Metropolitan Water Reclamation District of Greater Chicago

MONITORING AND RESEARCH DEPARTMENT

REPORT NO. 16-45

THORNTON COMPOSITE RESERVOIR

GROUNDWATER MONITORING REPORT

SECOND QUARTER 2016

December 2016

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

December 16, 2016

Richard P. Cobb, P.G.
Deputy Division Manager
Division of Public Water Supplies
Illinois Environmental Protection Agency
1021 North Grand Avenue East
Springfield, IL 62794

Dear Mr. Cobb:

Subject: Transmittal of the Report "Thornton Composite Reservoir Groundwater Monitoring Report Second Quarter 2016"

Please find attached the report entitled "Thornton Composite Reservoir Groundwater Monitoring Report Second Quarter 2016" transmitted electronically. The report is prepared for transmittal to the Illinois Environmental Protection Agency (IEPA) in accordance with the Thornton Composite Reservoir Groundwater Monitoring Plan. Also attached is a PDF of the Thornton Composite Reservoir raw data from Grace Analytical Laboratory as required by the IEPA.

If you have any questions or would like to have additional information, please contact Dr. Pauline Lindo at (708) 588-4109 or pauline.lindo@mwrd.org.

Very truly yours,

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

TCG:HZ:PL:cm
Attachments
cc: Mr. E. Podczerinski
Dr. H. Zhang
Dr. A. Cox
Dr. G. Tian
Dr. P. Lindo

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

Thornton Composite Reservoir
Groundwater Monitoring Report
Second Quarter 2016

Pauline Lindo
Associate Environmental Soil Scientist

Guanglong Tian
Provisional Supervising Environmental Soil Scientist

Albert Cox
Environmental Monitoring and Research Manager

Heng Zhang
Assistant Director of Monitoring and Research
Environmental Monitoring and Research Division

Monitoring and Research Department
Thomas C. Granato, Director

December 2016

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACKNOWLEDGEMENTS

The draft report for the Thornton Composite Reservoir Groundwater Monitoring was generated for the Engineering Department by the consultants of Black and Veatch, according to Engineering Contract 04-203-4F. All samples were collected and reports drafted by Black and Veatch, and all analyses performed by Grace Analytical Laboratory, Inc. The final report was produced according to the format guidelines of the Metropolitan Water Reclamation District of Greater Chicago's (District) Monitoring and Research (M&R) Department. Special thanks are due to Ms. Coleen Maurovich for converting the draft report to the M&R Department's format.

DISCLAIMER

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

LIST OF ACRONYMS

Acronym	Definition
Ca	Calcium
CCD	Chicago City Datum
CSO	Combined Sewer Overflow
FC	Fecal Coliform
GMP	Groundwater Monitoring Plan
GPS	Groundwater Protection System
IAC	Illinois Administrative Code
Mg	Magnesium
M&R	Monitoring and Research
TCR	Thornton Composite Reservoir
TDS	Total Dissolved Solids
UCLs	Upper Control Limits

INTRODUCTION

A Groundwater Protection System (GPS) has been constructed for the Thornton Composite Reservoir (TCR) to protect against the exfiltration of combined sewer overflow (CSO) into the surrounding dolomite aquifers. The CSOs and minimal amounts of storm water runoff are stored in the reservoir during and after large storm events. To monitor the performance of the GPS, a network of monitoring wells located outside the perimeter of the GPS is being monitored, as discussed in the Revised Groundwater Monitoring Plan (Revised GMP) (Black & Veatch, 2016). According to the Revised GMP, one sample of reservoir water, one of the Main Quarry Sump, and one from each of the seven wells are collected annually and analyzed for the Illinois Administrative Code (IAC) Title 35 Part 620 Class I groundwater constituents. In addition, following a reservoir fill event or during a routine quarterly event, groundwater is sampled from the seven wells and the Main Quarry Sump and tested for a targeted list of parameters that are more likely to be detected in CSO water.

The monitoring well system consists of one deep well, TB-124, which monitors the underlying Galena Aquifer, and six vertical Westbay multi-level monitoring wells: TB-118, TB-119, TB-120, TB-121, TB-122, and TB-123, which monitor the Silurian Dolomite aquifers. As discussed in the Revised GMP, following a reservoir fill event, bi-weekly sampling is required as long as the water elevation in the reservoir is above -280 CCD. Groundwater is sampled from each well at the first sample interval port immediately below the reservoir water elevation. Each of the multi-level monitoring wells is capable of monitoring four distinct 20-ft intervals in the Silurian Dolomite aquifer.

