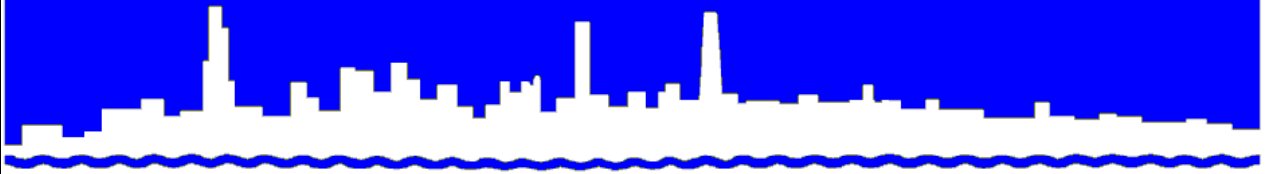


Protecting Our Water Environment



Metropolitan Water Reclamation District of Greater Chicago

***MONITORING AND RESEARCH
DEPARTMENT***

REPORT NO. 20-21

TUNNEL AND RESERVOIR PLAN

CALUMET TUNNEL SYSTEM

ANNUAL GROUNDWATER MONITORING REPORT

FOR 2019

July 2020

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Director of Monitoring and Research

July 16, 2020

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Illinois Environmental Protection Agency
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Springfield, IL 62794-9276

Dear Sir or Madam:

Subject: Tunnel and Reservoir Plan, Calumet Tunnel System, Annual
Groundwater Monitoring Report for 2019

Attached are three copies of "Tunnel and Reservoir Plan, Calumet Tunnel System,
Annual Groundwater Monitoring Report for 2019."

Very truly yours,



Albert E. Cox
Environmental Monitoring and Research Manager
Monitoring and Research Department

AC:EE:cm

cc w/att: Mr. Ryan Bahr (USEPA Region 5 - WC15J) - (2)
Mr. E. Podczerwinski
Dr. H. Zhang
cc w/o att.: Mr. J. Murray
Mr. T. Conway

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**TUNNEL AND RESERVOIR PLAN
CALUMET TUNNEL SYSTEM
ANNUAL GROUNDWATER MONITORING REPORT
FOR 2019**

**Monitoring and Research Department
Edward W. Podczerwinski, Director**

July 2020

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LIST OF ABBREVIATIONS

°C	degrees Celsius
CCD	Chicago City Datum
CFU	colony forming units
CTS	Calumet Tunnel System
Cl ⁻	chloride
District	Metropolitan Water Reclamation District of Greater Chicago
EC	electrical conductivity
FC	fecal coliform
ft	feet
hr	hour
IEPA	Illinois Environmental Protection Agency
L	liter
m	meter
mg	milligram
mS	millisiemens
NH ₃ -N	ammonia nitrogen
SO ₄ ²⁻	sulfate
TARP	Tunnel and Reservoir Plan
TDS	total dissolved solids
Temp	temperature
TOC	total organic carbon

ANNUAL DATA FOR MONITORING AND OBSERVATION WELLS

Introduction

All monitoring and observation wells are located along the length of the Calumet Tunnel System (CTS). Four monitoring wells (QC-1, -2, -2-1, and -2-2) and 11 observation wells (OC-1 through OC-11) are located along the tunnel between Crawford Avenue and the Calumet Water Reclamation Plant. Seventeen monitoring wells (QC-3 through QC-19) are located between 140th Street and Indiana Avenue, nine (QC-20 through QC-28) are along Torrence Avenue, and nine (QC-29 through QC-37) along the Little Calumet River (Figures 1 and 2). Monitoring well QC-3 was abandoned with the approval of the Illinois Environmental Protection Agency (IEPA).

The monitoring wells were sampled based on the modified groundwater monitoring program for the Metropolitan Water Reclamation District of Greater Chicago (District)'s Tunnel and Reservoir Plan (TARP) as briefly described below.

