Protecting Our Water Environment

Metropolitan Water Reclamation District of Greater Chicago

MONITORING AND RESEARCH DEPARTMENT

REPORT NO. 16-24

TUNNEL AND RESERVOIR PLAN

MAINSTREAM TUNNEL SYSTEM

ANNUAL GROUNDWATER MONITORING REPORT

FOR 2015

July 2016

Metropolitan Water Reclamation District of Greater Chicago
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TUNNEL AND RESERVOIR PLAN MAINSTREAM TUNNEL SYSTEM
ANNUAL GROUNDWATER MONITORING
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Monitoring and Research Department
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°C	degrees Celsius
CFU	colony forming units
Cl^-	chloride
EC	electrical conductivity
FC	fecal coliform
ft	feet
hr	hour
L	liter
m	meter
mg	milligram
mS	millisiemens
NH_3-N	ammonia nitrogen
SO_4^{2-}	sulfate
TDS	total dissolved solids
TOC	total organic carbon

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). The elevations for the observation wells are measured approximately twelve times per year, while the monitoring wells are sampled at various frequencies. Monitoring wells QM-53, -56, -58, -61, -66, -68 through -74, -76, -77, and -81 are sampled three times per year (Illinois Environmental Protection Agency [IEPA] memoranda dated July 9, 2004, and February 23, 2006). Monitoring wells QM-62 through -65, -67, -75, -78 through -80, and -82 are all sampled six times per year (IEPA memorandum dated July 9, 2004). In 1994, the termination of monitoring for Wells QM-51, -52, -54, -55, -57, and -60 was approved by the IEPA (memorandum dated May 4, 1994). Monitoring well QM-65 could not be sampled throughout the year due to a faulty pump. This well is scheduled for service. Only two samples were retrieved from Well QM-66 in 2015. Monitoring well QM-59 has been dry since February 1995 and is no longer monitored. Monitoring of observation well OM-17 was also discontinued with the approval of the IEPA (Appendix A).

Most monitoring wells in the Mainstream Tunnel System were sampled at the required frequencies. However, in a few instances, samples from specific wells could not be retrieved for various reasons. Throughout the year, monitoring wells QM-56 and -58 were inaccessible due to construction in the vicinity of these wells. Therefore, they were not sampled. The required six samples were retrieved during this year and last year from Wells QM-62 and -82, unlike previous years. Both wells were considered intermittently dry in the past.

Summary of Data

Monitoring Wells. The analytical data for groundwater sampled during 2015 from monitoring wells QM-53 through QM-82 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. Fecal coliform (FC) counts in Wells QM-61, -62, -63, -64, and -67 were much higher than expected at various times during the year. Three wells (QM-61, 64, and 68) were decontaminated using the standard procedure, and significant reductions in FC counts were observed in two wells. Additional wells will be decontaminated as time permits.

Wells QM-62 and -63 were recently selected for special evaluation by U.S. Geological Survey personnel. Following this evaluation, both wells were serviced and decontaminated. The pumps in both wells and PVC pipe in QM-63 were replaced. Table 2 lists the descriptive statistics for groundwater data of monitoring wells QM-53 through QM-82 for 2015.

Observation Wells. Measurement of groundwater elevations for observation wells OM-1 through -23 was attempted at the required frequencies. Several measurements were not taken as planned due to a number of factors limiting access to these wells (Table 3, Footnote 3). Adjusted