The locations of monitoring wells, Main Quarry Sump, TCR, and the GPS are presented in Figure 1. The Main Quarry Sump is located beyond the south boundary of the GPS and is not a component of the TCR but is an integral part of the Hanson Material Services mining quarry to the south of the TCR. This sump facilitates mining operations by minimizing the water level at the bottom of the quarry. It is possible that the bottom of this sump could extend beyond the lowest depth of the TCR (-297.5 ft Chicago City Datum [CCD]). The sump contains mainly groundwater and small quantities of surface runoff, and it is sampled quarterly, along with the wells, to evaluate the potential migration of contaminants from the TCR to the sump.

Table 1 lists the characteristics of all wells at the TCR site (well location coordinates, elevations and depths, and the sampling port interval elevations).

Prior to the TCR becoming operational in November 2015, eight (8) sampling events were conducted on a quarterly basis for two years (May 2012 through March 2014) to provide background data on the existing groundwater quality. In order to evaluate the effectiveness of the grout curtain and GPS, the Background Groundwater Quality Report (B&V, 2014) presents the analysis of data for all samples collected during the background monitoring period and provides a baseline for comparison with routine monitoring data. Changes over time in groundwater calcium (Ca) and magnesium (Mg) concentrations would also be useful in tracking the occurrence of infiltration/exfiltration. Groundwater analytical data routinely generated for the

FIGURE 1: MONITORING WELL AND MAIN QUARRY SUMP LOCATIONS

monitoring wells, reservoir, and sump will also be compared with Part 620 Class I Groundwater Standards (Illinois EPA, 2012) to evaluate any exceedances in groundwater standards.

There was no fill event from April to June 2016. This report presents field activities, observations, and analytical data for groundwater samples taken at all wells and the Main Quarry Sump for the second quarter of 2016.

TABLE 1: CHARACTERISTICS OF MONITORING WELLS TB-118 THROUGH TB-124 AT THE THORNTON COMPOSITE RESERVOIR SITE

Well ID	Coordinates[1] Northing (ft)	Coordinates[1] Easting (ft)	Ground Surface El (ft, CCD[2])	Top of Riser El (ft, CCD[2])	Depth of Well (ft)	Sampling Port Interval (ft, CCD) Interval 1	Interval 2	Interval 3	Interval 4
TB-118	1791110.38	693560.44	38.5	41.5	532	-85 to -105	-212 to -232	-283 to -303	-392 to -412
TB-119	1792316.63	695509.39	27.9	29.5	529	-85 to -105	-212 to -232	-283 to -303	-392 to -412
TB-120	1790782.31	696888.93	40.0	42.1	540	-86 to -106	-213 to -233	-284 to -304	-393 to -413
TB-121	1792193.10	696044.98	29.4	30.4	461	-84 to -104	-211 to -231	-282 to -302	-391 to -411
TB-122	1790288.61	693549.38	48.8	51.7	480	-85 to -105	-212 to -232	-283 to -303	-392 to -412
TB-123	1792185.60	693685.69	28.9	31.8	460	-84 to -104	-211 to -231	-282 to -302	-391 to -411
TB-124	1792200.77	695591.56	29.6	29.2	728	-663 to -698			

[1]Illinois State Plane Coordinate System (NAD 1927).
[2]Chicago City Datum (CCD).

FIELD ACTIVITIES

For this report, routine monitoring samples were collected from sampling port Interval 3 at all multi-level wells and the deep well. On April 27, 2016, one sample was collected from Well TB-123 while duplicate samples were collected from Well TB-122. On April 28, single samples were collected from the Main Quarry Sump and from Wells TB-118, -119, and -124. On April 29, single samples were collected from Wells TB-120 and -121.

Each well sample collected was immediately analyzed in the field for pH and electrical conductivity (EC), and the temperature recorded using a WTW Multi 3400i pH/conductivity/temperature meter.

Prior to sampling the multi-level wells, hydrostatic pressure was measured at the port sampled to calculate the groundwater elevation in each well. Table 2 lists the sampling elevations at Port 3 of the multi-level wells and the corresponding groundwater elevations at each well during the second quarter routine monitoring. The sampling elevation for the deep well (TB-124) is also included.

