Metropolitan Water Reclamation District of Greater Chicago

MONITORING AND RESEARCH DEPARTMENT

REPORT NO. 15-21

TUNNEL AND RESERVOIR PLAN

THORNTON TRANSITIONAL FLOOD CONTROL

RESERVOIR AND WELLS

ANNUAL GROUNDWATER MONITORING REPORT

FOR 2014

July 2015

Metropolitan Water Reclamation District of Greater Chicago
100 East Erie Street Chicago, Illinois 60611-2803 (312) 751-5600

TUNNEL AND RESERVOIR PLAN
THORNTON TRANSITIONAL FLOOD CONTROL RESERVOIR AND WELLS
ANNUAL GROUNDWATER MONITORING REPORT FOR 2014

Monitoring and Research Department
Thomas C. Granato, Director

July 2015

Protecting Our Water Environment

Metropolitan Water Reclamation District of Greater Chicago

100 East Erie Street Chicago, Illinois 60611-3154 f: 312.751.5194 312.751.5190

THOMAS C. GRANATO, Ph.D., BCES
Director of Monitoring and Research
thomas.granato@mwrd.org

July 9, 2015

Ms. Marcia Willhite
Bureau Chief
Bureau of Water
Illinois Environmental Protection Agency
P. O. Box 19276
Springfield, IL 62794-9276

Dear Ms. Willhite:

Subject: Thornton Transitional Flood Control Reservoir and Wells, Annual Groundwater Monitoring Report for 2014

Attached are three copies of "Tunnel and Reservoir Plan, Thornton Transitional Flood Control Reservoir and Wells, Annual Groundwater Monitoring Report for 2014."

Since there were several fill events in the Thornton Transitional Flood Control Reservoir during 2014, groundwater samples were collected and analyzed during the year.

Very truly yours,

Thomas C. Granato, Ph.D. BCES
Director
Monitoring and Research

TCG:PL:cm
Attachment
cc/att: Ms. Sally K. Swanson (USEPA Region 5 - WC15J) - (2)
Dr. Zhang
Dr. Cox
Dr. Hundal
Dr. Lindo
cc: Mr. St. Pierre
Ms. Sharma

TCG:HZ:AC:LH:PL:cm

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ANNUAL DATA FOR MONITORING WELLS AND TRANSITIONAL RESERVOIR

Introduction

This report is submitted annually to fulfill the reporting requirements of the Illinois Environmental Protection Agency (IEPA) regarding the utilization of the Thornton Transitional Reservoir for flood control. The reporting requirements, stated in Section 7 of the Scope of Work (SOW) approved by the IEPA on August 6, 2001, and modified May 9, 2005, for Groundwater Quality Monitoring of the Reservoir and adjacent wells, include:

1. Analytical data for the monitoring wells and transitional reservoir for the previous year
2. Review and comparison of analytical data for the monitoring wells with calculated statistical limits for previously analyzed background samples in order to evaluate exceedances in the concentration limits of analytes.

Project Description

The Reservoir is in the West Lobe of the Thornton Quarry, southeast of the intersection of the Tri-State Tollway and Halsted Street in Thornton, Illinois (Figure 1). The Reservoir was the final structure to be implemented for the Little Calumet River Watershed under the Natural Resources Conservation Service Little Calumet Watershed Plan of November 1998. The Reservoir provides 3.7 billion gallons (BG) of floodwater storage, increased from the original volume of 3.1 BG due to additional rock mining. This provides sufficient volume to capture a 100-year storm event from Thorn Creek at a point just south of the Tri-State Tollway. This project provides flood control benefits for 21 businesses and 4,400 residences, at an average cost of $6.8 million per year. Within the Little Calumet watershed are the Illinois communities of Blue Island, Calumet City, Dixmoor, Dolton, Glenwood, Harvey, Lansing, Phoenix, Riverdale, and South Holland, which all benefit from the implemented flood control measures.

