City of Milwaukee Health Department
Division of Disease Control and Prevention
Watershed Monitoring Report
2007

Purpose and Strategy

The waters of the Milwaukee River Watershed have been monitored by the City of Milwaukee Health Department (MHD) for *Cryptosporidium* and *Giardia* since 1994. The Watershed monitoring strategy has changed over the years as questions about *Cryptosporidium* and *Giardia* occurrence and distribution were answered and new questions arose.

In the past, samples were collected from the Milwaukee River and other sites. Because *Cryptosporidium* and *Giardia* concentrations in samples from the Milwaukee River Confluence were shown to be representative of the other sites then monitored, sampling from those other river sites, followed by other Milwaukee River sites, was discontinued. Currently, the purpose of monitoring is to track the occurrence and concentration of *Cryptosporidium* in waters (the River Confluence and diverted Waste Water Treatment Plant effluent) that are believed to potentially influence source water quality.

Environment

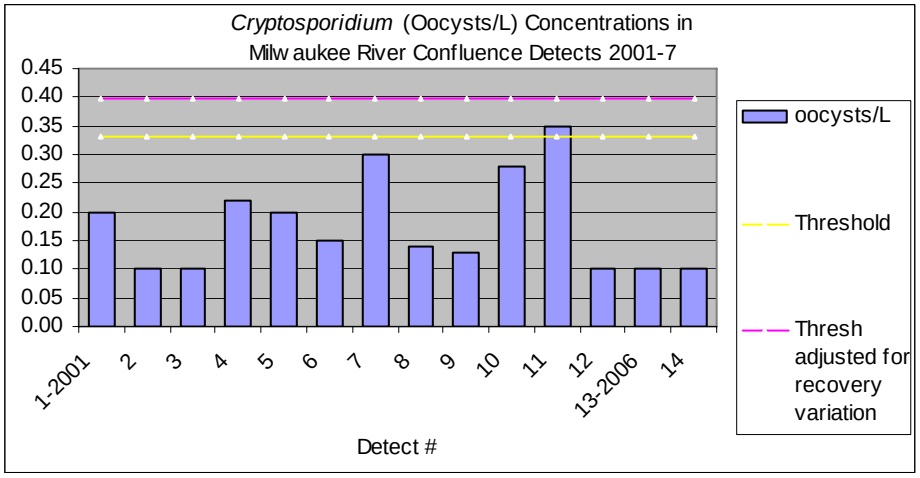
The River Confluence is comprised of three tributary rivers-the Milwaukee, Menomonee and Kinnickinnic, which are influenced by stormwater, other run-off, agriculture (Milwaukee and Menomonee) and upstream sewage treatment plants (Milwaukee River only). In addition, combined sewer and/or sanitary overflows, and/or Waste Water Treatment Plant diversions may occur during extensive periods of rainy weather and may affect River Confluence water quality.

The waters of the River Confluence are subsequently greatly diluted by the waters of Lake Michigan. The intakes for the Linnwood and Howard Water Purification Plants are each located approximately 1 mile offshore in Lake Michigan, where the effects of the Confluence, surface run-off, stormwater, combined and/or separate sewer overflows, and waste water effluent are greatly reduced. Source water at the two Water Purification Plants is monitored for *Cryptosporidium* and *Giardia* twice per month by Milwaukee Water Works.