Modified Groundwater Monitoring Program

In a letter dated July 13, 2017, the IEPA accepted the modifications for the District's TARP groundwater monitoring program effective from January 2017 for a period of three years (2017 – 2019). Under the revised monitoring plan, three wells (QC-2, QC-4, and QC-17), which had fecal coliform (FC) detected in 10 percent or more of samples during the period 1995 – 2013, will be sampled for four events of TARP tunnel fills, based on the water levels in the TARP following storm events. The fill event-based criterion that triggers a fill event sampling is when the level of water in the TARP Mainstream tunnel reaches -150 ft Chicago City Datum (CCD). At each event, sampling is done weekly for three weeks. The samples collected during the first week of sampling are analyzed for all parameters in the current monitoring program, including: pH, temperature, electrical conductivity, total dissolved solids, hardness, ammonia nitrogen, total organic carbon, chloride, sulfate, and FC. However, the samples from the second and third weeks are analyzed for only FC.

The other 28 wells associated with the CTS are sampled once per year. These wells had FC detected in less than 10 percent of samples during the period 1995 – 2013.

Groundwater elevations in the monitoring wells were measured during each sampling event, while elevations in the observation wells were measured biweekly with a minor variation. The groundwater level in monitoring well QC-8.1 no longer yields sufficient sample for analysis. However, this well was converted to an observation well several years ago, and its groundwater elevations are still measured biweekly.

Based on further evaluation of the monitoring wells, QC-1 did not function following repairs, and QC-3 and QC-8 were abandoned many years ago. Therefore, these wells were also added to the group of other wells (QC-32, QC-33, QC-34, QC-36, and QC-37) discontinued for monitoring under the modified groundwater monitoring program.

