

Protecting Our Water Environment



Metropolitan Water Reclamation District of Greater Chicago

***MONITORING AND RESEARCH
DEPARTMENT***

REPORT NO. 20-18

**TUNNEL AND RESERVOIR PLAN
UPPER DES PLAINES TUNNEL SYSTEM
ANNUAL GROUNDWATER MONITORING REPORT
FOR 2019**

July 2020

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Director of Monitoring and Research

July 16, 2020

Chief
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Springfield, IL 62794-9276

Dear Sir or Madam:

Subject: Tunnel and Reservoir Plan, Upper Des Plaines Tunnel System, Annual
Groundwater Monitoring Report for 2019

Attached are three copies of "Tunnel and Reservoir Plan, Upper Des Plaines 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

Attachment

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**TUNNEL AND RESERVOIR PLAN,
UPPER DES PLAINES TUNNEL SYSTEM,
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FOR 2019**

Monitoring and Research Department
Edward W. Podczewinski, Director

July 2020

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LIST OF ABBREVIATIONS

°C	degrees Celsius
CCD	Chicago City Datum
CFU	colony forming units
UDP	Upper Des Plaines
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 WELLS

Introduction

This system consists of two subsystems, Upper Des Plaines (UDP) 20 and UDP 21. The UDP 20 contains six monitoring wells, MW-1 through MW-6, while the UDP 21 contains three monitoring wells, MW-7 through MW-9 ([Figure 1](#)). Groundwater elevations in the monitoring wells were measured during each sampling event. In addition, groundwater elevations were measured biweekly since these wells also function as observation wells. 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 Illinois Environmental Protection Agency (IEPA) accepted the modifications for the District's TARP groundwater monitoring program effective in January 2017 for a period of three years (2017 – 2019). Under the revised monitoring plan, four wells (MW-5, -6, -7, and 8), which had fecal coliform 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 (fill event-based). The criterion that triggers a fill event sampling is that the level of water in the TARP Mainstream tunnels reaches -150 ft Chicago City Datum (CCD). At each event, sampling was done weekly for three weeks. The samples collected during the first week of sampling were analyzed for all parameters in the current monitoring program, including: pH, temperature, electrical conductivity, total dissolved solids, hardness, ammonia, total organic carbon, chloride, sulfate, and fecal coliform. However, the samples from the second and third weeks were analyzed for only fecal coliform.

The other five wells associated with the UDP Tunnel System were sampled once per year under the modified monitoring plan. These wells had fecal coliform detected in less than 10 percent of samples during the period 1995 – 2013.

Summary of Data for Monitoring Wells

The analytical data for groundwater sampled during 2019 from fill event-based monitoring wells MW-5 through MW-8, 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 fecal coliform 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), except for MW-3 with fecal coliform at 1 CFU/100 mL.

