

Protecting Our Water Environment



Metropolitan Water Reclamation District of Greater Chicago

***MONITORING AND RESEARCH
DEPARTMENT***

REPORT NO. 24-22

TUNNEL AND RESERVOIR PLAN

MAINSTREAM TUNNEL SYSTEM

ANNUAL GROUNDWATER MONITORING REPORT

FOR 2023

July 2024

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

Edward W. Podczewinski, P.E.
Director of Monitoring and Research
podczewinski@mwr.org

July 11, 2024

BOARD OF COMMISSIONERS

Kari K. Steele
President
Patricia Theresa Flynn
Vice President
Marcelino Garcia
Chairman of Finance
Precious Brady-Davis
Yumeka Brown
Cameron Davis
Daniel Pogorzelski
Eira L. Corral Sepúlveda
Mariyana T. Spyropoulos

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

Dear Ms. Logan-Pugh:

Subject: Tunnel and Reservoir Plan Mainstream Tunnel System Annual
Groundwater Monitoring Report for 2023

The report entitled “Tunnel and Reservoir Plan Mainstream Tunnel System Annual
Groundwater Monitoring Report for 2023” is attached.

Very truly yours,

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. Podczewinski
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
MAINSTREAM TUNNEL SYSTEM
ANNUAL GROUNDWATER MONITORING REPORT
FOR 2023**

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**

TABLE OF CONTENTS

	<u>Page</u>
LIST OF TABLES	ii
LIST OF FIGURES	iii
LIST OF ABBREVIATIONS	iv
ANNUAL DATA FOR MONITORING AND OBSERVATION WELLS	1
Introduction	1
Modified Groundwater Monitoring Program	1
Summary of Data	4
Monitoring Wells	4
Observation Wells	4

LIST OF TABLES

<u>Table No.</u>		<u>Page</u>
1	Analysis of Chemical and Physical Parameters and Fecal Coliform in Groundwater Sampled from Fill Event Monitoring Wells in the Mainstream Tunnel System of The Tunnel and Reservoir Plan During 2023	5
2	Analysis of Chemical and Physical Parameters and Fecal Coliform in Groundwater Sampled from Annual Monitoring Wells in the Mainstream Tunnel System of The Tunnel and Reservoir Plan During 2023	7
3	Groundwater Elevations for Observation Wells OM-1 Through OM-23 in the Mainstream Tunnel System of the Tunnel and Reservoir Plan Measured During 2023	8

LIST OF FIGURES

<u>Figure No.</u>		<u>Page</u>
1	Map of the Monitoring Wells in the Mainstream Tunnel System	2
2	Map of the Observation Wells in the Mainstream Tunnel System	3
3	Minimum, Mean, and Maximum Water Elevation for Observation Wells OM-1 Through OM-23 in the Mainstream Tunnel System of the Tunnel and Reservoir Plan Measured During 2023	10

LIST OF ABBREVIATIONS

Abbreviation	Definition
°C	degrees Celsius
CCD	Chicago City Datum
CFU	colony forming units
Cl ⁻	chloride
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
mL	milliliter

ANNUAL DATA FOR MONITORING AND OBSERVATION WELLS

Introduction

The monitoring and observation wells are located along the length of the Mainstream Tunnel System between Morton Grove and Hodgkins, Illinois ([Figures 1](#) and [2](#)). Groundwater elevations of the observation wells were measured monthly during 2023. The monitoring wells were sampled based on the modified groundwater monitoring program for the Metropolitan Water Reclamation District of Greater Chicago's (District's) Tunnel and Reservoir Plan (TARP) as briefly described below.

Modified 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 of 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, nine fill event-based monitoring wells in the Mainstream Tunnel System (QM-61, QM-62, QM-63, QM-64, QM-65, QM-67, QM-68, QM-75, and QM-77) 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 collected during the period 1995–2013. The criterion that triggers fill event sampling is that the level of water in the TARP Mainstream tunnels reaches -150 feet Chicago City Datum (CCD). Sampling is conducted during the second week following 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 (NH₃-N), total organic carbon (TOC), chloride (Cl⁻), sulfate (SO₄²⁻), and FC. For the second fill event, samples are analyzed for FC only.