FIGURE 1: MAP OF MONITORING WELLS IN THE CALUMET TUNNEL SYSTEM

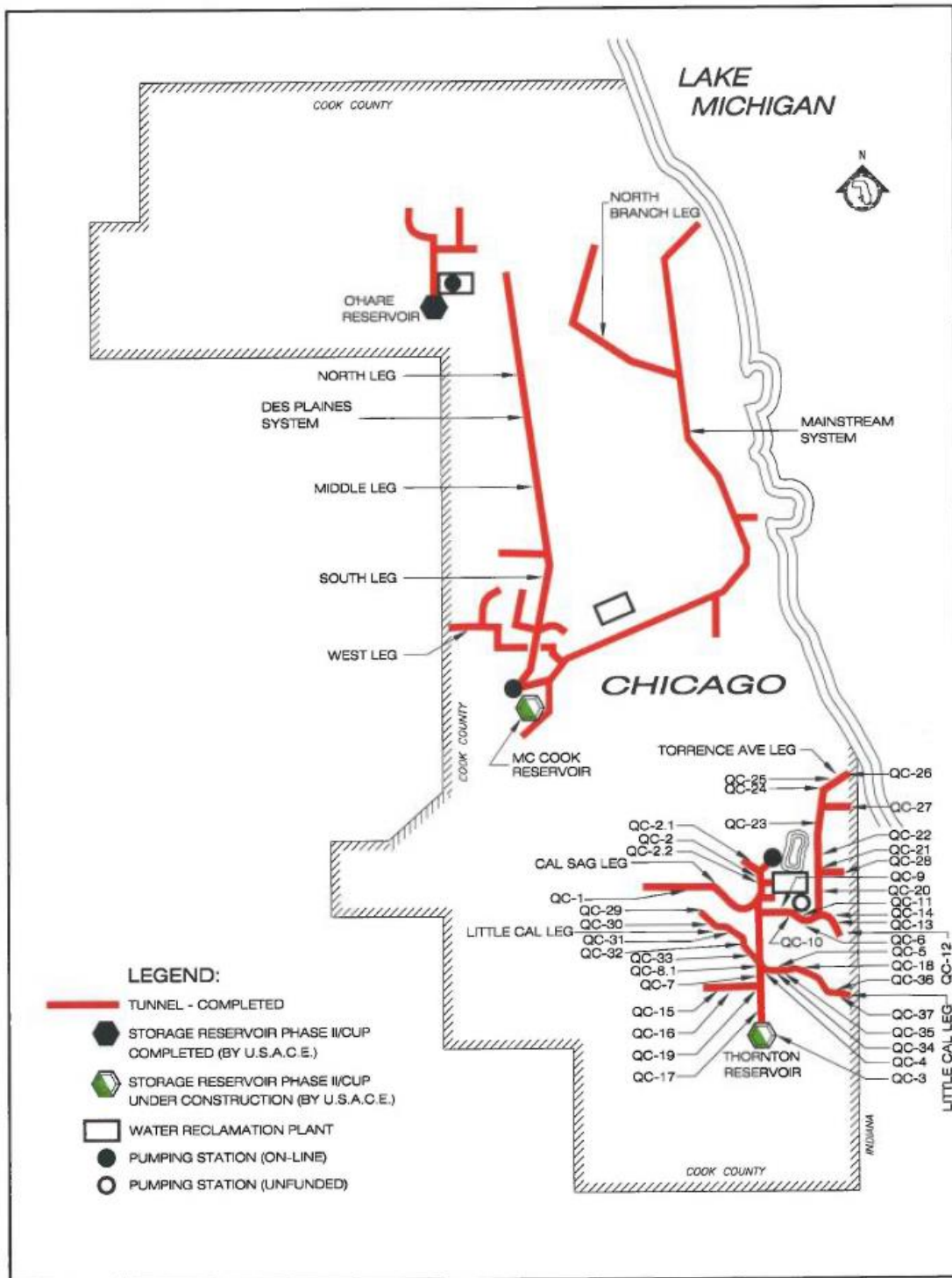
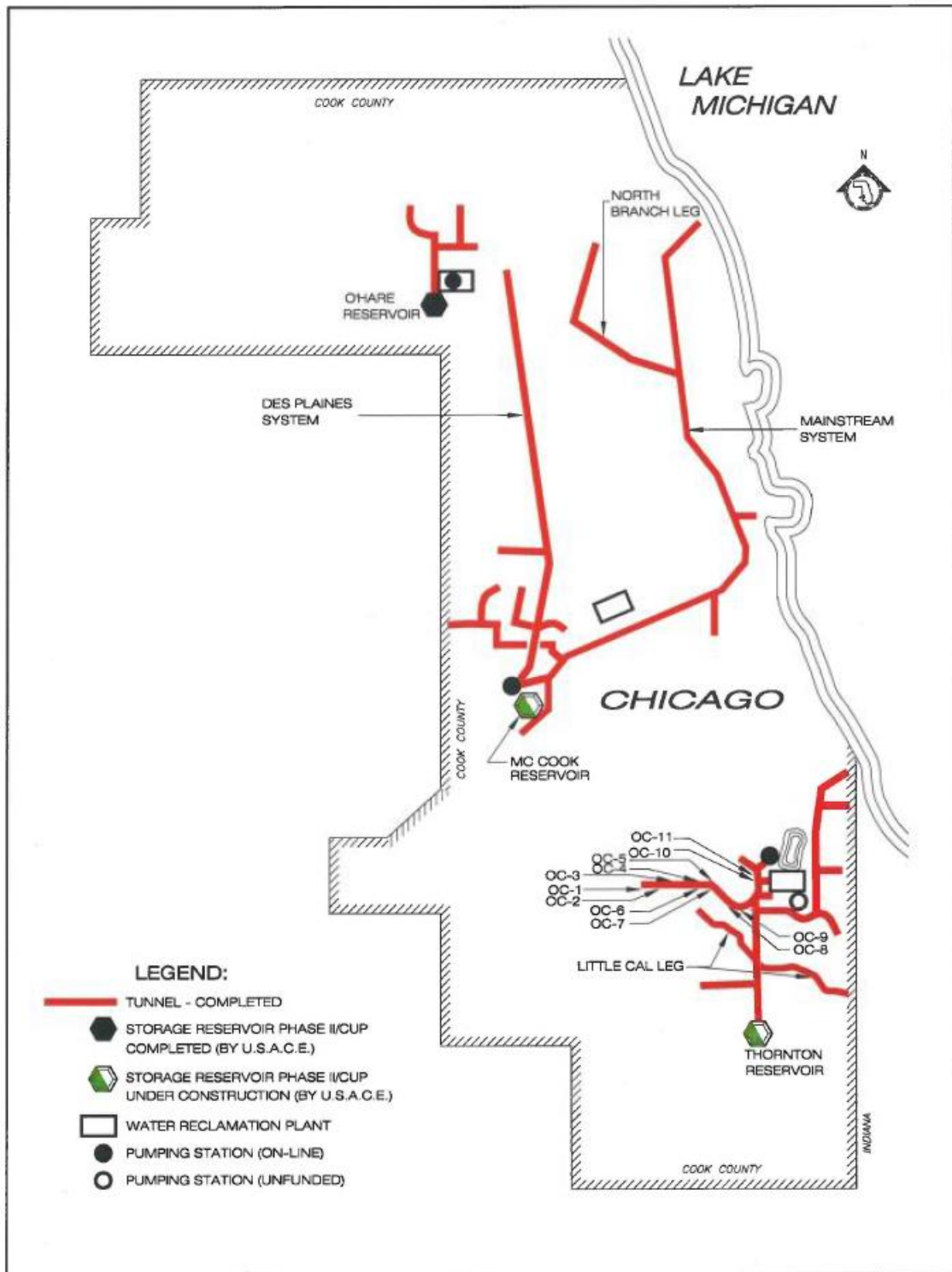