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

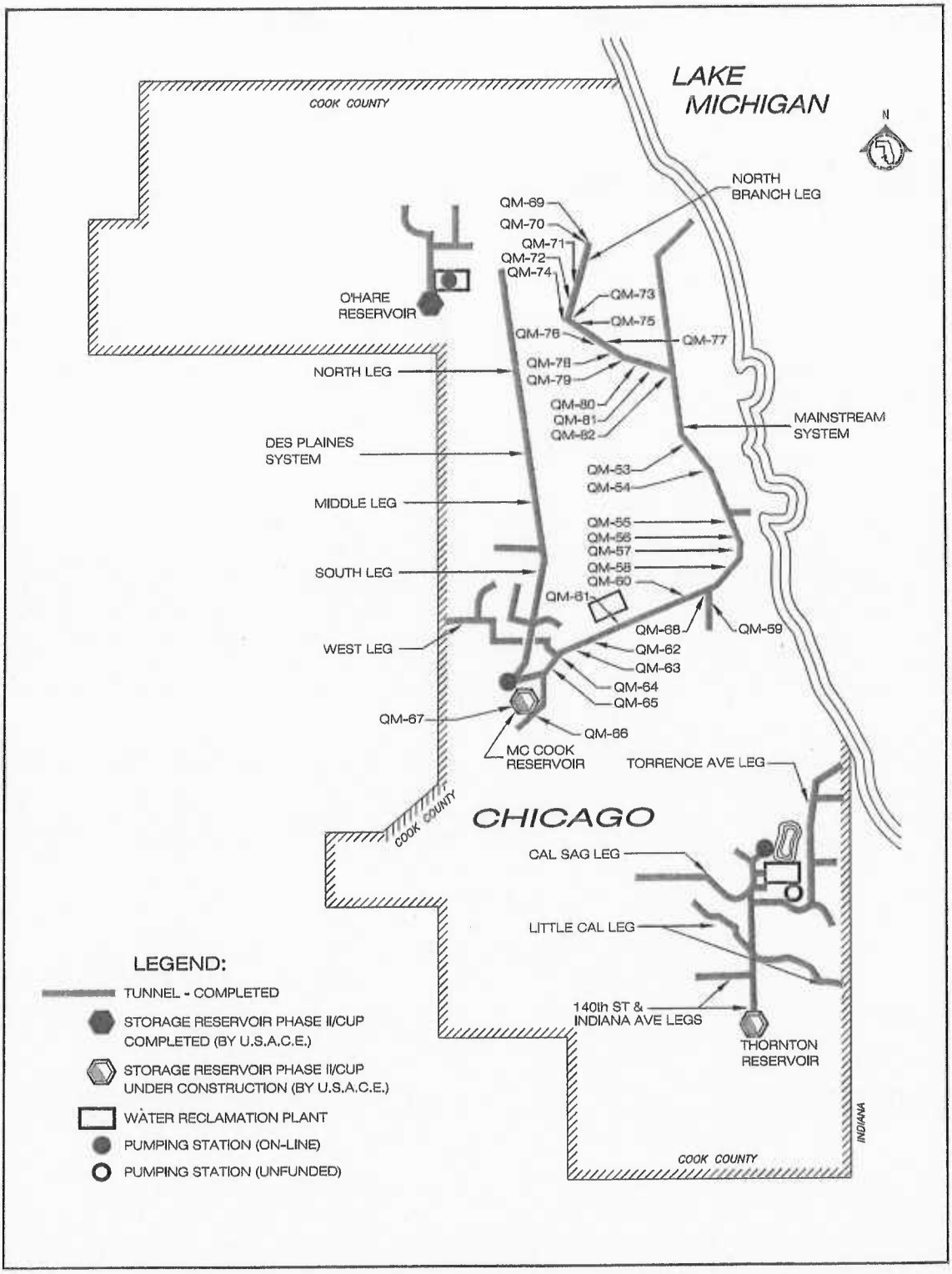


FIGURE 2: MAP OF THE OBSERVATION WELLS IN THE MAINSTREAM TUNNEL SYSTEM