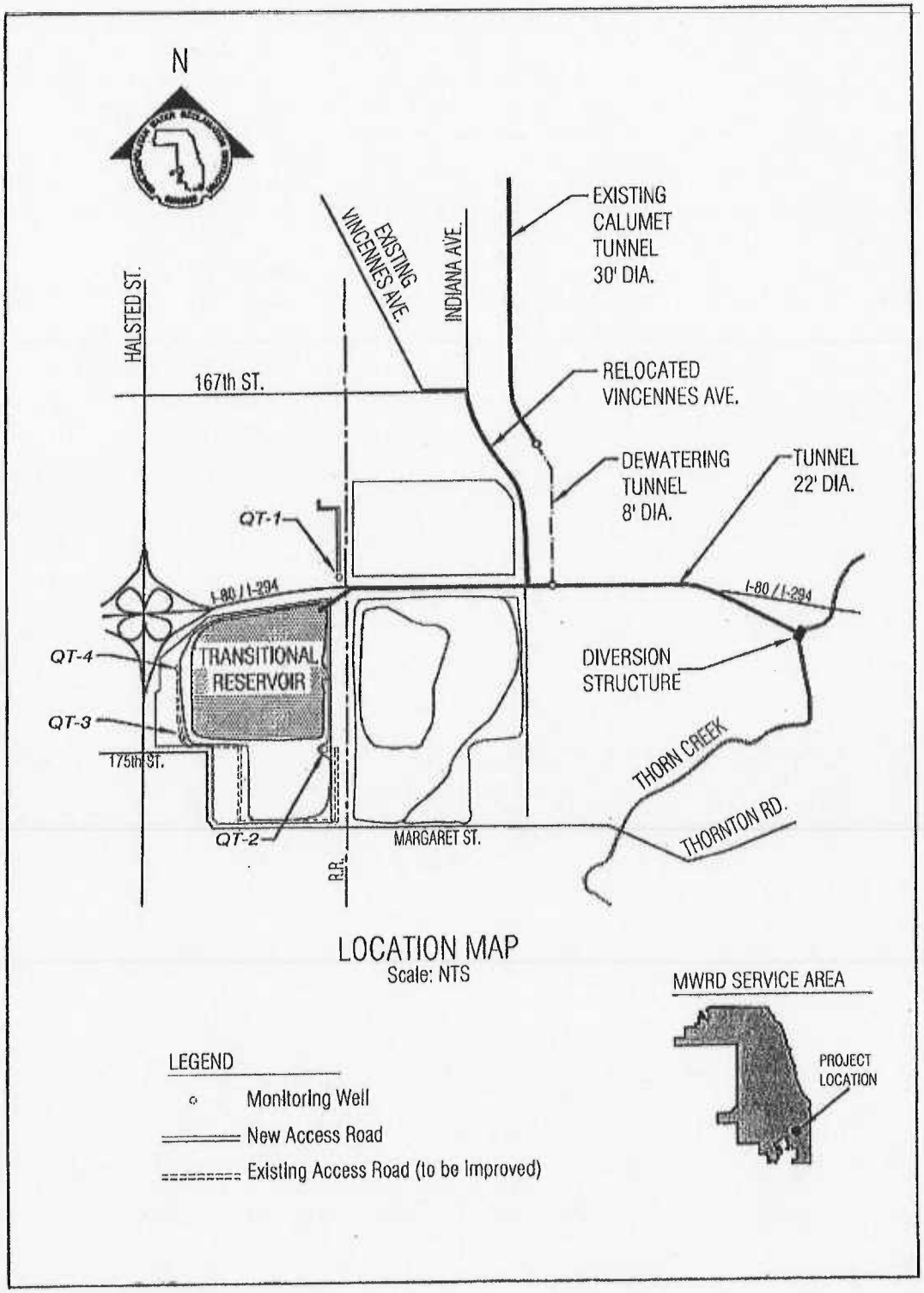
The Reservoir consists of a diversion structure at Thorn Creek, a 24-foot diameter dropshaft, and 22-foot diameter conveyance tunnel to the Lower West Lobe of Thornton Quarry. The project also includes an 8-foot diameter tunnel connected to the Calumet Tunnel and Reservoir Plan System that is utilized for Reservoir dewatering purposes only.