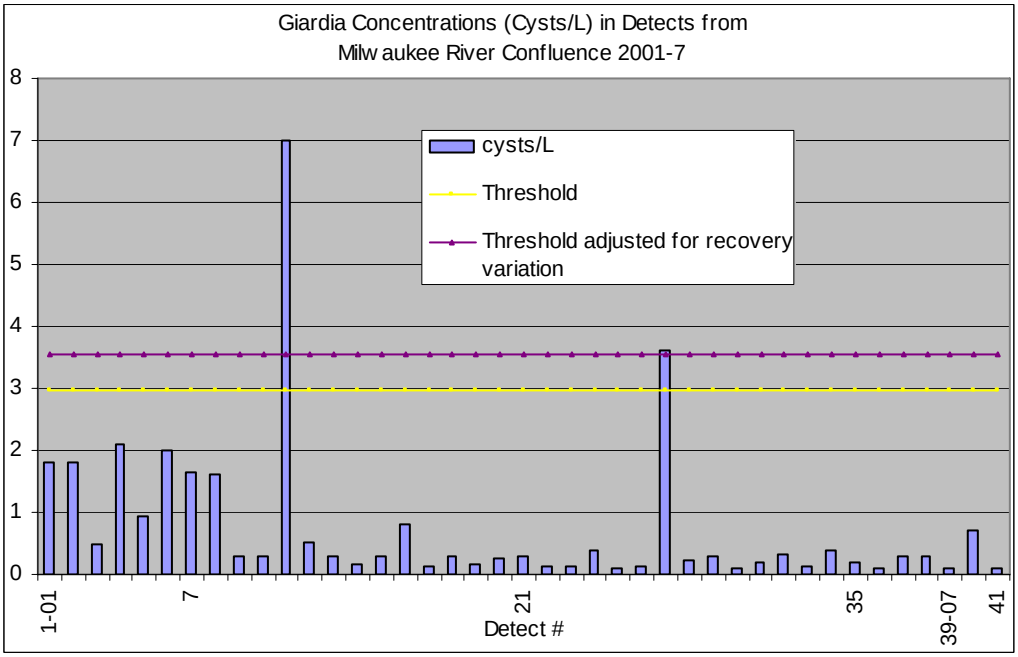
Results

Results (see Graphs A and B and Table 1) from samples collected in 2007 were similar to those of previous years.*Cryptosporidium* was infrequently detected. *Giardia* was detected in 3of 4 samples from the River Confluence in 2007, a frequency of detection that is similar to that of previous years. Ranges for *Cryptosporidium* and *Giardia* were similar to the ranges detected in samples collected during 2001-2006. No Waste Water Treatment Plant diversions occurred during the 2007 monitoring season (March 12 through October 8), so there were no samples to analyze.

Graph A *Cryptosporidium* Levels and Threshold



Graph B *Giardia* Levels and Threshold



Discussion

The *Cryptosporidium* and *Giardia* contribution from the River Confluence to Lake Michigan and source water in 2007 is thought to be similar to that of previous years, as the frequency of detection and concentration when detected for these pathogens was similar to what was observed in previous years. *Cryptosporidium* and *Giardia* levels detected in samples from the River Confluence 2001-2007 when detected, were relatively low when compared to those reported in other studies of United States surface waters (LeChevallier, et. al, 1991; WI-DNR, 2004). *Giardia* detected in Waste Water effluent was within range of that detected in previous years. No sample exceeded the Threshold for either organism (see Graph A and B; Threshold is the Geometric Mean of concentration for detects from the Confluence from 2001-6 plus twice the Standard Deviation).

Cryptosporidium was not detected in diverted waste water in 2006 (there were no diversions in 2007). It is not surprising that extremely low levels of *Cryptosporidium* and *Giardia* are detected, very rarely (data not shown here), in source water.

Most of the *Cryptosporidium* in samples collected from the River Confluence and analyzed by the Centers for Disease Control and Prevention in 1999-2001 were of a species not known to infect humans but rather those known to infect waterfowl or other animals (Heymann, 2004; Xiao, et. al, 2002).

For the past several years, information about the morphology of *Cryptosporidium* and *Giardia* detected in River Confluence samples has been gathered (data not shown here). Some of the oocysts/cysts appeared to have the organization, genetic material and structural integrity (though integrity does not guarantee the oocyst/cyst can cause an infection in a human) necessary support infection of a new host such as a human, but most oocysts and cysts did not.

In summary, monitoring results from the River Confluence show that very low levels of *Cryptosporidium* and *Giardia* may affect source water quality. These very low levels are likely to appear even less significant as a challenge to drinking water purification (removal or in activation of *Cryptosporidium* and *Giardia*) when it is considered that the ability of these organisms to actually establish infections in a human does not exist in all oocysts/cysts.

Plans for 2008

Testing of the River Confluence every other month from March through October will occur in order to track occurrence and concentration of *Cryptosporidium* and *Giardia*, and to watch for upward trends or spikes in frequency of occurrence or in concentration of either organism (see Graph A and B). A concentration of *Cryptosporidium* or *Giardia* that exceeds the 2001-7 Threshold (Geometric Mean plus twice the Standard Deviation, plus a percentage allowed for recovery variation) will trigger review of other available environmental data to determine if a *Cryptosporidium* or *Giardia* source has been introduced or enhanced.If a Waste Water Treatment Plant diversion occurs, a sample will be collected and analyzed for *Cryptosporidium* and *Giardia* content.