FIGURE 1: MAP OF MONITORING WELLS IN THE UPPER DES PLAINES TUNNEL SYSTEM

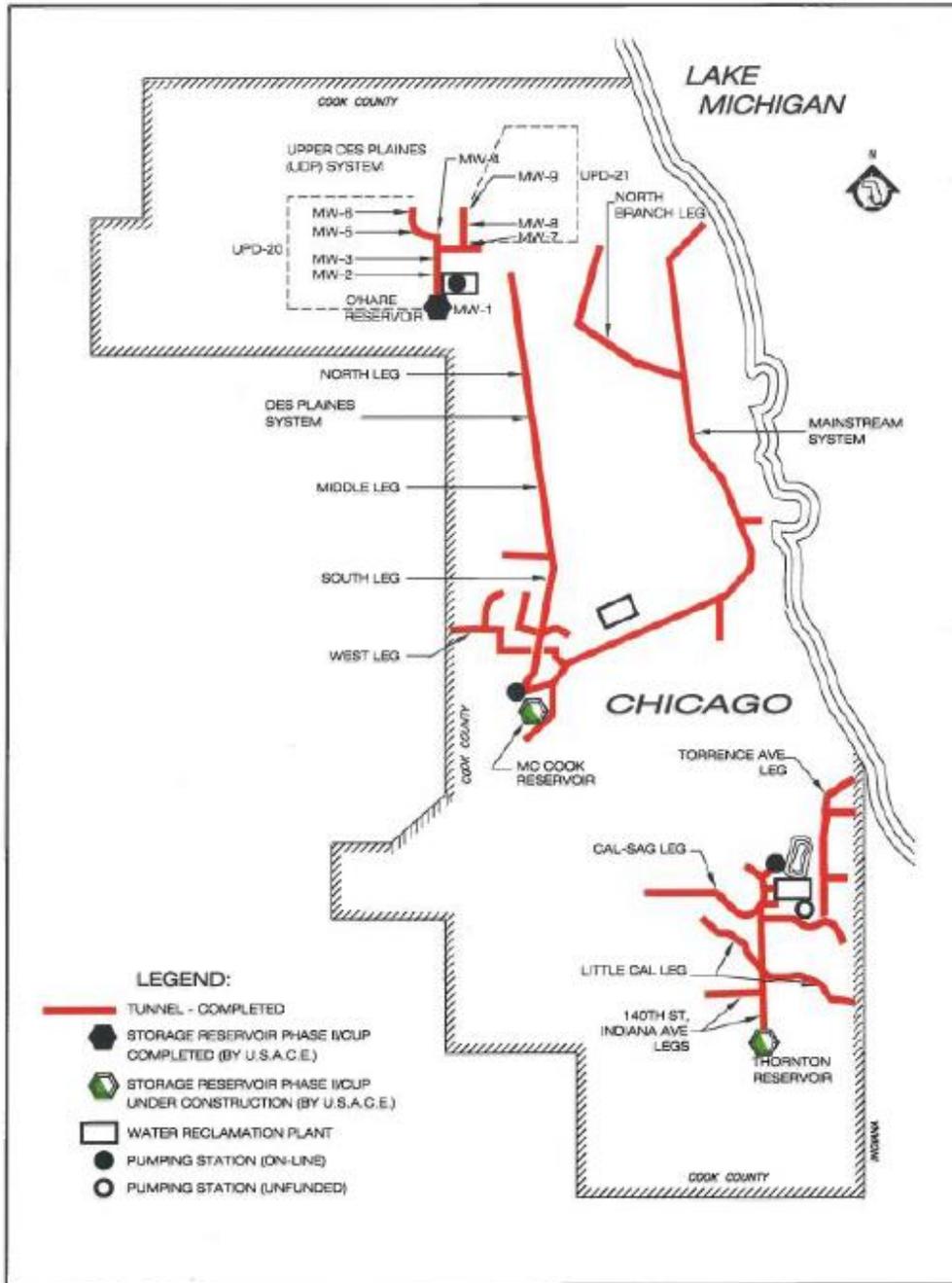


TABLE 1: ANALYSIS OF CHEMICAL AND PHYSICAL PARAMETERS IN GROUNDWATER FROM FILL EVENT MONITORING WELLS IN THE UPPER DES PLAINES TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2019 AND DESCRIPTIVE STATISTICS OF EACH OF THE PARAMETERS¹

Wells	Fill Event	Sample 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		
MW-5	F1	02/22/19	7.9	142	1,058	<1.0	359	210	<0.50	202	13.2	-60	<48	
	F2	03/21/19	7.9	106	806	<1.0	181	264	<0.50	217	13.0	-57	<48	
	F3	04/25/19	7.5	107	792	<1.0	204	230	<0.30	232	13.2	-54	<48	
	F4	08/02/19	7.9	84	726	<1.0	116	253	<0.30	207	15.0	-56	<48	
	F5	10/03/19	8.4	49	726	1.2	60	224	0.47	138	14.3	-52	<48	
		Minimum		7.5	49	726	<1.0	60	210	<0.30	138	13.0	-60	
		Median		7.9	106	792	1.0	181	230	0.47	207	13.2	-56	
		Mean		7.9	98	822	1.04	184	236	0.41	199	13.7	-56	
		Maximum		8.4	142	1,058	1.2	359	264	<0.50	232	15.0	-52	
		Standard deviation		0.3	34	137	0.09	113	22	0.10	36	0.87	3.0	
	Coefficient of variation (%)		4.0	35	17	9.0	61	9.0	24	18	6.0	5.0		
MW-6	F1	02/14/19	7.9	85	636	<1.0	51	334	<0.50	356	13.4	67	<48	
	F2	03/20/19	8.1	79	654	1.0	44	NRR ⁴	0.52	357	13.7	68	<48	
	F3	04/24/19	7.6	83	710	<1.0	38	343	0.50	343	14.8	71	<48	
	F4	07/31/19	7.6	75	724	<1.0	35	319	0.48	330	13.8	67	<48	
	F5	10/03/19	7.7	54	426	2.2	19	175	0.37	206	14.7	67	<48	
		Minimum		7.6	54	426	<1.0	19	175	0.37	206	13.4	67	
		Median		7.7	79	654	1.0	38	327	0.50	343	13.8	67	
		Mean		7.8	75	630	1.2	37	293	0.47	318	14.1	68	
		Maximum		8.1	85	724	2.2	51	343	0.52	357	14.8	71	
		Standard deviation		0.2	12	120	0.5	12	79	0.06	64	0.6	1.7	
	Coefficient of variation (%)		3.0	17	19	44	32	27	12.6	20	4.0	3.0		