FIGURE 2: MAP OF OBSERVATION WELLS IN THE CALUMET TUNNEL SYSTEM



Summary of Data

Monitoring Wells. The analytical data for groundwater sampled during 2019 from fill-based monitoring wells QC-2, QC-4 and QC-17, along with descriptive statistics, are presented in Table 1. Physical characteristics, such as elevation, groundwater temperature, and estimated time of recharge for each well between initial drawdown and sampling, are also included. The FC data for groundwater sampled during 2019 from these monitoring wells are presented in Table 2. The analytical data for groundwater from the wells sampled once per year are presented in Table 3. Fecal coliform counts in all the annual sampling wells were undetectable (<1 CFU/100 mL).

Observation Wells. Groundwater elevations were measured for observation wells OC-1 through -11. Water elevations were calculated relative to the CCD (579.48 ft. above mean sea level) at the intersection of Madison and State Streets and presented in Table 4. For most of the year, no measurements were conducted at wells OC-4 and OC-5 due to closed roads, and wells OC-8 and OC-9 due to swampy area. The minimum, mean, and maximum values for each well were calculated and plotted to determine fluctuations in groundwater elevations during the year (Figure 3). Generally, these fluctuations appeared to be minimal or within expected ranges throughout the year in most wells. However, there were notable fluctuations in groundwater elevations of 27 ft and 21 ft at OC-6 and OC-7, respectively.

TABLE 1: ANALYSIS OF CHEMICAL AND PHYSICAL PARAMETERS IN GROUNDWATER FROM FILL EVENT MONITORING WELLS IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN SAMPLED DURING 2019 AND DESCRIPTIVE STATISTICS OF EACH OF THE PARAMETERS¹

