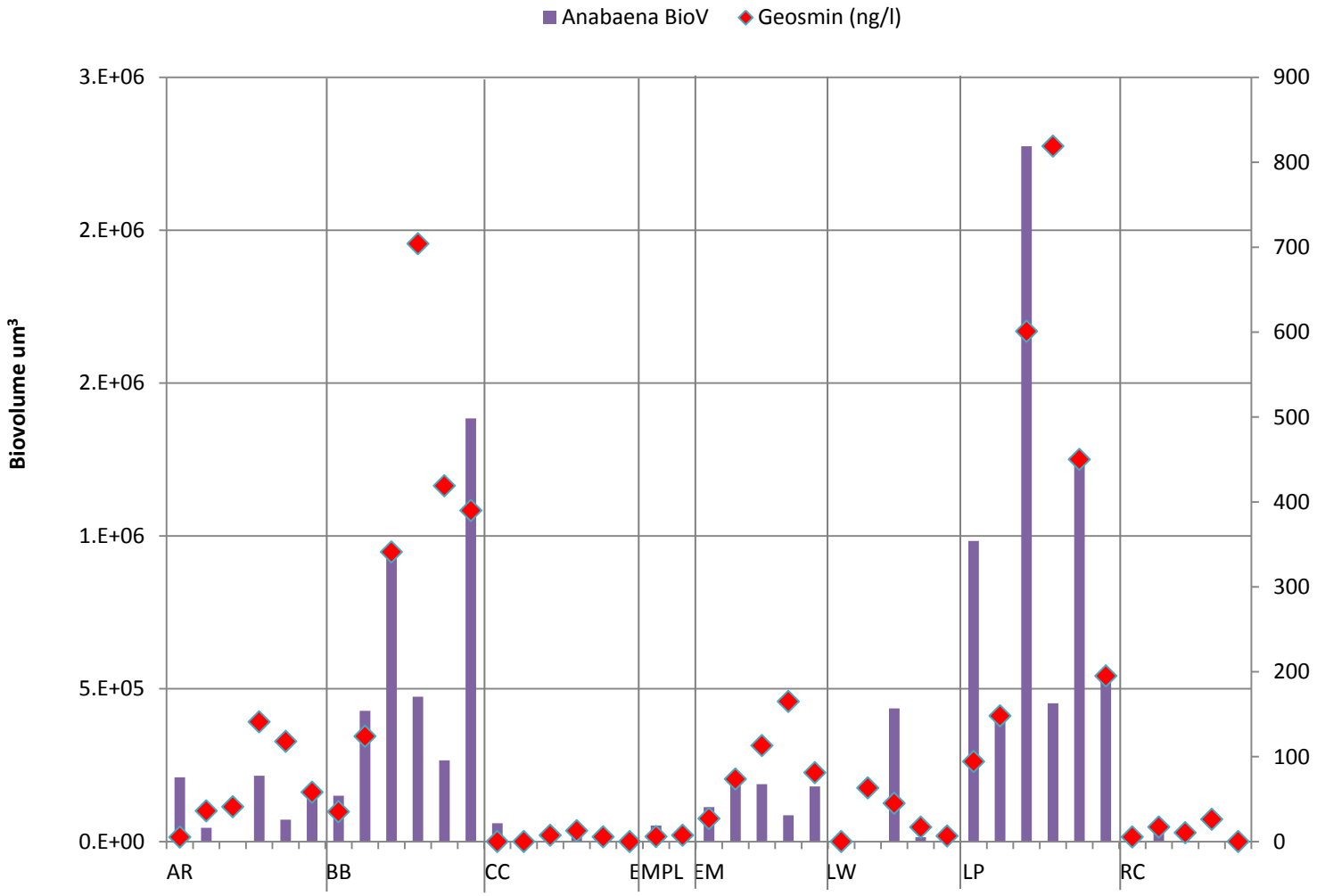
- The only geosmin synthase genes found were unique to *Anabaena* in BB, AR and PAL.
- CC has a bluegreen geosmin producer in low abundance but a genetic map to a genera is not clear.
- Microcystin synthase genes from a toxic *Microcystis* were found in low amounts in BB, AR and PAL.
- No Microcystin synthase genes were found in CC.
- No evidence for anatoxin-a, cylindrospermopsin or saxitoxin.