The rationale for collecting groundwater quality data for the four monitoring wells QT-1, QT-2, QT-3, and QT-4 and the Transitional Reservoir is to detect any potential contamination of groundwater in the monitoring wells and/or reservoir which may result from seepage during a fill or diversion event, and to immediately implement measures to curtail and/or correct that contamination.

The analytes measured are:

1. pH, electrical conductivity (EC), total dissolved solids (TDS), BOD_5, CN^-, F^-, Cl^-, SO_4^{2-}, NH_3-N, NO_2+NO_3-N, and phenol.

FIGURE 1: THORNTON TRANSITIONAL RESERVOIR MONITORING WELL LOCATIONS



2. Metals and trace elements: Ag, As, B, Ba, Cd, Cr, Cu, Fe, Hg, Mn, Ni, and Pb.

3. Other parameters: fecal coliform (FC), groundwater temperature, and water elevation.

There were three significant rain events and subsequent diversion/fill events during 2014 (Table 1), two of which required the sampling of both ground and surface water for analysis and evaluation. The first event did not produce a significant accumulation of water in the reservoir. As a result, no samples were collected from the reservoir or wells following this event. The third event occurred while there was still water in the reservoir from the second event. Analytical data for the second and third events are reported in Tables 2 through 6.

Summary of Data for Monitoring Wells and Reservoir

Prior to all diversion/pumpdown events and based on the requirements of the SOW, the monitoring wells and the Reservoir were sampled weekly as long as there was water in the Reservoir. Analytical data generated during the June 30 – July 1 and July 12 - 14 fill events of 2014 are presented (Tables 2 through 6) for wells QT-1, -2, -3, -4, and the Reservoir, respectively. During these events, several parameters exceeded the 95 percent upper confidence limits established for the background samples. There was no exceedance in Wells QT-1 through -4 for phenol, CN^-, NO_2+NO_3-N, FC, As, Cr, Hg, and Pb. However, there were exceedances in all wells for EC, TDS, F^-, Cl^-, SO_4^{2-}, NH_3-N, Ag, B, Ba, Fe, and Mn. Exceedances for Cd, Cu, Ni, and BOD_5 were sporadic in the wells. The confidence limit for BOD_5 was exceeded only once in Well QT-1, and that occurred during the second rain event of 2014. For all other wells, there was no BOD_5 exceedance during all rain events.

The Reservoir experienced a higher incidence of exceedances than the wells. There were exceedances for the following analytes: TDS, BOD_5, F^-, Cl^-, SO_4^{2-}, NH_3-N, NO_2+NO_3-N, FC, and metals Ag, B, Ba, Cu, Fe, Mn, and Ni. The analytes that showed no exceedances were CN^-, phenol, As, Cd, Cr, Hg, and Pb (Table 6).

Any event during which the concentrations of analytes exceed the upper limit of the 95 percent confidence interval is regarded as an excursion. An excursion may be defined as an elevated reading within a specific isolated location and indicates the potential for contamination relative to background groundwater concentrations. Notably, in nearly all cases where excursions were observed for any parameter in a well, the corresponding concentration of that parameter in the reservoir was much lower, indicating that the reservoir is unlikely the source of contamination causing the observed excursions.

TABLE 1: DIVERSIONS TO THE THORNTON TRANSITIONAL FLOOD CONTROL RESERVOIR DURING 2014

Date of Diversion	Volume Collected in Thornton Transitional Reservoir	Rainfall (measured at Calumet WRP)	Date Reservoir Completely Drained	Number of Weeks Sampled
	million gallons	inch		
06/22/14	175	0.94	NA[1]	0[2]
06/30 - 07/01/14	543	1.53	NA	2
07/12 - 07/14/14	658	2.27	08/05/14	3
09/10 - 09/11/14	267	2.13	NA	0

[1]Reservoir not drained completely.
[2]No reservoir and well samples collected following first and fourth rain events; insufficient water in reservoir.