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

Well	Fill Event	Sample 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		
MW-7	F1	02/15/19	8.0	92	814	<1.0	39	377	0.57	466	14.8	27	<48	
	F2	03/20/19	7.7	94	736	<1.0	43	NRR	0.59	493	15.1	27	<48	
	F3	04/24/19	7.4	92	808	<1.0	39	368	0.52	450	14.7	27	<48	
	F4	07/31/19	7.4	87	836	<1.0	38	359	0.52	432	14.9	27	<48	
	F5	10/03/19	7.3	78	816	<1.0	38	364	0.59	460	15.3	27	<48	
		Minimum		7.3	78	736	<1.0	38	359	0.52	432	14.7	27	
		Median		7.4	92	814	<1.0	39	366	0.57	460	14.9	27	
		Mean		7.6	89	802	<1.0	39	367	0.56	460	15.0	27	
		Maximum		8.0	94	836	<1.0	43	377	0.59	493	15.3	27	
		Standard deviation		0.3	7.0	38	0.0	2.0	7.62	0.03	22	0.2	0.0	
	Coefficient of variation (%)		4.0	8.0	5.0	0.0	5.0	2.0	6.0	5.0	2.0	0.0		
MW-8	F1	02/15/19	8.3	107	772	<1.0	241	184	<0.50	242	14.3	-34	<48	
	F2	03/21/19	8.1	84	686	1.0	50	351	<0.50	383	14.0	-37	<48	
	F3	04/25/19	7.8	89	736	1.2	54	337	<0.30	358	14.8	-36	<48	
	F4	08/02/19	7.8	69	666	<1.0	60	269	<0.30	327	14.5	-49	<48	
	F5	10/03/19	8.2	27	252	1.2	15	99	<0.30	130	14.8	6.0	<48	
		Minimum		7.8	27	252	<1.0	15	99	<0.30	130	14.0	-49	
		Median		8.1	84	686	1.0	54	269	<0.30	327	14.5	-36	
		Mean		8.0	75	622	1.1	84	248	0.38	288	14.5	-30	
		Maximum		8.3	107	772	1.2	241	351	<0.50	383	14.8	6.0	
		Standard deviation		0.3	30	211	0.1	90	106	0.11	103	0.3	21	
	Coefficient of variation (%)		3.0	40	34	10	107	43	29	36	2.0	69		

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

²Reporting limits changed to 0.3 mg/L on April 8, 2019 due to the change in the test equipment.

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

⁴No reportable result due to failure of QA/QC checks during lab analysis.

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

Well	Fill Event	Week 1 Sample Date	Week 1	Week 2	Week 3	
----- CFU/100 mL -----						
MW-5	F1	02/22/19	N/S ¹	<1	<1	
	F2	03/21/19	1	<1	<1	
	F3	04/25/19	<1	58	2	
	F4	08/02/19	24	14	4	
	F5	10/03/19	23	<1	<1	
		Minimum		<1	<1	<1
		Median		12	1	1
		Mean ²		5	4	2
		Maximum		24	58	4
	MW-6	F1	02/14/19	<1	<1	NReq ³
F2		03/20/19	<1	<1	NReq	
F3		04/24/19	<1	1,100	<1	
F4		07/31/19	260	2	7	
F5		10/03/19	9,100	200	76	
		Minimum		<1	<1	<1
		Median		1	2	7
		Mean		19	13	8
		Maximum		9,100	1,100	76
MW-7		F1	02/15/19	<1	<1	NReq
	F2	03/20/19	<1	<1	NReq	
	F3	04/24/19	<1	980	74	
	F4	07/31/19	<1	79	<1	
	F5	10/03/19	13	<1	<1	
		Minimum		<1	<1	<1
		Median		1	1	1
		Mean		2	10	4
		Maximum		13	980	74