Well	Fill Event	Sampled Date	pH	EC	TDS	TOC	Cl ⁻	SO ₄ ²⁻	NH ₃ -N ²	Hardness	Temp	Water Elevation ³	Recharge Time
				mS/m	-----mg/L-----					°C		ft	hr
QC-2	F1	02/13/19	8.1	41	320	6.1	28	29	<0.50	77	10.2	NA ⁴	<48
QC-2	F2	03/21/19	7.8	40	326	1.3	31	46	<0.50	72	11.7	NA	<48
QC-2	F3	04/25/19	7.8	45	338	1.2	29	49	<0.30	72	13.4	NA	<48
QC-2	F4	08/01/19	7.9	45	384	1.1	35	36	<0.30	90	14.0	NA	<48
QC-2	F5	10/01/19	8.1	43	358	1.4	36	31	0.49	78	13.0	NA	<48
		Minimum	7.8	40	320	1.1	28	29	0.30	72	10.2	NA	
		Median	7.9	43	338	1.3	31	36	0.50	77	13.0	NA	
		Mean	7.9	43	345	2.2	32	38	0.40	78	12.5	NA	
		Maximum	8.1	45	384	6.1	36	36	0.50	90	14.0	NA	
		Standard deviation	0.1	2.2	26	2.2	3.6	8.9	0.10	7.4	1.5	NA	
		Coefficient of variation (%)	2.0	5.0	8.0	98	11	23	26	9.0	12	NA	
QC-4	F1	02/13/19	8.2	51	400	<1.0	10	14	<0.50	18	11.7	-213	<48
QC-4	F2	03/21/19	7.6	45	384	<1.0	9.0	15	<0.50	13	11.5	-233	<48
QC-4	F3	04/25/19	8.3	50	394	<1.0	9.0	17	<0.30	26	12.0	-234	<48
QC-4	F4	08/01/19	8.7	63	456	<1.0	8.0	15	<0.30	10	12.6	-210	<48
QC-4	F5	10/01/19	8.5	46	408	<1.0	8.0	14	<0.30	13	13.4	-223	<48
		Minimum	7.6	45	384	<1.0	8.0	14	0.30	10	11.5	-234	
		Median	8.3	50	400	<1.0	9.0	15	0.30	13	12.0	-223	
		Mean	8.2	51	408	<1.0	8.8	15	0.38	16	12.2	-223	
		Maximum	8.7	63	456	<1.0	10	17	0.50	26	13.4	-210	
		Standard deviation	0.4	7.2	28	0.0	0.8	1.2	0.1	6.3	0.8	11	
		Coefficient of variation (%)	5.0	14	7.0	0	10	8.0	29	39	6.0	5.0	
QC-17	F1	02/13/19	8.4	50	458	<1.0	6.0	184	<0.50	141	10.8	-201	<48
QC-17	F2	03/21/19	7.1	51	436	<1.0	6.0	182	<0.50	147	11.6	-201	<48
QC-17	F3	04/25/19	7.9	58	386	1.1	6.0	178	<0.30	165	12.3	-201	<48

TABLE 1 (Continued): ANALYSIS OF CHEMICAL AND PHYSICAL PARAMETERS IN GROUNDWATER FROM FILL EVENT MONITORING WELLS IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN SAMPLED DURING 2019 AND DESCRIPTIVE STATISTICS OF EACH OF THE PARAMETERS¹

Well	Fill Event	Sampled Date	pH	EC	TDS	TOC ¹	Cl ⁻	SO ₄ ²⁻	NH ₃ -N ²	Hardness	Temp	Water Elevation ³	Recharge Time
				mS/m				mg/L			°C	ft	hr
QC-17	F4	08/01/19	7.7	77	524	<1.0	17	183	<0.30	167	12.8	-169	<48
QC-17	F5	10/01/19	7.2	65	498	<1.0	14	175	0.30	157	14.0	-177	<48
		Minimum	7.1	50	386	<1.0	6	175	<0.30	141	10.8	-201	
		Median	7.7	58	458	<1.0	6	182	0.30	157	12.3	-201	
		Mean	7.7	60	460	1.0	9.8	180	0.38	155	12.3	-190	
		Maximum	8.4	77	524	1.1	17	184	<0.50	167	14.0	-169	
		Standard deviation	0.5	11	54	0.0	5.3	3.8	0.10	11.3	1.2	16	
		Coefficient of variation (%)	7.0	19	12	4.0	54	2.0	29	7.0	10	8.0	

¹For values less than reporting limits, the reporting limits were used in calculation of descriptive statistics.

²Reporting limits changed to 0.3 mg/L in April 2019 due to the change in the test equipment.

³Relative to Chicago City Datum (579.48 ft above mean sea level) at intersection of Madison and State Streets.

⁴No measurement was determined because the water level indicator probe could get stuck in the well.