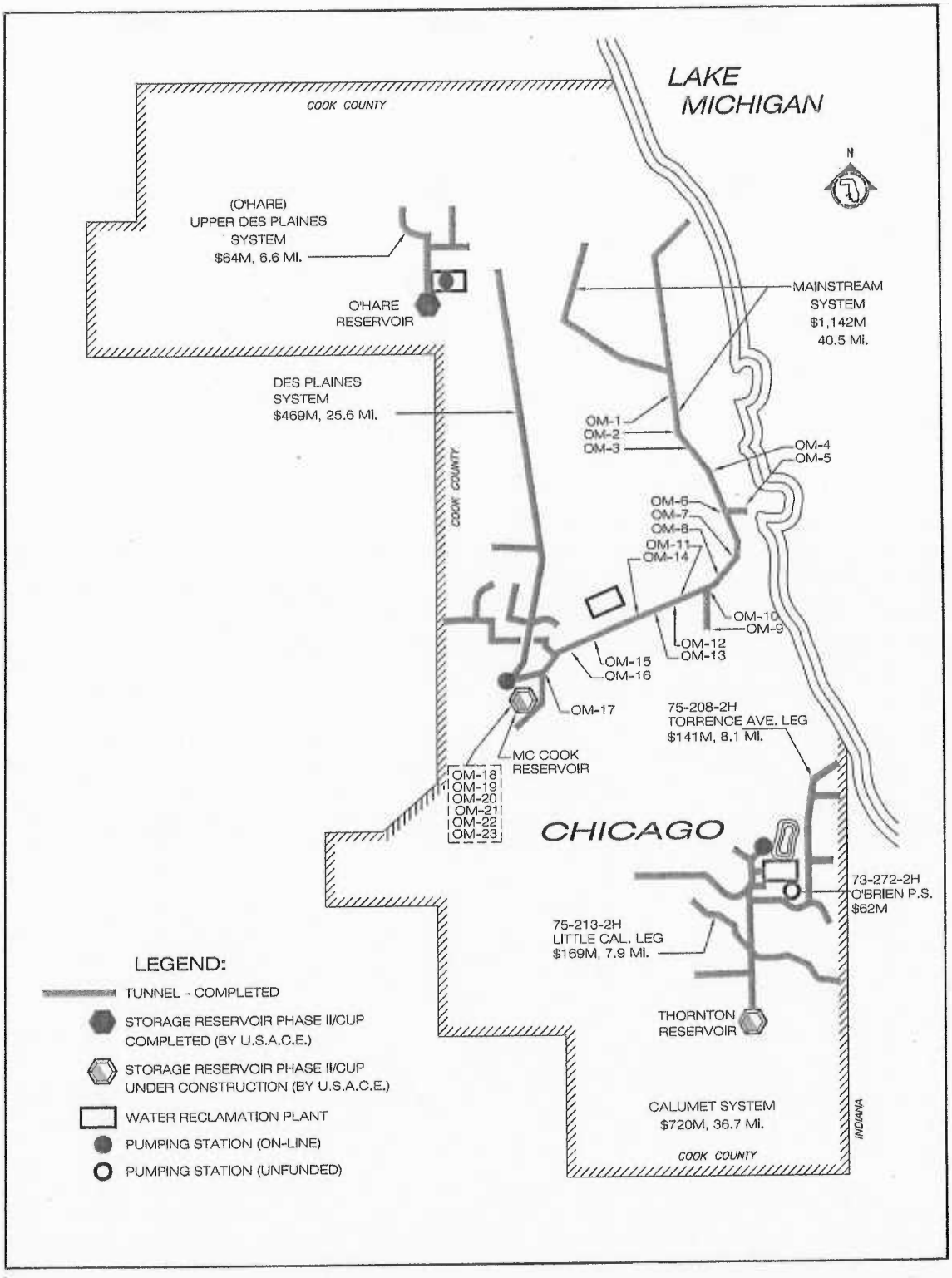


TABLE 1: ANALYSIS OF GROUNDWATER FROM MONITORING WELLS QM-53 THROUGH QM-82 IN THE MAINSTREAM TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN SAMPLED DURING 2015

