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RADIOLOGICAL MONITORING OF THE RAW SEWAGE OF THE METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO

2016 ANNUAL REPORT

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LIST OF ABBREVIATIONS

CAWS	Chicago Area Waterway System
District	Metropolitan Water Reclamation District of Greater Chicago
Egan	John E. Egan
IAC	Illinois Administrative Code
IEMA-DNS	Illinois Emergency Management Agency, Division of Nuclear Safety
IPCB	Illinois Pollution Control Board
Kirie	James C. Kirie
O'Brien	Terrence J. O'Brien
pCi/L	picocuries per liter
Ra-226	radium-226
Ra-228	radium-228
Sr-90	strontium-90
USEPA	United States Environmental Protection Agency
WRPs	water reclamation plants

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DISCLAIMER

Mention of proprietary equipment and chemicals in this report does not constitute endorsement by the Metropolitan Water Reclamation District of Greater Chicago.

SUMMARY AND CONCLUSIONS

The discharge of radioactive materials into the sanitary sewer system of the Metropolitan Water Reclamation District of Greater Chicago (District) is regulated by the Illinois Emergency Management Agency, Division of Nuclear Safety (IEMA-DNS). In Illinois, hospitals, industries, research organizations, and other radioactive material license holders are authorized to dispose of radionuclides into the District's sanitary sewer system in accordance with 32 Illinois Administrative Code (IAC), Section 340.1030. Naturally occurring radionuclides in groundwater and stormwater runoff also enter the sanitary sewer system. As an example, there are higher radionuclide values at the Lemont WRP because the village uses well water.

The purpose of wastewater treatment is to reduce or remove pollutants from raw sewage to ensure adequate effluent quality before it is discharged to surface water. The low concentrations of radioactive material from natural and man-made sources discharged into the sanitary sewer system may become concentrated in the sewage sludge during wastewater treatment and sludge processing. This monitoring is conducted to determine the concentration of radioactive material in raw sewage at the District's water reclamation plants (WRPs).

In August 2016, one raw sewage sample from each of the District's seven WRPs was collected and analyzed for gross alpha, gross beta, strontium-90 (Sr-90), and radium-226 and -228 (Ra-226 and Ra-228) radioactivity.

The 2016 gross alpha and gross beta radioactivity monitoring data was compared with the alpha and beta historical data from the last twenty years. The data show that there has not been a major change in the alpha and beta radioactivity concentrations of raw sewage samples of the WRPs over the last twenty years.

The gross alpha and gross beta radioactivity levels in the raw sewage influent are regularly less than the allowable contaminant levels in the drinking water standards set by the United States Environmental Protection Agency (USEPA) National Primary Drinking Water Regulations, 40 *Code of Federal Regulations* Part 141, published in 2000. The USEPA limit for gross alpha radioactivity (excluding radon and uranium) is 15 picocuries per liter (pCi/L), and for gross beta radioactivity (excluding naturally occurring potassium-40) the limit is 50 pCi/L. The gross beta radioactivity in the raw sewage influent is also much lower than the General Use Water Quality Standard, 100 pCi/L, established by the Illinois Pollution Control Board (IPCB), 35C IAC, Section 302.207. Furthermore, the 2016 combined concentrations of Ra-226 and Ra-228 and the Sr-90 concentration in the raw sewage influent were also less than the General Use Water Quality Standards of 3.75 pCi/L and 2.0 pCi/L, respectively, at all of the District's WRPs except the Lemont WRP. All of the monitoring data indicate that the discharge of the final effluent from the seven WRPs is unlikely to have any adverse effect on the radiological quality of the receiving waters.

INTRODUCTION

The District is located within the boundaries of Cook County, Illinois, and serves an area of 883.5 square miles. The area served by the District includes the city of Chicago and 125 suburban communities with a combined population of 5.25 million people. In addition, a waste-load equivalent of 5.1 million people is contributed by industrial and commercial sources within the District's service area. On average, the District treats approximately 1.5 billion gallons per day of wastewater at its seven WRPs.

The discharge of radionuclides to the District's sewerage system is regulated by the IEMA-DNS. Radioactivity in the sewerage system may come from a variety of sources including industries, hospitals, and research organizations. Naturally occurring and atmospheric fallout radionuclides also enter the sewerage system from groundwater and through stormwater runoff in the combined sewer areas.

The IPCB has assigned aquatic life use designations for each water body within the state of Illinois. General Use Waters have the following water quality standards for radioactivity: 100 pCi/L for gross beta, 3.75 pCi/L for combined Ra-226 and Ra-228, and 2 pCi/L for Sr-90. There are no General Use Water Quality Standards for gross alpha radioactivity in Illinois. The Egan WRP discharges into Salt Creek, the Kirie WRP discharges into Higgins Creek, and the Hanover Park WRP discharges into the West Branch of the Du Page River. These are the only District WRPs subject to General Use Water Quality Standards. The O'Brien and Calumet WRPs discharge into the North Shore Channel and the deep draft portion of the Little Calumet River, respectively, which are Chicago Area Waterway System (CAWS) Aquatic Life Use A (CAWS A) Waters. The Stickney and Lemont WRPs discharge into the Chicago Sanitary and Ship Canal, which is designated as a CAWS and Brandon Pool Aquatic Life Use B (CAWS B) Water. There are no water quality standards for radioactivity in CAWS A or B Waters.

The District has monitored the quality of its raw sewage and effluents from all of its WRPs monthly for gross alpha and gross beta radioactivity since 1996. In 2012, the raw sewage and final effluent samples were also analyzed quarterly for Ra-226 and Ra-228 and Sr-90 radioactivity.

