Metropolitan Water Reclamation District of Greater Chicago

MONITORING AND RESEARCH DEPARTMENT

REPORT NO. 23-20

TUNNEL AND RESERVOIR PLAN

CALUMET TUNNEL SYSTEM

ANNUAL GROUNDWATER MONITORING REPORT

FOR 2022

July 2023

Protecting Our Water Environment

Metropolitan Water Reclamation District of Greater Chicago

CECIL LUE-HING RESEARCH AND DEVELOPMENT COMPLEX
6001 West Pershing Road Cicero, Illinois 60804-4112

July 17, 2023

Mr. Sanjay Sofat
Bureau of Water
Illinois Environmental Protection Agency
P. O. Box 19276
Springfield, IL 62794-9276

Dear Mr. Sofat:

Subject: Tunnel and Reservoir Plan Calumet Tunnel System Annual Groundwater Monitoring Report for 2022

The report entitled "Tunnel and Reservoir Plan Calumet Tunnel System Annual Groundwater Monitoring Report for 2022" is attached.

Very truly yours,

Albert Cox

Albert E. Cox, Ph.D.
Environmental Monitoring and Research Manager
Monitoring and Research Department

AC:EE:lf
Attachment
cc: Mr. Ryan Bahr (USEPA Region 5 - WC15J)
Mr. E. Podczerwinski
Dr. H. Zhang
cc w/o att: Mr. J. Murray
Mr. A. Gronski

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

TUNNEL AND RESERVOIR PLAN
CALUMET TUNNEL SYSTEM
ANNUAL GROUNDWATER MONITORING REPORT
FOR 2022

By

Essam El-Naggar
Environmental Soil Scientist

Guanglong Tian
Principal Environmental 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
Edward W. Podczerwinski, Director **July 2023**

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

Abbreviation	Definition
°C	degrees Celsius
CCD	Chicago City Datum
CFU	colony forming units
Cl^-	chloride
CTS	Calumet Tunnel System
District	Metropolitan Water Reclamation District of Greater Chicago
EC	electrical conductivity
FC	fecal coliform
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, QC-2, QC-2-1, and QC-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) are 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.

Groundwater Monitoring Program

In a letter dated May 14, 2021, the Illinois Environmental Protection Agency (IEPA) approved a modified TARP groundwater monitoring program for the District's Calumet, Mainstream, Des Plaines, and Upper Des Plaines tunnel systems effective January 2021. The modification of the TARP groundwater monitoring program was based on the key findings from a three-year fill event-based groundwater monitoring study conducted by the District from 2017 to 2019, which were submitted to the IEPA in a report dated July 30, 2020.

Under the modified monitoring program, three CTS fill event-based monitoring wells (QC-2, QC-4, and QC-17) are sampled for two tunnel fill events per year, usually following storm events. Fecal coliforms (FC) in these wells were detected in 10 percent or more of samples during the period 1995–2013. The criterion that triggers fill event sampling is that the water level in the Thornton Composite Reservoir, which receives water from the CTS, reaches -280 feet Chicago City Datum (CCD). Sampling is conducted during the first week of each fill event. For the first fill event, samples are analyzed for all parameters including pH, temperature (Temp.), electrical conductivity (EC), total dissolved solids (TDS), hardness, ammonia nitrogen (NH_3-N), total organic carbon (TOC), chloride (Cl^-), sulfate (SO_4^{2-}), and fecal coliform (FC). For the second fill event, samples are analyzed for FC only.

The other 28 wells associated with the CTS, referred to as annual monitoring wells, 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 at each sampling event. The elevations in the observation wells were measured twice per month. Eight of the monitoring wells (QC-1, QC-3, QC-8, QC-32, QC-33, QC-34, QC-36, and QC-37) were abandoned previously. Therefore, the monitoring requirement for this group of wells has been discontinued under the modified groundwater monitoring program.