TABLE 2: ANALYSIS OF FECAL COLIFORM IN GROUNDWATER FROM FILL EVENT MONITORING WELLS IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN SAMPLED DURING 2019 AND ITS DESCRIPTIVE STATISTICS¹

Well	Fill Event	Week 1	Week 1	Week 2	Week 3	
		Sample Date				
----- CFU/100 ml -----						
QC-2	F1	02/13/19	<1	<1	NReq ²	
	F2	03/21/19	1	<1	<1	
	F3	04/25/19	<1	5	2	
	F4	08/01/19	<1	<1	NReq	
	F5	10/01/19	<1	4	46	
		Minimum		<1	<1	<1
		Median		1	1	2
		Mean ³		1	2	5
		Maximum		1	4	46
	QC-4	F1	02/13/19	<1	<1	NReq
F2		03/21/19	<1	<1	NReq	
F3		04/25/19	<1	3	<1	
F4		08/01/19	<1	<1	NReq	
F5		10/01/19	<1	<1	NReq	
		Minimum		<1	<1	<1
		Median		<1	1	<1
		Mean		<1	1	<1
		Maximum		<1	3	<1
QC-17		F1	02/13/19	<1	<1	NReq
	F2	03/21/19	1	<1	<1	
	F3	04/25/19	<1	3	<1	
	F4	08/01/19	<1	<1	NReq	
	F5	10/01/19	<1	<1	NReq	
		Minimum		<1	<1	<1
		Median		1	1	<1
		Mean ³		1	1	<1
		Maximum		1	3	<1

¹For values less than reporting limits, the reporting limit were used in calculation of descriptive statistics.

²NReq: Sampling is not required because the fecal coliform level was below detection limit in the previous week.

³Geometric mean calculated.

TABLE 3: ANALYSIS OF CHEMICAL AND PHYSICAL PARAMETERS AND FECAL COLIFORM IN GROUNDWATER FROM ANNUAL SAMPLING WELLS IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN SAMPLED DURING 2019

Well	Sampled Date	pH	EC	TDS	TOC	Cl ⁻	SO ₄ ²⁻	NH ₃ -N ¹	Hardness	Temp	Water Elevation ²	Fecal Coliform
			mS/m	-----mg/L-----							ft	CFU/100 mL
QC-2-1	01/17/19	8.1	63	480	1.0	35	1.0	0.70	59	11.9	-295	<1
QC-2-2	01/17/19	8.3	41	314	1.7	19	25	<0.50	42	11.6	-301	<1
QC-5	04/10/19	8.5	60	514	1.5	48	11	<0.30	8.0	12.0	-215	<1
QC-6	04/10/19	8.4	49	440	1.6	17	5.0	0.30	15	11.9	-211	<1
QC-7	04/10/19	8.3	43	382	1.7	12	1.0	0.30	13	11.9	-154	<1
QC-9	01/17/19	8.3	38	296	1.1	13	37	0.80	53	12.8	-235	<1
QC-10	09/05/19	7.9	49	426	<1.0	34	<1	<0.30	10	13.5	-161	<1
QC-11	09/05/19	7.9	36	312	<1.0	24	<1	<0.30	20	13.1	-187	<1
QC-12	11/18/19	7.5	77	808	<1.0	39	293	0.49	143	12.6	-218	<1
QC-13	11/18/19	7.8	46	420	1.2	59	12	<0.30	34	12.5	-233	<1
QC-14	01/17/19	7.9	83	686	5.1	155	1.0	<0.50	133	12.3	-210	<1
QC-15	01/17/19	8.4	36	284	1.0	13	1.0	<0.50	22	12.0	-206	<1
QC-16	04/10/19	8.1	48	494	1.1	25	81	<0.30	75	11.3	-256	<1
QC-18	04/10/19	8.7	39	342	<1.0	9.0	31	<0.30	8.0	11.6	-198	<1
QC-19	04/10/19	8.6	42	380	<1.0	7.0	140	0.30	85	11.7	-158	<1
QC-20	04/17/19	8.6	33	264	<1.0	21	2.0	<0.30	20	12.9	-257	<1
QC-21	04/17/19	8.0	39	306	3.8	18	2.0	0.30	25	13.4	-252	<1
QC-22	04/17/19	8.1	33	260	2.3	15	3.0	0.40	36	12.9	-250	<1
QC-23	04/18/19	8.8	43	302	<1.0	21	2.0	<0.30	6.0	12.6	-233	<1
QC-24	04/18/19	8.2	30	206	<1.0	30	<1	<0.30	13	12.6	-230	<1
QC-25	04/18/19	7.7	34	264	<1.0	14	47	<0.30	62	12.7	-230	<1
QC-26	07/17/19	8.4	36	354	<1.0	16	1.0	<0.30	7.0	13.2	-212	<1
QC-27	07/17/19	8.2	30	276	<1.0	32	<1	<0.30	23	13.5	-187	<1
QC-28	07/17/19	8.2	33	302	<1.0	12	<1	<0.30	13	14.3	-230	<1