TABLE 2 (Continued): ANALYSIS OF FECAL COLIFORM IN GROUNDWATER FROM FILL EVENT MONITORING WELLS IN THE UPPER DES PLAINES TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2019 AND ITS DESCRIPTIVE STATISTICS¹

Well	Fill Event	Week 1 Sample Date	Week 1	Week 2	Week 3
			----- CFU/100 mL -----		
MW-8	F1	02/15/19	<1	<1	NReq
	F2	03/21/19	<1	<1	NReq
	F3	04/25/19	1	9,600	150
	F4	08/02/19	1	2	1
	F5	10/03/19	5,000	280	29
		Minimum	<1	<1	1
		Median	1	2	29
		Mean	5	22	16
		Maximum	5,000	9,600	150

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

²Geometric mean calculated.

³NReq: Sampling is not required because the fecal coliform level was below detection limit in the previous week.

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

Well	Sample Date	pH	EC	TDS	TOC	Cl ⁻	SO ₄ ²⁻	NH ₃ -N	Hardness	Temp	Water Elevation ¹	Fecal Coliform
			mS/m			mg/L				°C	ft	CFU/100 mL
MW-1	07/18/19	7.5	82	836	<1.0	30	378	0.41	402	15.1	14	<1
MW-2	07/18/19	7.7	91	972	<1.0	59	415	0.61	479	14.3	47	<1
MW-3	08/29/19	7.6	86	800	1.6	18	336	0.38	420	15.2	36	1
MW-4	08/29/19	7.6	100	944	<1.0	76	389	<0.30	527	14.1	-3.6	<1
MW-9	08/29/19	7.6	79	710	1.2	32	351	0.45	339	14.4	8.8	<1

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

Groundwater elevations in monitoring Wells MW-1 through MW-9 were calculated relative to the CCD (579.48 ft. above mean sea level) at the intersection of Madison and State Streets (Table 4). No measurement was obtained from well MW-7 due to measuring probe trapped inside the well depth port. For most dates, no measurements were obtained at MW-3 due to flooding conditions. The minimum, mean, and maximum values for each well were calculated and plotted to determine fluctuations in groundwater elevations during the year (Figure 2). Fluctuations were mainly evident in Wells MW-3, -5, -8, and -9 during the year.

TABLE 4: GROUNDWATER ELEVATIONS FOR OBSERVATION WELLS MW-1 THROUGH MW-9 IN THE UPPER DES PLAINES TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN MEASURED DURING 2019