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

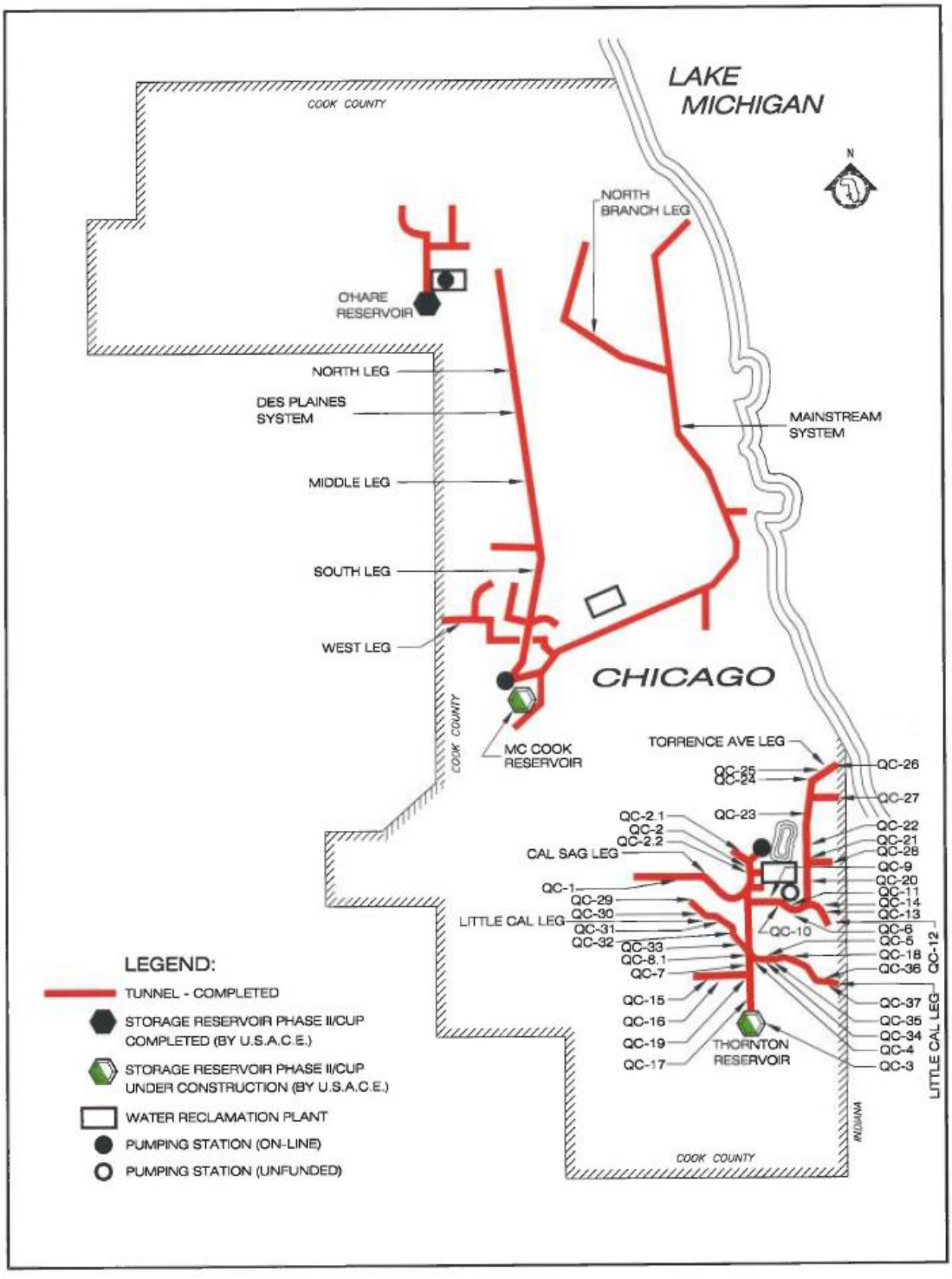
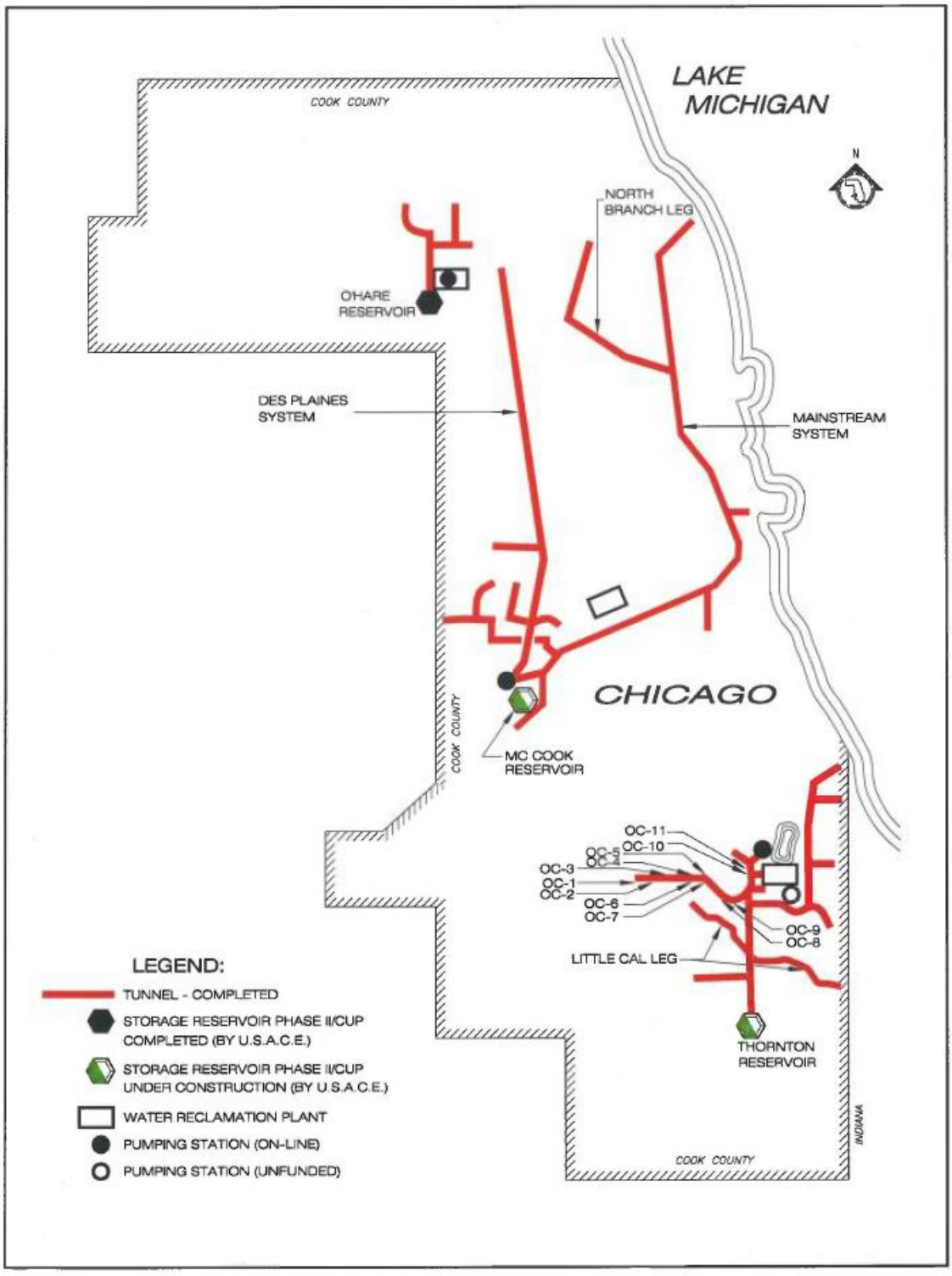