Well	Date Sampled	pH	EC[1]	TDS[1]	TOC[1]	Cl^-	SO_4^{2-}	NH_3-N	Hardness	Fecal Coliform	Temp	Water Elevation[2]	Recharge Time
			mS/m	mg/L						MPN/100 mL	°C	ft	hr
QM-53	02/25/15	7.5	23	118	<1	15	38	<0.10	144	<1	10.5	-35	<48
QM-53	06/11/15	8.2	24	222	<1	15	36	<0.10	148	<1	11.8	-36	<48
QM-53	09/17/15	8.2	32	174	1	15	35	<0.10	152	<1	11.6	-40	<48
QM-61	02/23/15	8.0	57	252	1	50	12	0.41	125	3	13.4	-169	<4
QM-61	04/13/15	7.3	41	432	2	150	27	0.89	171	11,000	13.8	-139	<4
QM-61	04/29/15	NR[3]	NR	NR	NR	151	NR	NR	NR	4,900	NR	-158	<4
QM-61	06/18/15	7.6	47	448	2	151	31	1.6	208	25,000	15.5	-	<4
QM-61	09/16/15	7.4	56	NA[4]	1	56	NA	NA	130	350	14.7	-	<4
QM-62	01/28/15	7.7	45	322	1	48	24	0.57	151	1	13.9	-181	<48
QM-62	04/09/15	7.5	40	342	1	45	36	0.54	165	<1	14.1	-183	<48
QM-62	06/11/15	7.8	46	378	<1	45	34	0.55	171	5	15.5	-180	<48
QM-62	09/17/15	7.5	63	354	1	37	42	0.45	182	500	15.1	-177	<48
QM-62	10/29/15	7.5	65	816	1	38	54	0.61	527	3,700	13.5	-179	<48
QM-62	12/10/15	7.0	58	326	<1	42	35	0.46	162	220	12.4	-176	<48
QM-63	01/28/15	7.6	146	1,692	3	52	1,025	2.1	886	<1	12.7	-178	<48
QM-63	04/09/16	7.7	136	1,748	3	50	1,032	2.2	1,004	<1	13.8	-183	<48
QM-63	06/11/15	7.8	132	1,778	3	51	964	2.2	925	<1	15.1	-179	<48
QM-63	09/17/15	7.5	177	1,632	3	50	933	2.1	886	24	14.4	-172	<48
QM-63	10/29/15	7.1	173	1,674	2	49	863	2.1	851	18	13.5	-169	<48
QM-63	12/10/15	7.1	170	1,680	2	50	760	2.2	883	320	12.2	-175	<48

TABLE 1 (Continued): ANALYSIS OF GROUNDWATER FROM MONITORING WELLS QM-53 THROUGH QM-82 IN THE MAINSTREAM TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN SAMPLED DURING 2015

Well	Date Sampled	pH	EC[1]	TDS[1]	TOC[1]	Cl^-	SO_4^{2-}	NH_3-N	Hardness	Fecal Coliform	Temp	Water Elevation[2]	Recharge Time
			mS/m	mg/L						MPN/100 mL	°C	ft	hr
QM-64	01/07/15	7.3	52	396	1	52	40	1.8	201	4	12.9	-171	<4
QM-64	03/17/15	7.5	53	382	1	52	28	1.7	192	1	13.2	-168	<4
QM-64	04/13/15	7.0	57	418	1	78	44	1.7	214	6,500	14.9	-150	<4
QM-64	04/29/15	NR	NR	NR	NR	79	NR	NR	NR	1,300	14.7	-163	<4
QM-64	06/18/15	7.6	63	346	1	53	40	1.5	191	8,400	15.8	-163	<4
QM-64	09/16/15	7.3	78	396	2	57	37	1.7	219	22	14.5	-118	<4
QM-64	12/22/15	7.1	77	364	1	49	37	1.6	187	10	13.5	-169	<4
QM-66	05/21/15	9.5	85	1,360	<1	165	216	0.18	11	<1	13.0	-319	<48
QM-66	08/26/15	9.7	205	1,282	<1	170	231	0.18	9	<1	14.7	-311	<48
QM-67	01/28/15	7.6	96	622	3	188	29	13	229	58	12.4	-155	<48
QM-67	03/05/15	7.5	110	740	4	270	8	14	279	69	12.0	-154	<48
QM-67	04/09/15	7.4	133	908	4	335	7	15	327	64	13.7	-153	<48
QM-67	09/17/15	7.2	148	756	5	615	9	13	261	780	14.9	-152	<48
QM-67	11/12/15	7.3	134	674	5	183	11	12	250	580	13.8	-151	<48
QM-67	12/10/15	7.3	119	606	4	163	6	12	218	570	14.2	**-152**	<48
QM-68	02/25/15	7.4	34	200	<1	32	39	0.65	210	<1	12.0	-118	<48
QM-68	06/11/15	7.7	41	422	1	66	38	0.70	287	<1	11.7	-117	<48
QM-68	09/17/15	7.5	76	468	2	93	40	0.68	337	4	15.5	-117	<48