All samples were packed in ice after collection and submitted the same day for analyses to Grace Analytical Laboratory, Inc., an IL State ELAP/NELAC-certified lab.

TABLE 2: SUMMARY OF ELEVATIONS IN THE DEEP WELL AND AT PORT 3 OF EACH MULTI-LEVEL WELL AND CORRESPONDING GROUNDWATER ELEVATIONS DURING THE APRIL 2016 MONITORING

Well and Interval ID	Sampling Elevation (ft CCD[1])	Groundwater Elevation (ft CCD)
TB-118-003	-289	-95
TB-119-003	-289	-173
TB-120-003	-290	-193
TB-121-003	-288	-177
TB-122-003	-288	-169
TB-123-003	-288	-55
TB-124[2]	-663	-

[1]Chicago City Datum.

[2]TB-124 is a conventional well screened from -663 to -698 CCD; sample was taken at an elevation of approximately -663 ft CCD.

ANALYTICAL RESULTS

The analytical methods for parameters used by the laboratory are listed in Table 3. The analytical data for all well samples and the sump sample collected during April 2016 are presented in Table 4. Analytical results were reviewed to identify any analytes that exceeded the Illinois Class I Groundwater Standards (35 IAC Part 620).

During the April 2016 sampling, boron was present in TB-122-003 (primary and duplicate samples) at concentrations of 2.3 and 2.2 mg/L, respectively, exceeding the Tier 1 groundwater standard of 2 mg/L. This exceedance is consistent with data from several background sampling events. The maximum detectable background concentration of 3.8 mg/L was measured in TB-122-004 during the fifth-quarter background sampling.

Chloride concentration in TB-118-003 (210 mg/L), TB-121-003 (205 mg/L), and TB-124 (299 mg/L) exceeded the Tier 1 groundwater standard of 200 mg/L during this event. Chloride concentration exceeded the groundwater standard during several background sampling events. The maximum concentration (1,230 mg/L) was detected during the background sampling.

Sulfate was present in TB-124 at a concentration of 710 mg/L, which exceeded the Tier I groundwater standard of 400 mg/L. This is consistent with previous background sampling events for which the maximum background sulfate concentration (890 mg/L) was detected during the first-quarter background sampling.

In addition, the concentration of total dissolved solids (TDS) in TB-124 (1,840 mg/L) exceeded the Tier 1 groundwater standard of 1,200 mg/L. This exceedance was consistent with that in several background sampling events. The maximum background concentration (2,960 mg/L) was detected during the background sampling.

All pH readings were within the Tier 1 pH groundwater standard (6.5 to 9.0) and lower than the maximum background value of 8.4. The pH at Well TB-124 was 7.7, a significant decline from 12 during the last two sampling events of December 2015 and January 2016. The present pH at TB-124 is more comparable with pH readings of 8.1 - 8.4 for this well during all quarterly background sampling events. The conductivity readings for duplicate samples at Well TB-122 were 851 and 1,180 mS/m, respectively, both higher than the maximum background concentration of 415 mS/m.

The fecal coliform (FC) of samples from monitoring wells were all <3 CFU/100 mL, while the Main Quarry Sump contained 28 CFU/100 mL.

TABLE 3: ANALYTICAL METHODS USED FOR REQUIRED PARAMETERS

Inorganic Chemical Parameters:	Analytical Method[1]
Chloride	325.2
Alkalinity, Bicarbonate	2320B
Total Dissolved Solids	2540C
Sulfate	4500-SO4-2 C or D
TAL metals	6010B & 7470A
Ammonia (as N)	350.1R2.0
Hardness	2340B
TOC	5310C
Others:	
Phenols	SVOC/8270C
Fecal Coliform	SM 9221E

[1]All standard EPA methods used by NELAC-certified and other laboratories.