Raw Data Table 1

Crypto Oocysts/L	Detect #	DIV WW EFF	CONFL	*Giardia* Cysts/L	Detect #	DIV WW EFF	CONFL
2/15/2001	1		0.20	2/15/2001	1		1.80
3/12/2001			nd	3/12/2001	2		1.80
3/21/2001	2		0.10	3/21/2001	3		0.50
3/28/2001	3		0.10	3/28/2001	4		2.10
4/4/2001			nd	4/4/2001	5		0.95
4/11/2001	4		0.22	4/11/2001	6		2.00
4/25/2001			nd	4/25/2001	7		1.65
6/20/2001	5		0.20	6/20/2001	8		1.60
6/27/2001			nd	6/27/2001	9		0.30
8/22/2001			nd	8/22/2001			nd
9/26/2001	6		0.15	9/26/2001	10		0.30
AVG (RANGE)		NO SAMPLING OF DIVERSIONS	**0.16 (0.10-0.22)**	**AVG (RANGE)**		NO SAMPLING OF DIVERSIONS	**1.30 (0.5-2.1)**
2/12/2002	7		0.30	2/12/2002	11		7.00
3/7/2002			nd	3/7/2002			nd
4/17/2002			nd	4/17/2002	12		0.53
5/16/2002			nd	5/16/2002			nd
6/19/2002			nd	6/19/2002			nd
7/23/2002			nd	7/23/2002			nd
7/29/2002			nd	7/29/2002			nd
9/11/2002	8		0.14	9/11/2002	13		0.28
10/9/2002			nd	10/9/2002	14		0.15
10/16/2002			nd	10/16/2002	15		0.30
10/23/2002			nd	10/23/2002	16		0.82
AVG (RANGE)			**0.22 (0.14-0.30)**	**AVG (RANGE)**			**1.51 (0.15-7.00)**
3/19/2003	9		0.13	3/19/2003	17		0.13
4/8/2003		NO DIVERSIONS	nd	4/8/2003		NO DIVERSIONS	nd
4/15/2003			nd	4/15/2003			nd
5/1/2003		1.1	NT	5/1/2003		500.3	NT
5/22/2003			nd	5/22/2003			nd
6/26/2003			nd	6/26/2003	18		0.28
7/17/2003			nd	7/17/2003			nd
9/3/2003			nd	9/3/2003			nd
10/7/2003		NO DIVERSIONS	nd	10/7/2003		NO DIVERSIONS	nd
11/24/2003			nd	11/24/2003	19		0.16
12/10/2003		nd	NT	12/10/2003		273.8	NT
AVG (RANGE)		**1.1**	**0.13 (0.13)**	**AVG (RANGE)**		**273.8-500.3**	**0.19 (0.13-0.28)**
3/11/2004		NO DIVERSIONS	nd	3/11/2004	20	NO DIVERSIONS	0.27
3/26/04		nd	NT	3/26/04		8.8	NT
4/14/2004		NO DIVERSIONS	nd	4/14/2004		NO DIVERSIONS	nd
5/14/04		nd	NT	5/14/04		117.8	NT
5/18/2004	10		0.28	5/18/2004	21		0.28
6/23/2004			nd	6/23/2004	22		0.13
7/21/2004			nd	7/21/2004	23		0.14
8/25/2004			nd	8/25/2004			nd
9/8/2004		NO DIVERSIONS	nd	9/8/2004	24	NO DIVERSIONS	0.38
10/13/2004			nd	10/13/2004	25		0.10
AVG (RANGE)		**nd**	**0.28 (0.28)**	**AVG (RANGE)**		**8.8-117.8**	**0.22 (0.10-0.38)**

Crypto Oocysts/L	Detect#	DIV WW EFF	CONFL	*Giardia* Cysts/L	*Detect #*	DIV WW EFF	CONFL
3/9/2005	11		0.35	3/9/2005	26		0.12
4/27/2005			nd	4/27/2005	27		3.50
5/26/2005			nd	5/26/2005	28		0.22
6/22/2005			nd	6/22/2005	29		0.30
7/13/2005	12		0.10	7/13/2005			nd
8/25/2005			nd	8/25/2005	30		0.10
9/22/2005			nd	9/22/2005			nd
10/19/2005			nd	10/19/2005	31		0.20
AVG (RANGE)		NO DIVERSIONS	**0.23 (0.10-0.35)**	**AVG (RANGE)**		NO DIVERSIONS	**0.74 (0.12-3.50)**
3/29/2006		nd	nd	3/29/2006		214	nd
4/26/2006			nd	4/26/2006	32		0.33
5/24/2006			nd	5/24/2006	33		0.13
6/21/2006			nd	6/21/2006	34		0.40
7/24/2006	13		0.10	7/24/2006	35		0.20
8/16/2006			nd	8/16/2006	36		0.10
9/13/2006			nd	9/13/2006	37		0.30
10/12/2006	14	NO DIVERSIONS	0.10	10/12/2006	38	NO DIVERSIONS	0.30
AVG (RANGE)			**0.10 (0.10-0.10)**	**AVG (RANGE)**			**0.25 (0.10-0.40)**
3/12/2007			nd	3/12/2007	39		0.10
5/1/2007			nd	5/1/2007	40		0.70
7/16/2007			nd	7/16/2007	41		0.10
10/8/2007			nd	10/8/2007			nd
AVG (RANGE)			**nd**	**AVG (RANGE)**	**AVG (RANGE)**		**0.3 (0.10-0.70)**
01-07 AVG (GM) (RANGE)	**14 Detects**	**1.1 (1.1) (1.1)**	**0.18 (GM=0.16) (0.10-0.35)**	**01-06 AVG (GM) (RANGE)**	**41 Detects**	**222.9 (133.2) (8.8-500.3)**	**0.76 (GM=0.37) (0.10-3.50)**

Partners
The City of Milwaukee Health Department wishes to thank the following for their assistance in Watershed Monitoring efforts:
Milwaukee Water Works
Milwaukee Metropolitan Sewerage District
Wisconsin State Laboratory of Hygiene
Water-Health Technical Subcommittee

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