FIGURE 2: MAP OF OBSERVATION WELLS IN THE CALUMET TUNNEL SYSTEM



Summary of Data

Monitoring Wells. Three fill events at Thornton Composite Reservoir were observed in the first half of 2022: February 17, March 31, and May 4. Fill event-based monitoring wells QC-2, QC-4, and QC-17 were sampled following the February 17 fill event. There were no fill events observed during the second half of the year, so sampling was conducted on December 8, 2022. The groundwater analytical data and physical parameters for fill event-based monitoring wells QC-2, QC-4, and QC-17 are presented in Table 1. For the two monitored events, FC was not detected (<1 CFU/100 mL) at the three monitored wells. (Table 1).

The analytical data for groundwater from the wells sampled once per year are presented in Table 2. No annual sampling was conducted at wells QC-15 and QC-27 due to well pump malfunction. Fecal coliforms were undetectable (<1 CFU/100 mL) in all sampled annual wells.

Observation Wells. Groundwater elevations were measured for observation wells OC-1 through OC-11 twice per month. Water elevations were calculated relative to CCD (579.48 feet. above mean sea level at the intersection of State and Madison Streets) and are presented in Table 3. The minimum, mean, and maximum values for each well were calculated and plotted to determine fluctuations in groundwater elevations during the year (Figure 3).

TABLE 1: ANALYSIS OF CHEMICAL AND PHYSICAL PARAMETERS AND FECAL COLIFORM IN GROUNDWATER SAMPLED FROM FILL EVENT MONITORING WELLS IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2022[1]

Well	Sample Date	pH	EC mS/m	TDS	TOC	Cl^-	SO_4^{2-}	NH_3-N	Hardness	Temp. °C	Water Elevation[2] feet	Fecal Coliform CFU/100 mL	Recharge Time hours
				mg/L									
QC-2	02/24/22	8.4	41	320	12.6	26	28	<0.3	69	11.1	-308	<1	<48
	12/08/22	8.5	41	—	—	—	—	—	—	12.7	-277	<1	<48
QC-4	02/24/22	8.9	50	398	<5.0	8	13	<0.3	11	11.8	-227	<1	<48
	12/08/22	8.8	53	—	—	—	—	—	—	12.1	-222	<1	<48
QC-17	02/24/22	8.6	53	486	<5.0	9	182	0.32	153	11.3	-178	<1	<48
	12/08/22	8.3	59	—	—	—	—	—	—	12.7	-186	<1	<48

[1]Chemistry parameters need to be analyzed for 1st fill event only.
[2]Relative to Chicago City Datum (579.48 feet above mean sea level) at intersection of State and Madison Streets.

TABLE 2: ANALYSIS OF CHEMICAL AND PHYSICAL PARAMETERS AND FECAL COLIFORM IN GROUNDWATER SAMPLED FROM ANNUAL MONITORING WELLS IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2022

Well	Sample Date	pH	EC mS/m	TDS	TOC	Cl^-	SO_4^{2-}	NH_3-N	Hardness	Temp. °C	Water Elevation[1] feet	Fecal Coliform CFU/100 mL
				mg/L								
QC-2-1	11/04/22	8.6	69	478	<5.0	34	12	0.40	68	16.6	-299	<1
QC-2-2	11/02/22	8.8	43	338	<5.0	13	23	<0.30	31	13.7	-300	<1
QC-5	03/03/22	8.7	65	540	<5.0	47	12	<0.30	13	11.9	-213	<1
QC-6	05/19/22	8.6	57	454	<5.0	16	4	0.42	58	13.5	-206	<1
QC-7	05/19/22	8.6	51	412	<5.0	10	<1.0	0.35	11	12.9	-146	<1
QC-9	05/19/22	8.4	39	320	<5.0	9	37	0.40	53	13.5	-256	<1
QC-10	11/08/22	8.3	48	382	<5.0	37	<1.0	<0.30	10	12.9	-166	<1
QC-11	11/08/22	8.6	37	274	<5.0	27	<1.0	<0.30	16	14.0	-189	<1
QC-12	03/02/22	8.6	94	716	<5.0	34	211	0.30	86	13.0	-221	<1
QC-13	03/02/22	8.2	47	368	<5.0	48	4	<0.30	30	12.5	-229	<1
QC-14	05/19/22	7.6	103	736	<5.0	148	<1.0	0.43	139	14.0	-203	<1
QC-15	NA[2]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
QC-16	11/02/22	8.2	64	476	<5.0	23	75	<0.30	78	14.2	-258	<1
QC-18	03/03/22	9.1	40	368	<5.0	8	29	<0.30	8	12.1	-187	<1
QC-19	03/03/22	8.9	40	438	<5.0	9	143	<0.30	106	12.1	-143	<1
QC-20	02/03/22	8.6	32	562	<5.0	21	5	<0.30	27	11.3	-242	<1
QC-21	11/02/22	8.8	43	346	<5.0	17	29	0.46	35	12.4	-238	<1
QC-22	11/02/22	8.4	31	248	<5.0	15	7	<0.30	36	13.0	-236	<1
QC-23	11/03/22	9.2	41	346	<5.0	20	2	<0.30	6	12.9	-222	<1
QC-24	02/03/22	8.5	28	470	<5.0	30	<1.0	<0.30	14	12.3	-222	<1
QC-25	02/03/25	8.4	37	470	<5.0	14	56	<0.30	75	12.7	-224	<1
QC-26	11/03/22	9.2	34	282	<5.0	12	1	<0.30	7	13.1	-215	<1
QC-27	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
QC-28	11/03/22	8.8	32	264	<5.0	12	<1.0	<0.30	14	13.3	-226	<1