TABLE 1 (Continued): ANALYSIS OF GROUNDWATER FROM MONITORING WELLS QM-53 THROUGH QM-82 IN THE MAINSTREAM TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN SAMPLED DURING 2015

Well	Date Sampled	pH	EC[1]	TDS[1]	TOC[1]	Cl^-	SO_4^{2-}	NH_3-N	Hardness	Fecal Coliform	Temp	Water Elevation[2]	Recharge Time
			mS/m	mg/L						MPN/100 mL	°C	ft	hr
QM-68	04/29/15	7.5	64	NR	NR	151	NR	NR	NR	4,900	13.0	NR	<48
QM-68	06/18/15	7.5	29	"	"	79	"	"	"	1,300	13.1	"	<48
QM-69	05/21/15	8.1	42	312	1	36	38	0.89	154	<1	11.9	-44	<48
QM-69	08/26/15	8.0	52	274	1	35	38	0.87	149	<1	12.1	-21	<48
QM-69	11/18/15	7.5	45	284	<1	36	43	0.82	152	<1	11.8	-30	<48
QM-70	03/11/15	7.9	42	318	<1	50	53	0.39	157	<1	12.5	-52	<48
QM-70	06/17/15	7.3	36	280	<1	50	50	0.40	160	<1	17.3	-46	<48
QM-70	10/07/15	9.3	55	298	<1	49	63	0.39	156	<1	12.4	-57	<48
QM-71	03/11/15	7.7	59	432	<1	128	70	0.46	201	<1	12.1	-58	<48
QM-71	06/17/15	7.6	46	432	<1	128	67	0.46	209	1	15.1	-63	<48
QM-71	10/07/15	9.0	77	434	<1	126	78	0.46	203	<1	12.4	-70	<48
QM-72	05/21/15	7.8	49	464	1	130	<5	0.39	234	<1	12.1	-80	<48
QM-72	08/26/15	7.7	69	376	1	123	<5	0.38	212	<1	11.5	-76	<48
QM-72	11/18/15	7.9	54	338	<1	126	<5	0.33	219	<1	13.0	-78	<48
QM-73	02/26/15	7.3	37	228	1	35	<5	0.30	151	<1	9.4	-164	<48
QM-73	06/17/15	7.7	30	236	1	35	<5	0.31	157	<1	17.1	-161	<48
QM-73	10/07/15	8.9	51	266	<1	36	10	0.22	156	<1	12.8	-153	<48

TABLE 1 (Continued): ANALYSIS OF GROUNDWATER FROM MONITORING WELLS QM-53 THROUGH QM-82 IN THE MAINSTREAM TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN SAMPLED DURING 2015

Well	Date Sampled	pH	EC[1]	TDS[1]	TOC[1]	Cl^-	SO_4^{2-}	NH_3-N	Hardness	Fecal Coliform	Temp	Water Elevation[2]	Recharge Time
			mS/m	mg/L						MPN/100 mL	°C	ft	hr
QM-74	02/26/15	7.6	34	196	1	59	<5	0.23	107	<1	10.0	-13	<48
QM-74	07/23/15	7.4	45	200	2	60	5	0.22	114	<1	13.1	-13	<48
QM-74	10/07/15	7.9	47	242	<1	58	5	0.12	114	<1	12.5	-17	<48
QM-75	01/28/15	8.7	27	178	<1	12	9	0.27	62	<1	11.1	-78	<48
QM-75	03/11/15	7.8	29	<60	<1	12	12	0.19	67	<1	13.0	-77	<48
QM-75	07/23/15	7.1	38	158	1	17	11	0.25	70	<2	12.9	-80	<48
QM-75	10/07/15	6.9	38	210	<1	13	18	0.16	65	1	12.6	-78	<48
QM-75	12/10/15	8.0	36	216	<1	13	8	0.23	65	<1	11.7	-78	<48
QM-74	02/26/15	7.6	34	196	1	59	<5	0.23	107	<1	10.0	-13	<48
QM-76	02/26/15	7.6	33	308	<1	12	80	0.25	66	<1	10.4	-186	<48
QM-76	07/23/15	7.5	49	264	1	14	50	0.26	51	<1	13.3	-187	<48
QM-76	10/07/15	7.3	55	320	<1	12	64	0.20	63	<1	12.7	-193	<48
QM-77	02/26/15	7.3	20	124	<1	10	<5	0.13	44	<1	9.6	-181	<48
QM-77	07/23/15	7.7	25	118	<1	13	<5	0.13	48	7	13.3	-179	<48
QM-77	10/07/15	7.3	24	152	<1	10	<5	<0.10	45	33	13.3	-177	<48
QM-78	01/29/15	9.0	33	246	<1	10	41	<0.10	9	<1	12.0	-157	<48
QM-78	03/04/15	8.6	32	220	<1	11	43	0.16	9	<1	10.5	-163	<48
QM-78	04/16/15	8.5	36	252	<1	10	42	<0.10	11	1	11.8	-150	<48