The other 13 monitoring wells associated with the Mainstream Tunnel System, referred to as annual monitoring wells, are sampled once per year. These wells had FC detected in less than 10 percent of samples during 1995–2013.

In 1994, the termination of monitoring of wells QM-51, QM-52, QM-54, QM-55, QM-57, and QM-60 was approved by the IEPA (memorandum dated May 4, 1994). Monitoring well QM-59 has been dry since February 1995 and is no longer monitored. Monitoring wells QM-56 and QM-58 were officially abandoned in the modified program. Monitoring of observation well OM-17 was also discontinued with the approval of the IEPA (letter dated December 16, 2011).

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

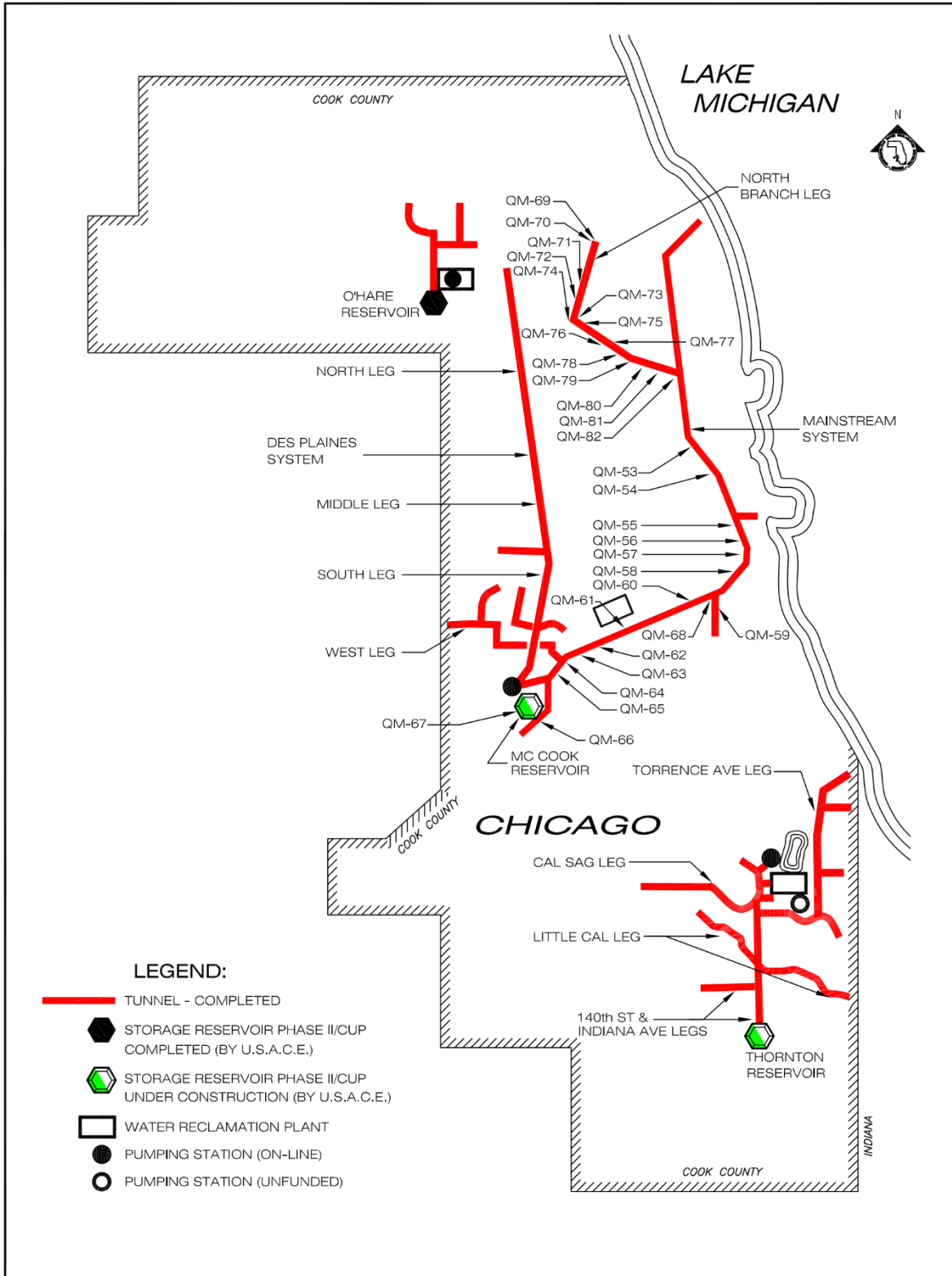
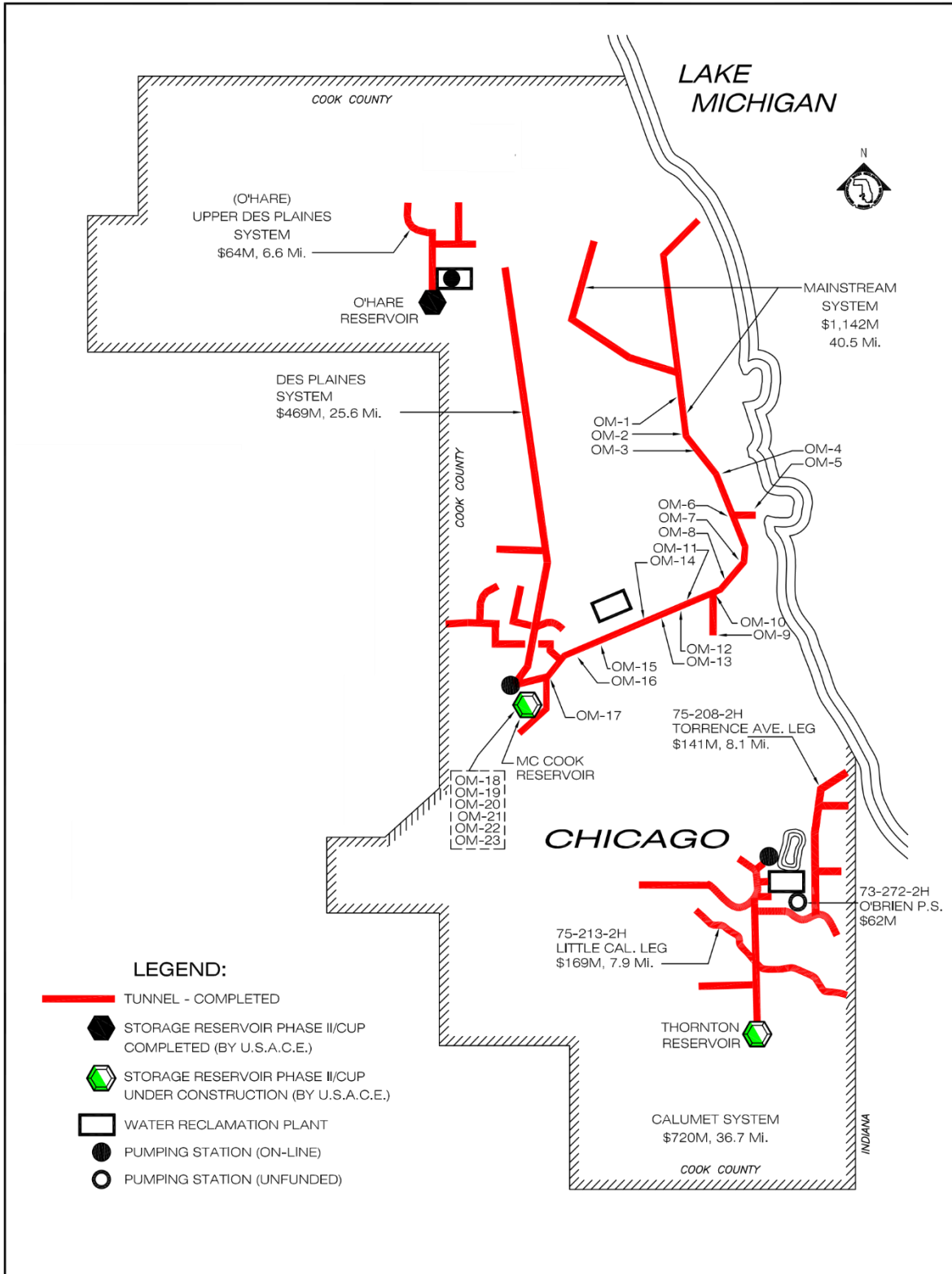