TABLE 2 (Continued): ANALYSIS OF CHEMICAL AND PHYSICAL PARAMETERS AND FECAL COLIFORM IN GROUNDWATER SAMPLED FROM ANNUAL MONITORING WELLS IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2022

Well	Sample Date	pH	EC mS/m	TDS	TOC	Cl^-	SO_4^{2-}	NH_3-N	Hardness	Temp. °C	Water Elevation[1] feet	Fecal Coliform CFU/100 mL
				mg/L								
QC-29	02/03/22	7.4	103	886	<5.0	167	206	0.84	380	11.4	-44	<1
QC-30	11/03/22	8.0	71	566	<5.0	46	144	0.59	110	12.1	-111	<1
QC-31	11/03/22	7.8	69	538	<5.0	19	195	1.05	229	13.4	-38	<1
QC-35	11/23/22	8.8	97	810	<5.0	33	18	<0.30	31	13.0	-153	<1

[1]Relative to Chicago City Datum (579.48 feet above mean sea level) at intersection of State and Madison Streets.
[2]Well was not sampled due to well pump malfunction.

TABLE 3: GROUNDWATER ELEVATIONS FOR OBSERVATION WELLS IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN MEASURED DURING 2022

Date	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 (feet)[1]											
01/04/22	-40	-23	-152	-151	-146	-73	-208	-176	-210	-210	-222	-224
01/21/22	-39	-23	-152	-152	-147	-73	-209	-178	-210	-213	-216	-225
02/04/22	NA[2]	-23	-153	-151	NA	-73	NA	NA	-210	-211	-217	-225
02/18/22	-39	-23	-152	-151	-167	-73	NA	NA	-210	-211	-216	-224
03/04/22	-38	-22	-153	-151	-147	-72	-208	-171	-210	-211	-218	-224
03/18/22	-38	-32	-152	-150	-146	-72	-208	-173	-210	-210	-218	-224
04/01/22	-37	-23	-152	-151	-147	-72	-208	-174	-210	-210	-220	-224
04/15/22	-38	-22	-152	-150	-147	-71	-208	-171	-209	-208	-219	-224
05/06/22	-38	-22	-152	-150	-147	-72	-208	NA	-211	-207	-221	-225
05/20/22	-38	-22	-152	-149	-146	-72	-258	-175	-210	-209	-223	-223
06/03/22	-39	-22	-152	-150	-146	-72	-208	-176	-209	-210	-222	-224
06/17/22	-39	-22	-152	-150	-146	-72	-208	-176	-209	-210	-224	-224
07/01/22	-40	-23	-152	-150	-146	-72	-209	-176	-209	-210	-224	-224
07/15/22	-40	-23	-152	-150	-147	-73	-209	-176	-210	-211	-224	-225
08/05/22	-39	-23	-152	-150	-146	-71	-208	-176	-209	-211	-224	-225
08/19/22	-39	-23	-152	-149	-147	-72	-208	-176	-209	-210	-224	-225
09/02/22	-40	-22	-152	-150	-147	-72	-209	-177	-209	-211	-225	-225
09/16/22	-40	-23	-153	-150	-147	-69	-208	-176	-209	-211	-224	-225
10/07/22	-41	-23	-153	-149	-147	-72	-209	-176	-209	-211	-224	-225
10/21/22	-41	-34	-152	-149	-146	-72	-208	-176	-209	-211	-225	-225
11/04/22	-40	-23	-153	-149	-146	-72	-209	-175	-209	-211	-225	-225
11/18/22	-41	-24	-153	-150	-147	-72	-209	-177	-209	-211	-226	-225
12/02/22	-40	-24	-152	-148	-146	-72	-208	-176	-209	-211	-225	-225
12/16/22	-40	-23	-152	-149	-146	-72	-208	-176	-209	-211	-224	-225

[1]Relative to Chicago city datum (579.48 feet above mean sea level) at intersection of State and Madison Streets.
[2]No measurements were obtained due to inaccessibility and snow accumulation.

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 2022