TABLE 2: ANALYSIS OF GROUNDWATER FROM MONITORING WELL QT-1 AT THE THORNTON RESERVOIR SITE SAMPLED FOLLOWING EACH FILL EVENT DURING 2014

Well[1]	Date Sampled	pH	EC[2]	TDS[2]	BOD_5	CN^-	F^-	Cl^-	SO_4^{2-}	NH_3-N	NO_2+NO_3-N	Phenol	Ag
			mS/M	mg/L									
Upper 95% Confidence Limit		N[4]	1	60	2	0.005	0.10	10	5	0.10	0.15	0.005	0.001
QT-1 **(Event 2)**	07/03/14	7.2	238	2,370	<2	<0.005	0.39	946	339	0.47	<0.15	<0.005	<0.001
QT-1	07/10/14	7.0	252	2,228	5	<0.005	0.38	985	334	0.42	<0.15	<0.005	0.0026
Excursion		N	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No	No	Yes
QT-1 **(Event 3)**	07/17/14	7.3	315	2,432	<2	<0.005	0.38	995	293	0.42	<0.15	<0.005	0.0028
QT-1	07/24/14	7.5	298	2,116	<2	<0.005	0.37	922	297	0.36	<0.15	<0.005	0.0029
QT-1	07/29/14	7.2	312	2,520	<2	<0.005	0.36	1,010	296	0.38	<0.15	<0.005	0.0027
Excursion		N	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	No	Yes

TABLE 2 (Continued): ANALYSIS OF GROUNDWATER FROM MONITORING WELL QT-1 AT THE THORNTON RESERVOIR SITE SAMPLED FOLLOWING EACH FILL EVENT DURING 2014

Well[1]	Date Sampled	As	B	Ba	Cd	Cr	Cu	Fe	Hg	Mn	Ni	Pb	Fecal Coliform	Temp	Water Elevation[3]
		mg/L											CFU/100mL	°C	(ft)
Upper 95% Confidence Limit		0.050	0.05	0.004	0.001	0.005	0.005	0.10	0.0002	0.001	0.005	0.02	1	N	N
QT-1 **(Event 2)**	07/03/14	<0.050	0.31	0.072	<0.001	<0.005	0.005	9.0	<0.0002	0.153	<0.005	<0.02	<1	13.3	-139
QT-1	07/10/14	<0.050	0.29	0.083	<0.001	<0.005	0.006	12	<0.0002	0.095	<0.005	<0.02	<1	14.3	-141
Excursion		No	Yes	Yes	No	No	Yes	Yes	No	Yes	No	No	No	N	N
QT-1 **(Event 3)**	07/17/14	<0.050	0.27	0.084	<0.001	<0.005	0.017	11	<0.0002	0.059	<0.005	<0.02	<1	14.6	-149
QT-1	07/24/14	<0.050	0.24	0.083	<0.001	<0.005	<0.005	11	<0.0002	0.075	<0.005	<0.02	<1	15.7	-158
QT-1	07/29/14	<0.050	0.24	0.086	<0.001	<0.005	<0.005	8.8	<0.0002	0.069	<0.005	<0.02	<1	14.1	-159
Excursions		No	Yes	Yes	No	No	Yes	Yes	No	Yes	No	No	No	N	N

[1]Samples retrieved from QT-1 following rain and fill events of 2014.
[2]EC = electrical conductivity; TDS = total dissolved solids.
[3]Relative to Chicago city datum (579.48 ft above mean sea level) at intersection of Madison and State Streets.
[4]Not applicable; no specified confidence limits for several parameters.

TABLE 3: ANALYSIS OF GROUNDWATER FROM MONITORING WELL QT-2 AT THE THORNTON RESERVOIR SITE SAMPLED FOLLOWING EACH FILL EVENT DURING 2014

Well[1]	Date Sampled	pH	EC[2]	TDS[2]	BOD_5	CN^-	F^-	Cl^-	SO_4^{2-}	NH_3-N	NO_2+NO_3-N	Phenol	Ag
			mS/M	mg/L									
Upper 95% Confidence Limit		N[4]	1	60	2	0.005	0.10	10	5	0.10	0.15	0.005	0.001
QT-2 (**Event 2**)	07/03/14	7.3	135	1,274	<2	<0.005	0.27	182	468	0.13	<0.15	<0.005	0.0019
QT-2	07/10/14	7.4	134	1,130	<2	<0.005	0.30	180	487	0.17	<0.15	<0.005	0.0022
Excursion		N	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	No	Yes
QT-2 (**Event 3**)	07/17/14	7.4	148	1,248	<2	<0.005	0.28	175	452	0.14	<0.15	<0.005	0.0022
QT-2	07/24/14	7.2	145	1,314	<2	<0.005	0.25	202	545	0.14	<0.15	<0.005	0.0026
QT-2	07/29/14	7.0	162	1,542	<2	<0.005	0.23	139	725	0.17	<0.15	<0.005	0.0030
Excursion		N	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	No	Yes

