

## **2009 Microcystin Detection**

Toxic cyanobacteria, blue-green algae, blooms are an emerging issue for the Des Moines Water Works because of increased source water pollution caused by eutrophication. Microcystins are fresh water hepatoxins produced by a number of cyanobacterial genera (*Microcystis*, *Anabeena*, *Oscillatoria*, *Nostoc*, *Anabaenopsis*, and terrestrial Hepalosiphon). Microcystin-LR is the primary hepatoxin produced by *Microcystis aeruginosa*. It is speculated that low-level exposure to the microcystin toxin may promote the development of cancer and other chronic gastrointestinal disorders.

In response to documented health risks and to protect consumers from adverse effects from exposure to the microcystin toxin, the World Health Organization (WHO) issued a provisional concentration guideline of 1 ug/L microcystin for drinking water. There is a sliding scale of risk associated with recreational contact, with moderate risk beginning at 20 ug/L. The United States Environmental Protection Agency placed cyanobacteria on its Candidate Contaminant List in 2005.

The development of a quick, inexpensive and highly sensitive Enzyme-Linked ImmunoSorbent Assay, ELISA, has made it feasible for the DMWW to effectively investigate the presence/absence of Microcystin-LR. This assay has allowed the DMWW to efficiently screen environmental waters of concern for public health risks from toxigenic cyanobacteria (microcystin). The following assessment presents the findings of the summer 2009 survey of microcystin-LR in the source waters for the DMWW.

### **The Study: Microcystin 2009 Assessment**

Microcystin analysis was conducted on watershed samples which exceeded 100,000 cells/mL cyanobacteria during the sampling period of April through October 2009.

### **Methods:**

#### **Sampling Sites:**

Samples from both the Raccoon River and Des Moines River watershed were monitored on semi-monthly bases for cyanobacteria. The sample sites were chosen by Tony Seeman of the Iowa Soybean Association and Gordon Brand of the Des Moines Water Works. Figure 1 lists the sample sites monitored for cyanobacteria and Figure 2 lists the sample sites which exceed 100,000 cells/mL cyanobacteria. Figure 3 correlates the sample site IDs with their corresponding location in the watershed.

SITE	LOCATION
LC 12	Des Moines River at Ft. Dodge
WF 30	West Fork Des Moines at Jackson, MN
DM 01	Des Moines River near Stratford
EF 01	East Fork Des Moines at Dakota City
EF 17	East Fork Des Moines Below Lake Tuttle
EF 30	East Fork Above Lake Tuttle
WF 02	West Fork Des Moines at Humboldt
WF 08	West Fork Des Moines Near Emmetsburg
WF 10	West Fork Des Moines near Estherville
BR 03	Boone River near Webster City
BC04	Beaver Creek near Grimes
RR 9	Indian Creek near Lakeview
RR 14A	North Raccoon River near Lanesboro
WF 31	West Fork Des Moines near Windom, MN

**Figure 1: Cyanobacteria Sampling Sites**

SITE	LOCATION
DM01	Des Moines River Near Stratford
EF 17	East Fork Des Moines Below Lake Tuttle
EF 30	East Fork Above Lake Tuttle
WF 02	West Fork Des Moines At Humboldt
WF 08	West Fork Des Moines Near Emmetsburg
WF 10	West Fork Des Moines At Esterville
WF 30	West Fork Des Moines At Jackson
WF 31	West Fork Des Moines Near Windom

**Figure 2: Sites exceeding 100,000 cells/mL cyanobacteria**

**Sampling Procedure:**

Raw water samples containing greater than 100,000 cells/mL cyanobacteria were collected in 7mL amber glass vials and stored in the freezer at -1°C until analyzed. A sample blank was collected in the lab by pouring Type 1 water into a 7mL amber glass vial and stored in the freezer. Microcystins were not detected in the blank.

**ELISA Analysis:**

Microcystin samples were analyzed using an ELISA assay. The ELISA assay is a simple and accurate method that may be used for the analysis of environmental waters for microcystins. The assay achieves a detection limit of 0.10ug/L. Microcystin ELISA assays were purchased from Abraxis (Warminster, PA). The assay format was a 96 well microtiter plate based on the recognition of microcystins by specific antibodies.