FIGURE 2: MAP OF THE OBSERVATION WELLS IN THE MAINSTREAM TUNNEL SYSTEM



Summary of Data

Monitoring Wells. During the first half of 2023, there were no Mainstream tunnel fill events. To substitute for the fill event sampling, the nine Mainstream priority monitoring wells were sampled during the period from May 24, 2023, to June 1, 2023. In the second half of the year, one tunnel fill event occurred on July 2, 2023, and lasted till July 7, 2023. Fill event-based sampling was conducted in the second week of the fill event on July 11 and July 12, 2023. Because the two samplings for the year (May and July) were close together, additional sampling for FC testing only was conducted from November 15 to November 30, 2024.

The groundwater analytical data and physical parameters for fill event-based monitoring wells QM-61 through QM-68 (except QM-66), QM-75, and QM-77 are presented in [Table 1](#). Fecal coliforms were detected in wells QM-62 and QM-67 during the first sampling event, wells QM-61, QM-62, QM-63, QM-64, QM-65, QM-67, QM-68, QM-75, and QM-77 during the second sampling event, and wells QM-62, QM-63, QM-65, QM-67, QM-68, and QM-77 during the third sampling event.

The analytical data for groundwater from the 13 Mainstream wells sampled once per year are presented in [Table 2](#). Fecal coliforms were undetectable (<1 colony forming unit/100 mL) in all annual wells.

Observation Wells. Groundwater elevations were measured for observation wells OM-1 through OM-23 once per month. Groundwater elevations were calculated relative to the 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 groundwater elevations for each well during the year are presented in [Figure 3](#).

TABLE 1: ANALYSIS OF CHEMICAL AND PHYSICAL PARAMETERS AND FECAL COLIFORM IN GROUNDWATER SAMPLED FROM FILL EVENT MONITORING WELLS IN THE MAINSTREAM TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2023¹

Well	Sample Date	pH	EC mS/m	TDS	TOC	Cl ⁻	SO ₄ ²⁻ mg/L	NH ₃ -N	Hardness	Temp. °C	Water Elevation ² feet	Fecal Coliform CFU/100 mL	Recharge Time hours
QM-61	05/24/23	7.8	46	308	<5.0	55	11	0.37	120	14.4	-138	<1	<4
	07/11/23	7.6	46	346	<5.0	57	27	0.39	132	14.4	-128	3,100	<4
	11/15/23	7.9	45	—	—	—	—	—	—	13.5	-144	<1	<4
QM-62	06/01/23	7.9	47	334	<5.0	45	12	0.91	134	15.0	-139	4	<48
	07/12/23	7.8	46	330	<5.0	46	17	1.06	145	14.3	-134	2,400	<48
	11/30/23	7.6	50	—	—	—	—	—	—	14.6	-154	460	<48
QM-63	05/25/23	7.6	155	1,396	<5.0	43	749	1.85	724	14.0	-138	<1	<48
	07/12/23	7.6	66	1,366	<5.0	44	716	1.70	743	14.0	-146	1,800	<48
	11/30/23	7.6	142	—	—	—	—	—	—	14.6	-166	3	<48
QM-64	05/24/23	7.6	62	400	<5.0	NDR ³	NDR	1.58	201	14.2	-115	<1	<4
	07/11/23	7.5	62	426	<5.0	51	34	1.36	134	14.9	-116	9	<4
	11/15/23	7.5	57	—	—	—	—	—	—	14.3	-130	<1	<4
QM-65	05/25/23	7.3	80	578	6.1	73	114	3.34	291	13.6	-168	<1	<48
	07/12/23	7.4	84	600	<5.0	77	111	3.32	327	14.2	-152	130	<48
	11/29/23	7.3	84	—	—	—	—	—	—	13.5	-182	2	<48

TABLE 1 (Continued): ANALYSIS OF CHEMICAL AND PHYSICAL PARAMETERS AND FECAL COLIFORM IN GROUND-WATER SAMPLED FROM FILL EVENT MONITORING WELLS IN THE MAINSTREAM TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2023