TABLE 3 (Continued): ANALYSIS OF GROUNDWATER FROM MONITORING WELL QT-2 AT THE THORNTON RESERVOIR SITE SAMPLED FOLLOWING EACH FILL EVENT DURING 2014

Well	Date Sampled	As	B	Ba	Cd	Cr	Cu	Fe	Hg	Mn	Ni	Pb	Fecal Coliform	Temp	Water Elevation[3]
		mg/L											CFU/100mL	°C	(ft)
Upper 95% Confidence Limit		0.050	0.05	0.004	0.001	0.005	0.005	0.10	0.0002	0.001	0.005	0.02	1	N	N
QT-2 (**Event 2**)	07/03/14	<0.050	0.24	0.034	0.001	<0.005	<0.005	3.0	<0.0002	0.034	0.013	<0.02	<1	15.1	-183
QT-2	07/10/14	<0.050	0.25	0.038	0.001	<0.005	<0.005	4.2	<0.0002	0.056	0.009	<0.02	<1	15.3	-180
Excursion		No	Yes	Yes	No	No	No	Yes	No	Yes	Yes	No	No	N	N
QT-2 (**Event 3**)	07/17/14	<0.050	0.24	0.040	0.001	<0.005	<0.005	5.0	<0.0002	0.044	0.013	<0.02	<1	15.6	-182
QT-2	07/24/14	<0.050	0.21	0.043	0.002	<0.005	<0.005	10	<0.0002	0.075	0.021	<0.02	<1	14.4	-185
QT-2	07/29/14	<0.050	0.18	0.047	0.001	<0.005	<0.005	15	<0.0002	0.104	0.036	<0.02	<1	14.6	-187
Excursion		No	Yes	Yes	Yes	No	No	Yes	No	Yes	Yes	No	No	N	N

[1]Samples retrieved from QT-2 following rain and fill events of 2014.
[2]EC = electrical conductivity; TDS = total dissolved solids.
[3]Relative to Chicago city datum (579.48 ft above mean sea level) at intersection of Madison and State Streets.
[4]Not applicable; no specified confidence limits for several parameters.

TABLE 4: ANALYSIS OF GROUNDWATER FROM MONITORING WELL QT-3 AT THE THORNTON RESERVOIR SITE SAMPLED FOLLOWING EACH FILL EVENT DURING 2014

Well[1]	Date Sampled	pH	EC[2]	TDS[2]	BOD_5	CN^-	F^-	Cl^-	SO_4^{2-}	NH_3-N	NO_2+NO_3-N	Phenol	Ag
			mS/M	mg/L									
Upper 95% Confidence Limit		N[4]	1	60	2	0.005	0.10	10	5	0.10	0.15	0.005	0.001
QT-3 (**Event 2**)	07/03/14	7.2	143	1,210	<2	<0.005	0.22	329	197	0.35	<0.15	<0.005	0.0021
QT-3	07/10/14	7.4	136	1,106	<2	<0.005	0.24	315	205	0.37	<0.15	<0.005	0.0024
Excursion		N	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	No	Yes
QT-3 (**Event 3**)	07/17/14	7.2	87	1,248	<2	<0.005	0.24	335	191	0.35	<0.15	<0.005	0.0024
QT-3	07/24/14	7.2	157	1,224	<2	<0.005	0.29	345	188	0.31	<0.15	<0.005	0.0028
QT-3	07/29/14	7.1	151	1,312	<2	<0.005	0.21	339	198	0.32	<0.15	<0.005	0.0026
Excursion		N	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	No	Yes