Study Conclusions

- The only geosmin synthase genes found were unique to *Anabaena* in BB, AR and PAL. **Abundant**
- CC has a bluegreen geosmin producer in low abundance but a genetic map to a genera is not clear.
- Microcystin synthase genes from a toxic *Microcystis* were found in low amounts in BB, AR and PAL. **Rare**
- No Microcystin synthase genes were found in CC.
- No evidence for anatoxin-a, cylindrospermopsin or saxitoxin. **Out of Season**

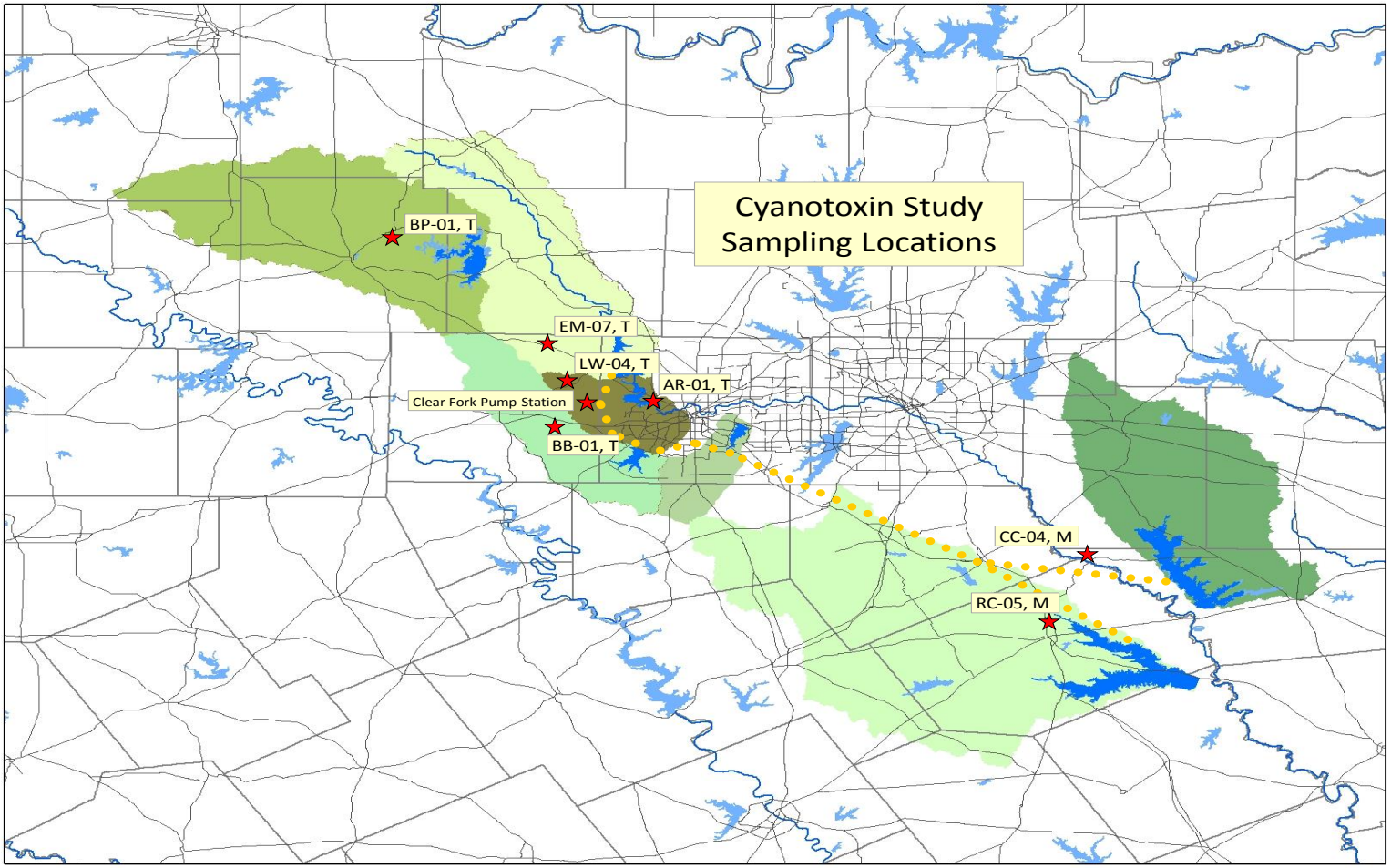

A046 1280x1024 2014/01/13 15:49:11
BB TO episode 1/13/2014 200x

T&O Algae Biovolume



What about Toxins?

Cyanotoxin Sampling Program



Date	Sampling Location
July 20, 2015	Lake Worth
July 22, 2015	Eagle Mountain
July 28, 2015	Clear Fork Pump Station
August 4, 2015	Cedar Creek Lake
August 5, 2015	Lake Bridgeport
August 10, 2015	Richland Chambers
August 12, 2015	Lake Arlington
August 17, 2015	Benbrook Lake
August 19, 2015	Lake Worth
August 24, 2015	Eagle Mountain
August 25, 2015	Clear Fork Pump Station
September 2, 2015	Richland Chambers
September 8, 2015	Lake Bridgeport
September 9, 2015	Benbrook Lake
September 9, 2015	Cedar Creek Lake

Cyanotoxin Database

									ELISA	LCMS	LCMS	LCMS		
Site	Phycocyanin	Chl-a	BG Algae	Microcystis	Total Algae	BG Algae	Microcystis	Total Algae	Microcystin	Microcystin	Cylindrospermopsin	Anatoxin a	Geosmin	MIB
	cells/mL	ug/L	cells/mL	cells/mL	cell/mL	um3/mL	um3/mL	um3/mL	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