Well	Sample Date	pH	EC mS/m	TDS	TOC	Cl ⁻	SO ₄ ²⁻ mg/L	NH ₃ -N	Hardness	Temp. °C	Water Elevation ² feet	Fecal Coliform CFU/100 mL	Recharge Time hours
QM-67	05/25/23	7.5	108	640	<5.0	193	7	15.6	243	14.1	-156	240	<48
	07/12/23	7.4	112	718	<5.0	201	9	13.8	267	14.0	-160	1,300	<48
	11/29/23	7.6	104	—	—	—	—	—	—	13.8	-164	6,900	<48
QM-68	05/25/23	7.6	85	622	<5.0	128	60	0.95	351	14.2	-110	<1	<48
	07/12/23	7.2	81	642	<5.0	124	65	0.80	373	14.2	-101	22	<48
	11/29/23	7.3	77	—	—	—	—	—	—	13.5	-111	1	<48
QM-75	05/26/23	8.0	29	220	<5.0	13	10	<0.30	56	12.7	-68	<1	<48
	07/12/23	7.9	28	244	<5.0	14	10	<0.30	66	12.5	-70	3	<48
	11/29/23	8.0	28	—	—	—	—	—	—	12.9	-72	<1	<48
QM-77	05/26/23	8.2	21	134	<5.0	10	2	<0.30	38	14.1	-173	<1	<48
	07/12/23	8.1	20	164	<5.0	11	2	<0.30	45	12.5	-172	650	<48
	11/29/23	8.1	20	—	—	—	—	—	—	12.3	-180	1	<48

¹Chemistry parameters were analyzed for the first two sampling events.

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

³No data reported due to sample cooler malfunction and loss of thermal preservation.

TABLE 2: ANALYSIS OF CHEMICAL AND PHYSICAL PARAMETERS AND FECAL COLIFORM IN GROUNDWATER SAMPLED FROM ANNUAL MONITORING WELLS IN THE MAINSTREAM TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2023

Well	Sample Date	pH	EC mS/m	TDS	TOC	Cl ⁻	SO ₄ ²⁻ mg/L	NH ₃ -N	Hardness	Temp. °C	Water Elevation ¹ feet	Fecal Coliform CFU/100 mL
QM-53	04/12/23	8.4	24	218	<5.0	16	37	<0.30	139	12.8	-37	<1
QM-69	03/09/23	8.1	57	256	<5.0	39	36	0.86	114	11.8	-20	<1
QM-70	03/09/23	8.1	40	288	<5.0	51	56	0.38	144	12.0	-61	<1
QM-71	03/09/23	8.5	57	404	<5.0	130	68	0.42	184	11.3	-65	<1
QM-72	10/05/23	7.9	51	280	<5.0	121	2	<0.30	191	12.5	-78	<1
QM-73	04/12/23	7.9	38	294	<5.0	38	2	<0.30	157	13.0	-157	<1
QM-74	10/05/23	7.3	35	198	<5.0	63	1	<0.30	102	12.1	-21	<1
QM-76	10/05/23	8.3	42	228	<5.0	16	31	<0.30	38	12.7	-191	<1
QM-78	10/05/23	9.0	35	240	<5.0	12	47	<0.30	13	12.0	-175	<1
QM-79	10/05/23	8.1	33	248	<5.0	14	26	<0.30	15	12.1	-135	<1
QM-80	10/19/23	8.5	23	178	<5.0	14	2	<0.30	20	12.6	-142	<1
QM-81	10/19/23	8.2	30	226	<5.0	24	8	<0.30	27	13.0	-125	<1
QM-82	10/19/23	8.6	36	292	<5.0	32	9	<0.30	15	13.0	-183	<1

¹Relative to Chicago City Datum (579.48 feet above sea level) at intersection of State and Madison Streets.

TABLE 3: GROUNDWATER ELEVATIONS FOR OBSERVATION WELLS OM-1 THROUGH OM-23 IN THE MAINSTREAM TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN MEASURED DURING 2023