This report presents gross alpha, gross beta, Sr-90, and Ra-226 and Ra-228 radioactivity concentrations in raw sewage influent from the District's seven WRPs collected in August 2016. The 2016 radiological monitoring data are compared with the historical alpha and beta data of the last twenty years and radium and strontium data from 2012.

MATERIALS AND METHODS

Sample Collection

One raw sewage sample (composited over a period of 24 hours) was collected on August 1, 2016, from the Stickney, John E. Egan (Egan), Terrence J. O'Brien (O'Brien [formerly North Side]), James C. Kirie (Kirie), Hanover Park, and Calumet WRPs, and on August 2, 2016, from the Lemont WRP. The samples were preserved with hydrochloric acid.

Sample Analysis

The raw sewage samples were analyzed by the District's radiochemistry laboratory from the inception of the program through 2007. The samples collected in 2008, 2011 through 2013, 2015, and 2016 were analyzed by the Environmental Inc., Midwest Laboratory, and samples collected in 2009 and 2010 were analyzed by Eberline Analytical Corporation.

RESULTS

Table 1 shows gross alpha radioactivity of the raw sewage influent of all seven WRPs during 1996–2016. The levels of gross alpha radioactivity in the influent to all WRPs in 2016 were within the range of previous years. Table 2 shows gross beta radioactivity of the raw sewage influent of all seven District WRPs during 1996–2016. The levels of gross beta radioactivity in the influent to all WRPs in 2016 were within the range of previous years. Table 3 shows values for Sr-90, Ra-226, and Ra-228 of the raw sewage influent of all seven District WRPs analyzed in 2012 (quarterly) and 2016 (one-time sample taken in August). The levels of Sr-90, Ra-226, and Ra-228 in the influent to all WRPs in 2016 were similar to values determined in 2012.

TABLE 1: GROSS ALPHA RADIOACTIVITY IN ALL METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO WATER RECLAMATION PLANTS' RAW SEWAGE – 1996 THROUGH 2016[1]

Sample Location WRP	1996−2006	2007	2008	2009	2010	2011	2012	2013	2015	2016
	pCi/L									
Calumet	<4.6	<5.5	<4.6	<3.5	<4.2	4.2	2.6	2.2	2.4	<1.8
Egan	<4.3	<5.4	<2.8	<4.4	<4.1	<2.5	<2.0	2.4	1.9	<1.8
Hanover Park	<4.2	<5.0	<2.7	<2.6	<3.2	<2.7	<1.9	1.8	1.9	<1.6
Kirie	<4.5	<5.6	<3.1	<3.7	<3.4	<3.1	<1.9	2.6	3.5	<1.8
Lemont	24.5	15.2	23.6	16.5	21.0	13.9	14.7	16.8	18.3	3.7
O'Brien	<4.1	<5.0	<2.8	<3.1	<2.8	<2.9	<1.9	1.9	3.3	<1.7
Stickney	5.2	<6.1	8.6	<4.8	5.5	7.6	<4.2	6.5	5.0	5.3

[1]The 1996–2015 samples were analyzed monthly, and the value(s) are the average for the year(s). The 2016 samples were collected once in August. Raw sewage was not analyzed in 2014.

TABLE 2: GROSS BETA RADIOACTIVITY IN ALL METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO WATER RECLAMATION PLANTS' RAW SEWAGE – 1996 THROUGH 2016[1]

Sample Location WRP	1996−2006	2007	2008	2009	2010	2011	2012	2013	2015	2016
	pCi/L									
Calumet	15.9	9.8	8.5	10.3	9.3	7.2	6.1	4.8	4.9	3.7
Egan	16.0	11.4	9.0	10.4	11.4	6.2	6.2	6.0	5.9	4.7
Hanover Park	14.2	9.8	8.9	10.8	9.7	5.8	6.1	6.3	6.1	5.7
Kirie	17.6	13.0	11.8	9.6	10.5	6.6	5.7	5.7	6.7	7.5
Lemont	40.1	26.3	27.0	24.8	24.4	17.2	16.9	19.6	18.3	9.9
O'Brien	13.4	9.0	7.5	7.0	7.9	5.1	4.0	3.9	5.1	4.8
Stickney	20.1	17.0	17.9	12.6	13.5	12.4	8.5	12.2	10.2	8.4

[1]The 1996–2015 samples were analyzed monthly, and the value(s) are the average for the year(s). The 2016 samples were collected once in August. Raw sewage was not analyzed in 2014.

TABLE 3: RADIUM-226, RADIUM-228, AND STRONTIUM-90 IN ALL METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO WATER RECLAMATION PLANTS' RAW SEWAGE – 2012 AND 2016[1]

Sample Location WRP	Radium-226		Radium-228		Strontium-90	
	2012	2016	2012	2016	2012	2016
	pCi/L					
Calumet	0.5	<0.4	<1.8	<1.5	<1.0	<0.9
Egan	<0.6	0.3	2.0	<1.6	<1.0	<1.1
Hanover Park	0.4	0.3	<1.7	<1.8	<1.0	<1.0
Kirie	<0.4	<0.3	<2.0	<1.6	<1.1	<1.0
Lemont	7.6	3.2	5.4	<1.4	<0.9	<1.0
O'Brien	<0.4	<0.2	<1.9	<1.8	<1.0	<1.3
Stickney	0.9	1.1	<1.9	1.6	<1.1	<1.0

[1]The 2012 samples were analyzed quarterly, and reported value is the average for the year. The 2016 samples were collected once in August.