LW-04	1437	6.2	24,072	0	34,027	95,935	0	5,716,099	<0.3	<0.1	<0.05	<0.02	<5.0	<5.0
EM-07	1400	14.7	5,386	0	12,322	1,247	0	2,957,296	<0.3	<0.1	<0.05	<0.02	<5.0	<5.0
CF@TP	1671	18	25,378	0	36,149	280,051	0	2,500,344	<0.3	<0.1	<0.05	<0.02	<5.0	12.3
CC-04	No Data	18.7	87,720	2,040	91,800	972,235	110,160	1,655,120	<0.3	<0.1	<0.05	<0.02	6.91	<5.0
BP-01	1207	8.5	18,197	0	22,522	97,171	0	1,528,070	<0.3	<0.1	<0.05	<0.02	<5.0	<5.0
RC-05	2482	27.7	143,208	6,202	147,614	2,006,347	334,886	3,112,076	<0.3	<0.1	<0.05	<0.02	6.93	14.4
AR-01	No Data	29.2	245,616	6,202	250,267	3,359,455	334,886	5,559,339	<0.3	<0.1	<0.05	<0.02	7.26	<5.0
BB-01	2338	19.6	275,482	5,712	278,256	6,285,246	308,448	7,937,544	<0.3	<0.1	<0.05	<0.02	5.88	9.17
LW-04	3352	31.4	121,013	4,896	132,763	3,442,842	264,384	9,250,427	<0.3	<0.1	<0.05	<0.02	11.3	14
EM-07	3048	< 0.5	138,638	653	156,509	2,898,223	35,251	6,834,322	<0.3	<0.1	<0.05	<0.02	12.5	<5.0
RC-05	4665	6.2	181,234	5,467	186,782	3,509,749	295,229	5,146,631	<0.3	<0.1	<0.05	<0.02	9	5.8
BP-01	1257	1.8	24,970	0	28,886	310,379	0	2,689,537	<0.3	<0.1	<0.05	<0.02	12.9	25.8
BB-01	4043	17.8	86,414	1,306	97,512	980,528	70,502	4,323,463	<0.3	<0.1	<0.05	<0.02	<5.0	13.6
CC-04	No Data	18.7	40,147	4,488	49,205	871,897	78,855	3,315,377	<0.3	<0.1	<0.05	<0.02	<5.0	7.48
CF@TP	1704	8.9	40,066	4,488	57,446	572,316	284,976	9,783,646	<0.3	<0.1	<0.05	<0.02	<5.0	<5.0