Date	Observation Well No.										
	OM-1	OM-2	OM-3	OM-4	OM-5	OM-6	OM-7	OM-8	OM-9	OM-10	OM-11
	-----Elevation (feet) ¹ -----										
01/10/23	-36.8	-30.7	-33.7	-66.6	-54.5	-35.4	-50.6	-41.2	-26.8	-20.0	-47.4
02/17/23	-36.8	-30.7	-30.7	-66.6	-54.5	-34.4	-50.6	-41.2	-27.8	-20.0	-46.4
03/16/23	-36.8	-30.7	-32.7	-65.6	-54.5	-34.4	-50.6	-40.2	-27.8	-21.0	-46.4
04/13/23	-36.8	-30.7	-32.7	-65.6	-54.5	-34.4	-50.6	-40.2	-29.8	-18.0	-46.4
05/16/23	-35.8	-29.7	-32.7	-65.6	-54.5	-34.4	-50.6	-40.2	-26.8	-20.0	-46.4
06/09/23	-35.8	-30.7	-32.7	-65.6	-54.5	-34.4	-50.6	-40.2	-26.8	-20.0	-45.4
07/21/23	-36.8	-28.7	-31.7	-63.6	-54.5	-45.4	-50.6	-40.2	-27.8	-18.0	-45.4
08/22/23	-37.8	-29.7	-30.7	-66.6	-53.5	-34.4	-50.6	-40.2	-27.8	-20.0	NA ²
09/19/23	-37.9	-30.4	-33.2	-66.5	-53.9	-34.4	-50.4	-40.1	-28.2	-20.3	-46.8
10/11/23	-28.6	-30.5	-32.5	-67.4	-53.3	-34.2	-49.4	-40.0	-27.6	-20.8	-46.2
11/21/23	-37.8	-30.7	-33.7	-67.6	-53.5	-35.4	-49.6	-39.2	-28.8	-20.0	-46.4
12/06/23	-37.8	-30.7	-32.7	-67.6	-53.5	-34.4	-50.6	-40.2	-28.8	-21.0	-46.4

8

TABLE 3 (Continued): GROUNDWATER ELEVATIONS FOR OBSERVATION WELLS OM-1 THROUGH OM-23 IN THE MAINSTREAM TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN MEASURED DURING 2023

Date	Observation Well No.										
	OM-12	OM-13	OM-14	OM-15	OM-16	OM-18	OM-19	OM-20	OM-21	OM-22	OM-23
	-----Elevation (feet) ¹ -----										
01/10/23	-7.7	41.4	-58.8	-132.3	-89.7	-213.0	-83.5	-83.9	-73.9	-83.3	-188.7
02/16/23	-7.7	41.4	-58.8	-132.3	-89.7	-204.0	-83.5	-81.9	-75.9	-73.3	-185.7
03/16/23	-7.7	42.4	-57.8	-132.3	-91.7	-181.0	-84.5	-82.9	-70.9	-74.3	-184.7
04/13/23	-7.7	41.4	-58.8	-132.3	-88.7	-175.0	-81.5	-80.9	-65.9	-69.3	-174.7
05/17/23	-7.7	42.4	-57.8	-132.3	-88.7	-195.0	-82.5	-88.9	-70.9	-70.3	-175.7
06/09/23	-7.7	41.4	-56.8	-131.3	-88.7	-203.0	-83.5	-91.9	-71.9	-71.3	-171.7
07/21/23	-6.7	41.4	-50.8	-119.3	-87.7	-144.0	-83.5	-62.9	-62.9	-66.3	-130.7
08/22/23	-8.7	42.4	-57.8	-133.3	-87.7	-196.0	-81.5	-70.9	-63.9	-64.3	-169.7
09/18/23	-7.8	43.0	-56.2	-133.3	-88.0	-212.7	-82.1	-80.4	-59.7	-63.9	-162.6
10/11/23	-7.5	42.7	-60.6	-139.1	-88.0	-215.7	-83.0	-88.4	-67.3	-63.3	-182.8
11/21/23	-7.7	41.4	-59.8	-139.3	-84.7	-218.0	-83.5	-91.9	-58.9	-71.3	-179.7
12/06/23	-7.7	41.4	-60.1	-141.6	-89.2	-218.9	-84.3	-92.8	-72.2	-72.9	-182.7

¹Relative to Chicago city datum (579.48' above mean sea level) at intersection of State and Madison Streets.

²No measurements was conducted due to restricted access at well location.

FIGURE 3: MINIMUM, MEAN, AND MAXIMUM WATER ELEVATION FOR OBSERVATION WELLS OM-1 THROUGH OM-23 IN THE MAINSTREAM TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN MEASURED DURING 2023