TABLE 4 (Continued): ANALYSIS OF GROUNDWATER FROM MONITORING WELL QT-3 AT THE THORNTON RESERVOIR SITE SAMPLED FOLLOWING EACH FILL EVENT DURING 2014

Well[1]	Date Sampled	As	B	Ba	Cd	Cr	Cu	Fe	Hg	Mn	Ni	Pb	Fecal Coliform	Temp	Water Elevation[3]
		mg/L											CFU/100mL	°C	(ft)
Upper 95% Confidence Limit		0.050	0.05	0.004	0.001	0.005	0.005	0.10	0.0002	0.001	0.005	0.02	1	N	N
QT-3 (**Event 2**)	07/03/14	<0.050	0.30	0.065	<0.001	<0.005	<0.005	6.6	<0.0002	0.073	<0.005	<0.02	<1	13.4	-188
QT-3	07/10/14	<0.050	0.28	0.074	<0.001	<0.005	<0.005	9.3	<0.0002	0.080	<0.005	<0.02	<1	13.1	-191
Excursion		No	Yes	Yes	No	No	No	Yes	No	Yes	No	No	No	N	N
QT-3 (**Event 3**)	07/17/14	<0.050	0.27	0.074	<0.001	<0.005	<0.005	8.2	<0.0002	0.087	<0.005	<0.02	<1	14.3	-170
QT-3	07/24/14	<0.050	0.26	0.075	<0.001	<0.005	<0.005	5.9	<0.0002	0.076	0.005	<0.02	<1	14.2	-170
QT-3	07/29/14	<0.050	0.25	0.080	<0.001	<0.005	<0.005	6.8	<0.0002	0.086	0.005	<0.02	<1	12.8	-173
Excursion		No	Yes	Yes	No	No	No	Yes	No	Yes	No	No	No	N	N

[1]Samples retrieved from QT-3 following rain and fill events of 2014.
[2]EC = electrical conductivity; TDS = total dissolved solids.
[3]Relative to Chicago city datum (579.48 ft above mean sea level) at intersection of Madison and State Streets.
[4]Not applicable; no specified confidence limits for several parameters.

TABLE 5: ANALYSIS OF GROUNDWATER FROM MONITORING WELL QT-4 AT THE THORNTON RESERVOIR SITE SAMPLED FOLLOWING EACH FILL EVENT DURING 2014

Well[1]	Date Sampled	pH	EC[2]	TDS[2]	BOD_5	CN^-	F^-	Cl^-	SO_4^{2-}	NH_3-N	NO_2+NO_3-N	Phenol	Ag
			mS/M	mg/L									
Upper 95% Confidence Limit		N[4]	1	60	2	0.005	0.10	10	5	0.10	0.15	0.005	0.001
QT-4 (**Event 3**)	07/29/14	7.2	170	1,354	<2	<0.005	0.28	328	39	0.41	<0.15	<0.005	0.0024
Excursion		N	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	No	Yes

TABLE 5 (Continued): ANALYSIS OF GROUNDWATER FROM MONITORING WELL QT-4 AT THE THORNTON RESERVOIR SITE SAMPLED FOLLOWING EACH FILL EVENT DURING 2014

Well[1]	Date Sampled	As	B	Ba	Cd	Cr	Cu	Fe	Hg	Mn	Ni	Pb	Fecal Coliform	Temp	Water Elevation[3]
		mg/L											CFU/100mL	°C	(ft)
Upper 95% Confidence Limit		0.050	0.05	0.004	0.001	0.005	0.005	0.10	0.0002	0.001	0.005	0.02	1	N	N
QT-4 **(Event 3)**	07/29/14	<0.050	0.42	0.082	<0.001	<0.005	<0.005	6.9	<0.0002	0.205	<0.005	<0.02	<1	15.2	-103
Excursion		No	Yes	Yes	No	No	No	Yes	No	Yes	No	No	No	N	N

[1]Only one sample retrieved from QT-4 following rain and fill events of 2014; no access to QT-4 due to very poor condition of road.
[2]EC = electrical conductivity; TDS = total dissolved solids.
[3]Relative to Chicago city datum (579.48 ft above mean sea level) at intersection of Madison and State Streets.
[4]Not applicable; no specified confidence limits for several parameters.