TABLE 1 (Continued): ANALYSIS OF GROUNDWATER FROM MONITORING WELLS QM-53 THROUGH QM-82 IN THE MAINSTREAM TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN SAMPLED DURING 2015

Well	Date Sampled	pH	EC[1]	TDS[1]	TOC[1]	Cl^-	SO_4^{2-}	NH_3-N	Hardness	Fecal Coliform	Temp	Water Elevation[2]	Recharge Time
			mS/m	mg/L						MPN/100 mL	°C	ft	hr
QM-78	08/26/15	8.6	46	258	<1	10	41	<0.10	10	<1	11.8	-160	<48
QM-78	10/08/15	8.6	46	262	<1	10	47	0.11	10	<1	12.1	-119	<48
QM-78	12/10/15	8.7	43	250	<1	11	40	<0.10	9	<1	11.6	-155	<48
QM-79	01/29/15	9.1	33	246	<1	16	19	<0.10	12	<1	10.9	-147	<48
QM-79	04/16/15	8.4	35	254	<1	15	18	<0.10	14	<1	11.8	-146	<48
QM-79	05/21/15	8.3	36	310	<1	15	17	<0.10	14	<1	12.1	-149	<48
QM-79	08/26/15	8.6	46	264	<1	14	17	0.16	14	<1	11.8	-147	<48
QM-79	10/08/15	8.7	48	258	<1	15	19	<0.10	13	<1	12.0	-147	<48
QM-79	12/10/15	8.6	44	246	<1	14	15	<0.10	13	<1	11.4	-147	<48
QM-80	01/29/15	8.8	23	156	<1	13	<5	<0.10	22	<1	11.6	-140	<48
QM-80	03/04/15	8.0	30	126	<1	12	<5	<0.10	22	<1	11.3	-148	<48
QM-80	04/16/15	8.2	25	162	<1	13	<5	<0.10	22	<1	12.3	-144	<48
QM-80	08/26/15	8.6	31	176	<1	12	<5	<0.10	22	<1	12.4	-149	<48
QM-80	10/08/15	8.1	32	228	<1	12	<5	<0.10	22	<1	13.2	-146	<48
QM-80	12/10/15	8.3	30	164	<1	12	<5	<0.10	22	<1	12.2	-146	<48
QM-81	05/21/15	8.1	32	266	<1	20	10	0.16	34	<1	12.7	-137	<48
QM-81	08/26/15	8.4	37	212	<1	20	11	0.10	36	<1	12.8	-132	<48
QM-81	11/18/15	8.3	30	204	<1	20	13	<0.10	32	<1	13.9	-125	<48

TABLE 1 (Continued): ANALYSIS OF GROUNDWATER FROM MONITORING WELLS QM-53 THROUGH QM-82 IN THE MAINSTREAM TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN SAMPLED DURING 2015