TABLE 3 (Continued): ANALYSIS OF CHEMICAL AND PHYSICAL PARAMETERS AND FECAL COLIFORM IN GROUNDWATER FROM ANNUAL SAMPLING WELLS IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN SAMPLED DURING 2019

Well	Sampled Date	pH	EC	TDS	TOC	Cl ⁻	SO ₄ ²⁻	NH ₃ -N ¹	Hardness	Temp	Water Elevation ²	Fecal Coliform
			mS/m	----- mg/L -----							ft	CFU/100 mL
QC-29	08/21/19	6.6	104	928	1.7	167	210	0.80	434	12.2	-50	<1
QC-30	08/21/19	8.3	50	444	<1.0	29	93	0.60	90	13.5	-112	<1
QC-31	08/21/19	7.7	58	550	1.1	18	187	1.10	242	13.3	-39	<1
QC-35	08/21/19	8.7	102	854	3.1	34	26	<0.30	23	13.9	-153	<1

¹Reporting limits changed to 0.3 mg/L on April 8, 2019, due to change in laboratory equipment.

²Relative to Chicago City Datum (579.48 ft above mean sea level) at intersection of Madison and State Streets.

TABLE 4: GROUNDWATER ELEVATIONS FOR OBSERVATION WELLS IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN MEASURED DURING 2019