# 2009 Cyanobacteria Monitoring

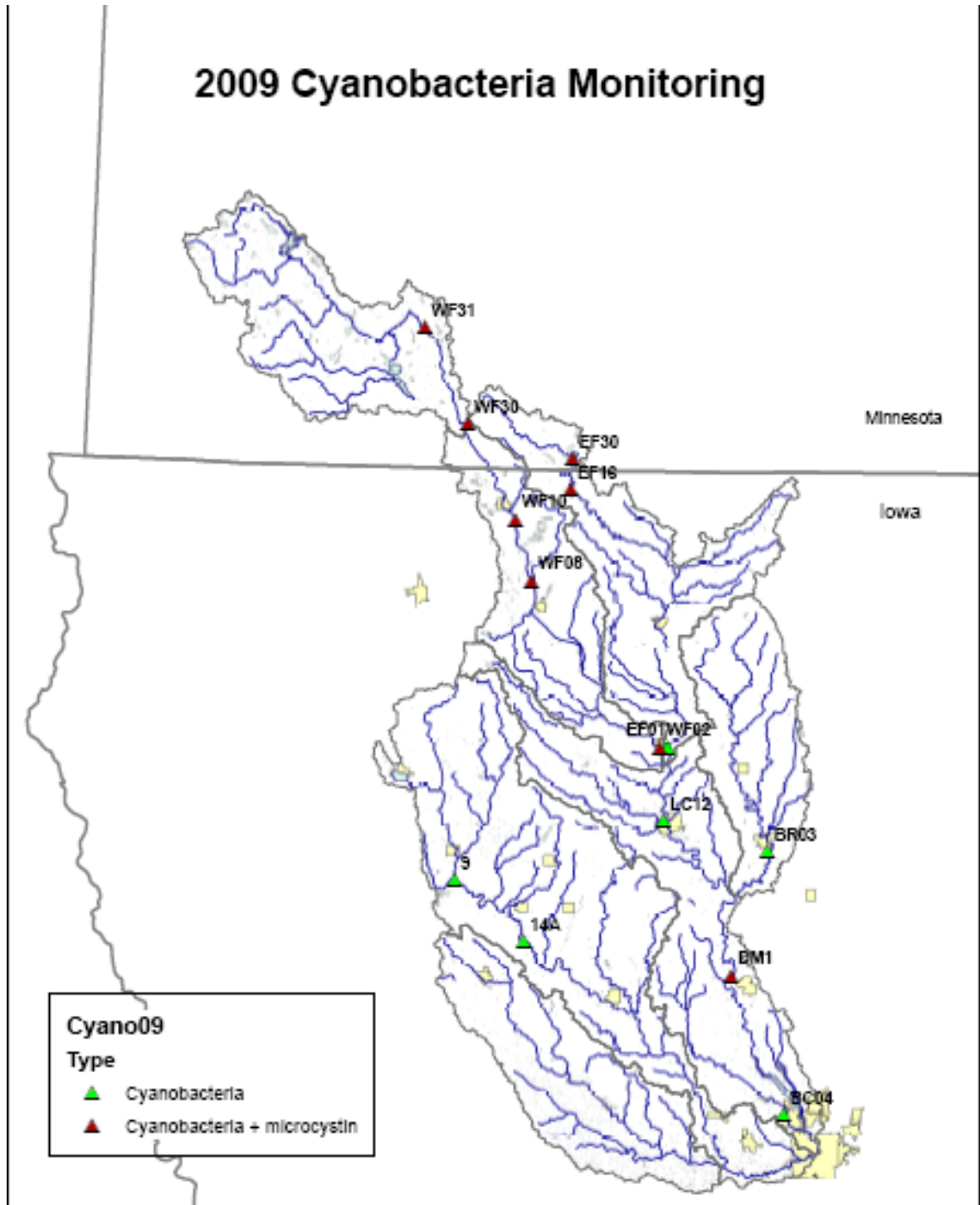


Figure 3: Sample site location in the watershed

**Results:**

Microcystins were detected in all samples containing greater than 100,000 cells/mL cyanobacteria. Microcystins detects ranged from 0.237 ug/L at site DM01 to 2.9 ug/L at site WF31, as shown in Figure 4. These results are graphically represented in Figure 5. The majority of the source water samples, exceeding 100,000 cells/mL cyanobacteria, contained microcystins in the range of 0.5 ug/L – 1.0 ug/L. Peak levels of the microcystin toxin appeared the week of August 11 at sites WF 30, WF31, WF10 and WF02 respectively.