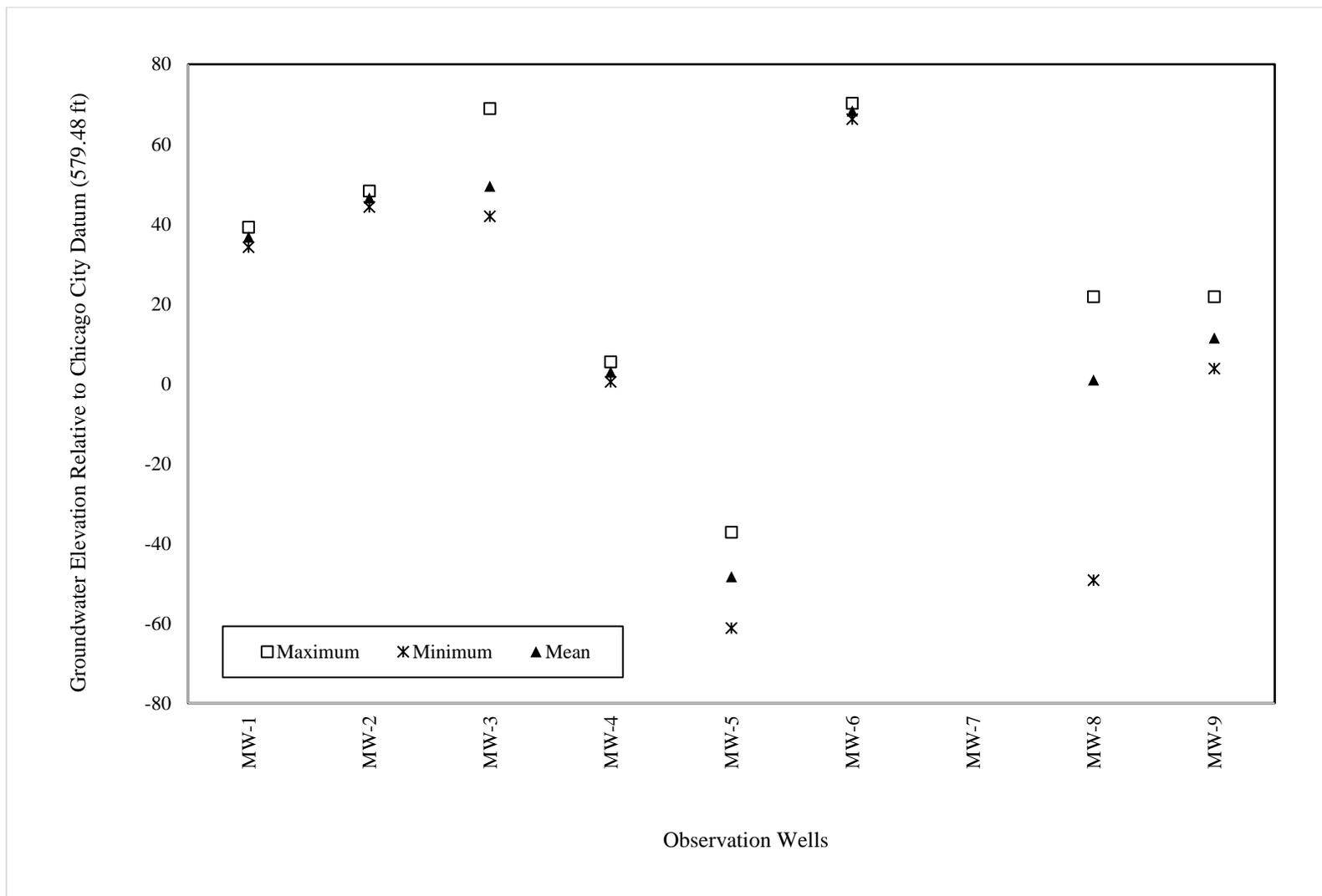
Date	Observation Well No.								
	MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	MW-7	MW-8	MW-9
	----- Elevation (ft) ¹ -----								
01/11/19	36	47	43	3	-37	68	NA ²	21	8
02/01/19	36	48	NA	NA	NA	NA	NA	NA	NA
02/08/19	36	47	NA	3	-37	67	NA	NA	4
03/06/19	37	46	43	NA	-59	68	NA	20	9
04/05/19	37	47	NA	4	-58	69	NA	7	9
04/19/19	NA	NA	NA	NA	NA	NA	NA	NA	NA
05/17/19	NA	NA	NA	NA	NA	NA	NA	NA	NA
06/13/19	NA	NA	NA	NA	NA	NA	NA	NA	NA
06/21/19	37	46	68	5	-38	68	NA	21	22
07/12/19	35	46	69	1	-38	67	NA	20	9
08/16/19	36	45	43	2	-59	68	NA	-47	12
08/21/19	37	46	44	2	-53	70	NA	-44	14
09/13/19	34	44	NA	0	-46	66	NA	21	12
09/19/19	NA	NA	NA	NA	NA	NA	NA	NA	NA
10/11/19	NA	NA	NA	NA	NA	NA	NA	NA	NA
10/28/19	35	47	NA	3	-43	69	NA	16	22
11/07/19	NA	NA	42	NA	-61	NA	NA	NA	13
11/29/19	38	47	NA	NA	-44	69	NA	22	8
12/13/19	39	47	NA	2	-44	69	NA	21	9
12/19/19	39	47	NA	1	-45	69	NA	22	9

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

²No measurements were obtained due to blockage at MW-7 or freezing and flooding conditions at some of other wells, or not recorded by field staff.

FIGURE 2: MINIMUM, MEAN, AND MAXIMUM WATER ELEVATIONS FOR MONITORING/OBSERVATION WELLS MW-1 THROUGH MW-9 IN THE UPPER DES PLAINES TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN MEASURED DURING 2019¹

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¹No measurements were taken at well MW-7.