TABLE 4: ANALYSIS OF GROUNDWATER SAMPLED FROM MONITORING WELLS TB-118-003 THROUGH TB-124 AND THE MAIN QUARRY SUMP AT THE THORNTON COMPOSITE RESERVOIR SITE DURING THE APRIL 2016 MONITORING

Parameter	Unit	Part 620 Groundwater Standard	Maximum Background	Lab RL[1]	Well TB-118-003	TB-119-003	TB-120-003	TB-121-003	TB-122-003	TB-122-003D[2]	TB-123-003	TB-124	Sump
pH		6.5-9.0	8.4	NL[3]	6.9	7.2	7.5	7.5	7.0	7.0	7.0	7.7	7.7
Electrical Conductivity	mS/m	NL	415	0.5	154	79	117	138	851	1,180	91	224	94
Total Dissolved Solids	mg/L	1,200	2,960	NL	1,120	527	731	894	845	788	583	1,840	734
Total Organic Carbon	"	NL	1.0	0.1	2.1	1.7	1.5	1.2	1.6	1.5	1.6	0.20	2.2
Chloride	"	200	1,230	5	210	54	138	205	170	190	49	299	114
Sulfate	"	400	890	15	229	126	112	212	83	81	134	710	205
Ammonia as N	"	NL	NA[4]	0.10	0.56	0.31	0.13	0.40	0.53	0.38	0.35	0.73	0.23
Phenol	"	0.10	0.06	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Fecal Coliform	CFU/ 100 mL	NL	<1	3	<3	<3	<3	<3	<3	<3	<3	<3	28
Ag	mg/L	0.05	0.003	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
B	"	2	3.8	0.05	0.81	0.76	0.92	0.88	2.3	2.2	1.6	1.1	0.13
Be	"	0.004	0.002	0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Co	"	1	0.035	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cr	"	0.1	86.4	0.005	<0.005	0.011	0.013	0.016	0.013	0.010	0.019	0.009	<0.005
Cu	"	0.65	0.004	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Mn	"	0.15	0.183	0.005	<0.005	0.013	0.005	<0.005	<0.005	0.006	<0.005	0.019	0.039
Se	"	0.05	0.008	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
V	"	0.049	NA	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

TABLE 4 (Continued): ANALYSIS OF GROUNDWATER SAMPLED FROM MONITORING WELLS TB-118-003 THROUGH TB-124 AND THE MAIN QUARRY SUMP AT THE THORNTON COMPOSITE RESERVOIR SITE DURING THE APRIL 2016 MONITORING

Parameter	Unit	Part 620 Groundwater Standard	Maximum Background	Lab RL[1]	Well								Sump
					TB-118-003	TB-119-003	TB-120-003	TB-121-003	TB-122-003	TB-122-003D[2]	TB-123-003	TB-124	
Zn	"	5	10	0.010	<0.010	0.043	0.035	0.040	0.055	0.089	0.057	0.715	<0.01
Ca	"	NL[3]	276	0.5	132	77	83	112	64	61	70	97	84
Mg	"	NL	153	0.5	65	38	41	58	32	31	37	50	46

[1]Lab reporting limit.
[2]Duplicate sample.
[3]No existing limit.
[4]No analysis performed.

REFERENCES

Black & Veatch, 2014, "Background Groundwater Quality Report for Thornton Composite Reservoir," prepared for the Metropolitan Water Reclamation District of Greater Chicago, July 2014.

Black & Veatch, 2016a, December 16 - 19, 2015, "Fill-Event/Annual Sampling Groundwater Monitoring Report for Thornton Composite Reservoir," prepared for the Metropolitan Water Reclamation District of Greater Chicago, March 2016.

Black & Veatch, 2016b, January 11 - 13, 2016, "Fill-Event Sampling Groundwater Monitoring Report for Thornton Composite Reservoir," prepared for the Metropolitan Water Reclamation District of Greater Chicago, April 2016.

Black & Veatch. 2016c, "Revised Groundwater Monitoring Plan, Groundwater Protection System for Thornton Composite Reservoir," prepared for the Metropolitan Water Reclamation District of Greater Chicago, May 2016.

Griffiths, W., P. Camara, K. Lerner, National Center for Biotechnology Information (NCBI), 1985, "Bis(2-ethylhexyl)phthalate, an Ubiquitous Environmental Contaminant," 1985.

Illinois EPA, 2012, 35 Illinois Administrative Code (IAC) Part 620 Class I Groundwater Standards, 2012.

Illinois Pollution Control Board, 2013, Illinois Administrative Code Title 35: Environmental Protection, Subtitle F: Potable Water Supplies, Chapter I: Pollution Control Board, Part 620 – Groundwater Quality, October 7, 2013.