	DM1	EF17	EF30	WF02	WF08	WF10	WF30	WF31
06/30/2009	NA	NA	0.294	NA	NA	1.637	1.120	NA
07/14/2009	0.237	0.250	NA	NA	0.669	0.878	0.747	0.665
07/28/2009	0.567	NA	NA	1.509	NA	1.118	1.182	NA
08/11/2009	NA	NA	0.506	1.570	NA	2.080	2.935	2.610
08/13/2009	NA	NA	NA	NA	NA	NA	NA	NA
08/25/2009	0.381	NA	NA	NA	NA	NA	1.537	NA

Figure 4: Microcystin Results      NA : samples contained <100,000 cells/mL cyanobacteria

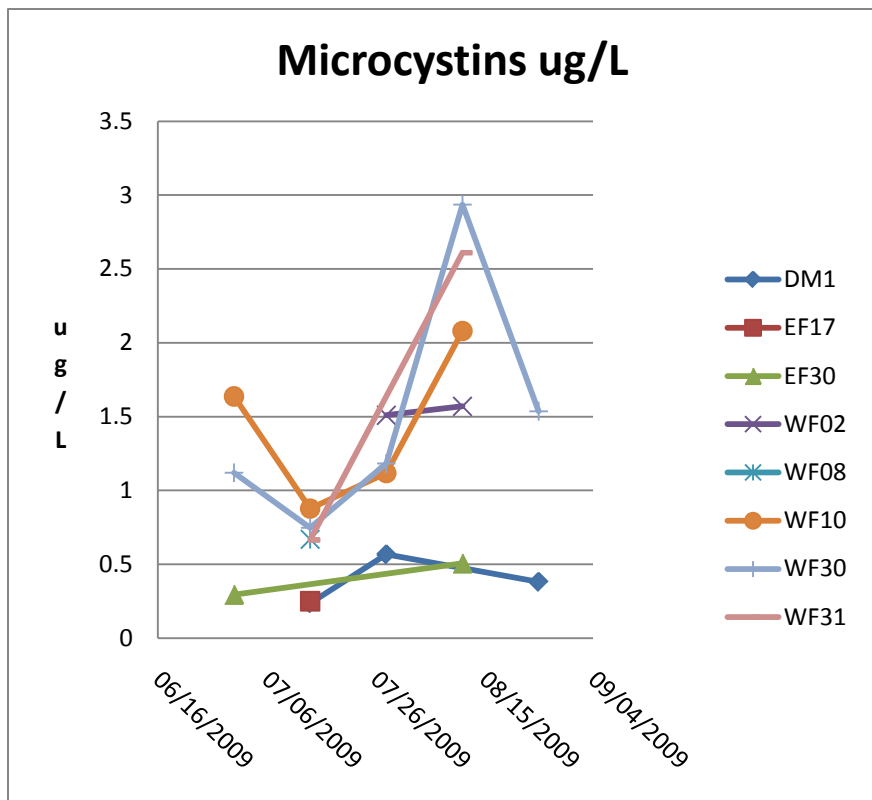


Figure 5: Microcystin Results

**Conclusion:**

Microcystins were detected in all samples that contained greater than 100,000 cells/mL cyanobacteria. The microcystin concentrations appeared to slowly dissipate as they flowed downstream through the watershed. No samples in this study that contained greater than 100,00 cells/mL cyanobacteria were within close proximity to the Des Moines Water Works. However, the potential exists for the microcystins concentrated in the West Fork of the Des Moines River to reach the Des Moines Water Works and thus pose a potential health concern. A more in depth study of microcystins in the watershed has been proposed for next year. This study would include further monitoring of microcystins after cyanobacteria counts subside, thus exploring the viability of microcystins in the watershed.

Figure 6 depicts microcystins in relation to the cyanobacteria detects and class of cyanobacteria.

		Date Collected				
		06/30/2009	07/14/2009	07/28/2009	08/11/2009	08/25/2009
DM1	Cyanobacteria cells/mL			199600 pla		134320 pse pla ana
	Microcystins ug/L		0.237	0.567		0.381
EF17	Cyanobacteria		331200 pla			
	Microcystins ug/L		0.250			
EF30	Cyanobacteria	290000 pla			855600 pla	
	Microcystins ug/L	0.294			0.506	
LC01	Cyanobacteria	182000 aph pse				
	Microcystins ug/L	Not sampled				
WF02	Cyanobacteria				285200 pla cyl pse	
	Microcystins ug/L			1.509	1.570	
WF08	Cyanobacteria		164000 pla			
	Microcystins ug/L		0.669			
WF10	Cyanobacteria	154000 pse pla	104000 pla	354200 pla	239200 pla pse ana	
	Microcystins ug/L	1.637	0.878	1.118	2.080	
WF30	Cyanobacteria	99600 pse pla ana	192000 pla	334000 pla	1591600 pla ana	379040 pla pse ana
	Microcystins ug/L	1.120	0.747	1.182	2.935	1.537
WF31	Cyanobacteria		128000 pla			
	Microcystins ug/L		0.665			

**KEY: Class of Cyanobacteria**

Planktothrix

Oscillatoria

Anabaena

Pseudanabaena

Cylindrospermopsis

Microcystis

Aphanizomenon

Nodularia