Cyanotoxin Database

		Count				Biovolume				ELISA	LCMS	LCMS	LCMS
Site	Chl-a	BG Algae	Microcystis	Cylindro	Total Algae	BG Algae	Microcystis	Cylindro	Total Algae	Microcystin	Microcystin	Cylindrospermopsin	Anatoxin a
	ug/L	cells/mL	cells/mL	cells/mL	cell/mL	um3/mL	um3/mL	um3/mL	um3/mL	ug/L	ug/L	ug/L	ug/L
LW-04	6.2	24,072	0	0	34,027	95,935	0	0	5,716,099	<0.3	<0.1	<0.05	<0.02
EM-07	14.7	5,386	0	0	12,322	1,247	0	0	2,957,296	<0.3	<0.1	<0.05	<0.02
CF@TP	18	25,378	0	0	36,149	280,051	0	0	2,500,344	<0.3	<0.1	<0.05	<0.02
CC-04	18.7	87,720	2,040	12,240	91,800	972,235	110,160	123,367	1,655,120	<0.3	<0.1	<0.05	<0.02
BP-01	8.5	18,197	0	0	22,522	97,171	0	0	1,528,070	<0.3	<0.1	<0.05	<0.02
RC-05	27.7	143,208	6,202	60,384	147,614	2,006,347	334,886	664,900	3,112,076	<0.3	<0.1	<0.05	<0.02
AR-01	29.2	245,616	6,202	125,664	250,267	3,359,455	334,886	1,732,935	5,559,339	<0.3	<0.1	<0.05	<0.02
BB-01	19.6	275,482	5,712	166,464	278,256	6,285,246	308,448	4,251,917	7,937,544	<0.3	<0.1	<0.05	<0.02
LW-04	31.4	121,013	4,896	6,528	132,763	3,442,842	264,384	674,740	9,250,427	<0.3	<0.1	<0.05	<0.02
EM-07	< 0.5	138,638	653	6,528	156,509	2,898,223	35,251	157,364	6,834,322	<0.3	<0.1	<0.05	<0.02
RC-05	6.2	181,234	5,467	88,944	186,782	3,509,749	295,229	2,318,487	5,146,631	<0.3	<0.1	<0.05	<0.02
BP-01	1.8	24,970	0	0	28,886	310,379	0	0	2,689,537	<0.3	<0.1	<0.05	<0.02
BB-01	17.8	86,414	1,306	17,136	97,512	980,528	70,502	401,758	4,323,463	<0.3	<0.1	<0.05	<0.02
CC-04	18.7	40,147	4,488	5,712	49,205	871,897	78,855	538,813	3,315,377	<0.3	<0.1	<0.05	<0.02
CF@TP	8.9	40,066	4,488	816	57,446	572,316	284,976	76,973	9,783,646	<0.3	<0.1	<0.05	<0.02

Conclusions

- Winter Taste and Odor problem is associated with Anabaena spp.
- Algal toxins are not very prevalent. Linkage to Microcystis spp. A genera not common in our reservoirs in large amounts (Blooms).