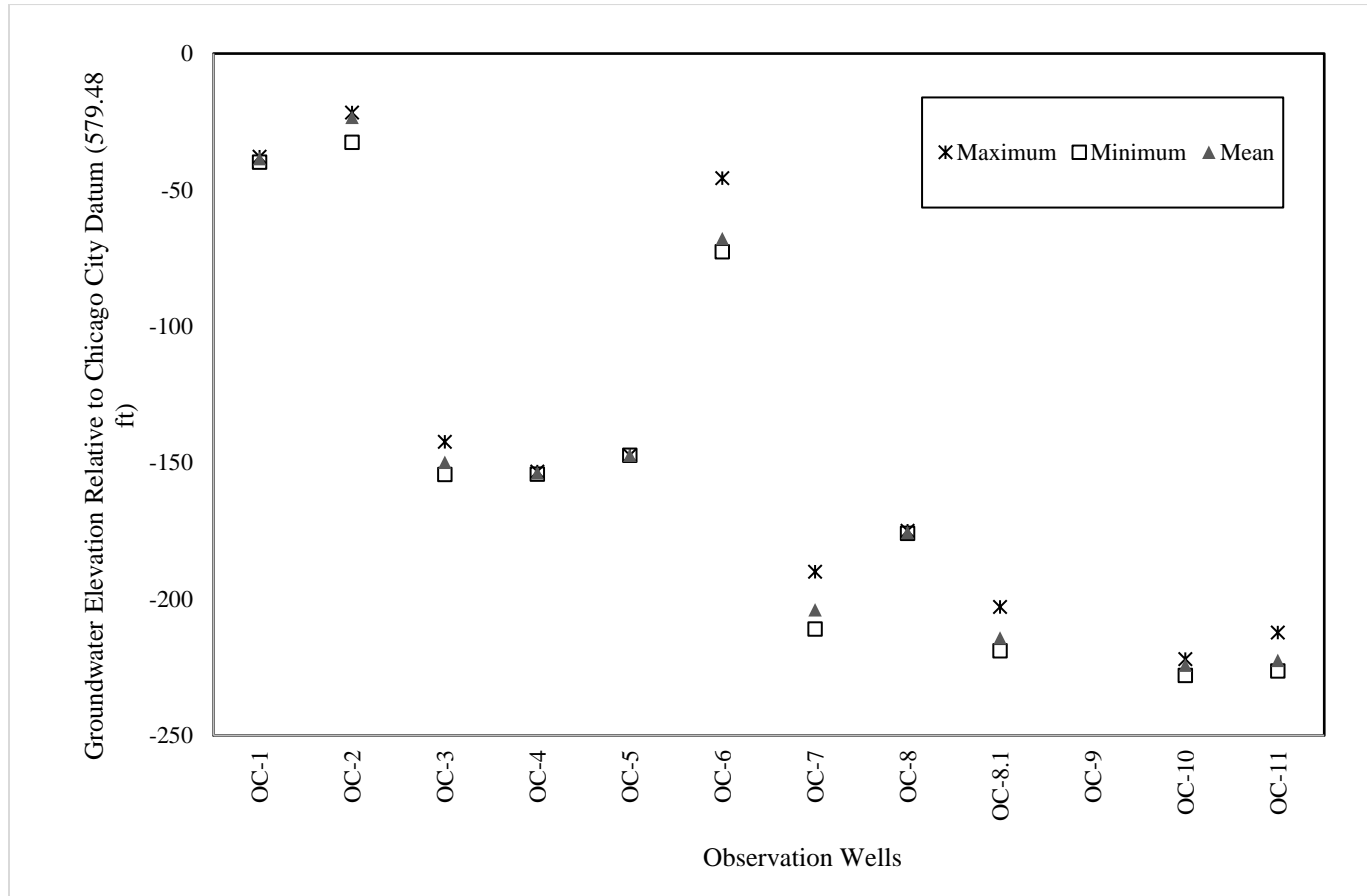
Date ¹	Observation Well No.											
	OC-1	OC-2	OC-3	OC-4	OC-5	OC-6	OC-7	OC-8	OC-8.1	OC-9	OC-10	OC-11
	Elevation (ft) ²											
01/11/19	NA ³	-33	-150	NA	NA	-71	-211	NA	-219	NA	-228	-226
02/15/19	-38	-23	-149	-154	NA	-71	-209	-175	-219	NA	-227	-225
03/01/19	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
03/22/19	NA	NA	NA	NA	NA	NA	NA	NA	-218	NA	NA	NA
04/05/19	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
04/19/19	-38	-23	-149	NA	NA	-46	-210	NA	-219	NA	-225	-226
05/24/19	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
06/06/19	NA	-29	-142	NA	NA	-52	-190	NA	-203	NA	NA	-212
06/28/19	NA	-23	-147	NA	NA	NA	NA	NA	NA	NA	NA	NA
07/19/19	-39	-22	-149	NA	NA	-69	-201	NA	NA	NA	NA	NA
07/26/19	-39	-22	-149	NA	NA	-70	-202	NA	-215	NA	NA	NA
08/16/19	-39	-24	-150	NA	NA	-72	-203	NA	-215	NA	NA	-222
08/23/19	-40	-25	-151	NA	NA	-73	-203	NA	-215	NA	NA	-222
09/20/19	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
09/27/19	-38	-24	-149	NA	NA	-71	-204	NA	-214	NA	NA	-222
10/11/19	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
10/25/19	NA	NA	-151	NA	NA	-72	-205	NA	-214	NA	NA	-223
11/15/19	NA	-24	-154	NA	NA	-72	-206	NA	-213	NA	-223	-222
11/22/19	-39	-23	-151	NA	NA	-72	-205	NA	-213	NA	NA	-223
12/06/19	-38	-24	-151	-153	-147	-73	-206	-176	-214	NA	-222	-223
12/20/19	-39	-23	-152	NA	NA	-73	-207	-176	-214	NA	-224	-224

¹Date measurements were taken.

²Relative to Chicago city datum (579.48' above mean sea level) at intersection of State and Madison Streets.

³No measurements were obtained due to inaccessibility of well or not recorded by field staff.

FIGURE 3: MINIMUM, MEAN, AND MAXIMUM WATER ELEVATION FOR OBSERVATION WELLS OC-1 THROUGH OC-11 IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN MEASURED DURING 2019¹



¹No measurements were taken at OC-9, two measurements were taken at OC-4, and one measurement was taken at OC-5.