Well	Date Sampled	pH	EC[1]	TDS[1]	TOC[1]	Cl^-	SO_4^{2-}	NH_3-N	Hardness	Fecal Coliform	Temp	Water Elevation[2]	Recharge Time
			mS/m	mg/L						MPN/100 mL	°C	ft	hr
QM-82	01/29/15	9.0	34	246	<1	29	20	<0.10	16	<1	11.5	-184	<48
QM-82	03/04/15	8.2	32	198	1	30	38	<0.10	16	<1	11.2	-188	<48
QM-82	04/16/15	8.3	36	252	1	30	<5	<0.10	18	<1	12.4	-187	<48
QM-82	10/08/15	8.1	47	266	<1	29	11	<0.10	16	<1	13.1	-185	<48
QM-82	11/18/15	8.6	42	268	<1	29	11	<0.10	17	<1	12.8	-188	<48
QM-82	12/10/15	8.4	43	264	<1	27	6	<0.10	16	<1	12.6	-185	<48

[1]EC = electrical conductivity; TDS = total dissolved solids; TOC = total dissolved organic carbon.

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

[3]Not required for well decontamination.

[4]No analysis.

TABLE 2: DESCRIPTIVE STATISTICS FOR GROUNDWATER DATA OF MONITORING WELLS QM-53 THROUGH QM-82 IN THE MAINSTREAM TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2015

Well	Statistic	pH	EC[1]	TDS[1]	TOC[1]	Cl^-	SO_4^{2-}	NH_3-N	Hardness	Fecal Coliform[2]
			mS/m	mg/L						MPN/100 mL
QM-53	Minimum	7.5	23	118	<1	15	35	<.010	144	<1
	Mean	8.0	26	171	<1	15	36	<0.10	148	<1
	Maximum	8.2	32	222	1.0	15	38	<0.10	152	<1
	Std. Dev.	0.4	5	52	0.0	0.0	1	0.00	4	NA[3]
	Median	8.2	24	174	<1	15	36	<0.10	148	<1
	Coeff. of Var. (%)	5.5	19	30	0.0	0.0	4	0.00	3	NA
QM-61	Minimum	7.3	41	252	1	50	12	0.41	125	3
	Mean	7.6	50	377	2	112	23	1.0	159	1,072
	Maximum	8.0	57	448	2	151	31	1.6	208	25,000
	Std. Dev.	0.5	8	109	0.6	54	10	0.57	39	NA
	Median	7.5	52	432	2	150	27	0.89	151	4,900
	Coeff. of Var. (%)	6.4	15	29	35	48	43	60	25	NA
QM-62	Minimum	7.0	40	322	1	37	24	0.45	151	<1
	Mean	7.5	53	423	1	43	38	0.53	226	36
	Maximum	7.8	65	816	1	48	54	0.61	527	3,700
	Std. Dev.	0.3	10	194	0.2	4	10	0.06	148	NA
	Median	7.5	52	348	1	44	36	0.55	168	220
	Coeff. of Var. (%)	3.6	20	46	14	10	26	12	65	NA
QM-63	Minimum	7.1	132	1,632	2	49	760	2.1	851	<1
	Mean	7.5	156	1,701	3	50	929	2.1	906	7
	Maximum	7.8	177	1,778	3	52	1,032	2.2	1004	320
	Std. Dev.	0.3	20	53	0.3	1	104	0.06	54	NA
	Median	7.5	158	1,686	3	50	948	2.2	886	24
	Coeff. of Var. (%)	4.1	13	3	11	2	11	2.6	6	NA

TABLE 2 (Continued): DESCRIPTIVE STATISTICS FOR GROUNDWATER DATA OF MONITORING WELLS QM-53 THROUGH QM-82 IN THE MAINSTREAM TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2015

Well	Statistic	pH	EC[1]	TDS[1]	TOC[1]	Cl^-	SO_4^{2-}	NH_3-N	Hardness	Fecal Coliform[2]
			mS/m	mg/L						MPN/100 mL
QM-64	Minimum	7.0	52	346	1	49	28	1.5	187	1
	Mean	7.3	64	384	1	60	38	1.7	201	93
	Maximum	7.6	78	418	2	79	44	1.8	219	8,400
	Std. Dev.	0.2	12	26	0.2	13	5	0.09	13	NA
	Median	7.3	60	389	1	53	38	1.7	197	22
	Coeff. of Var. (%)	2.9	18	7	12	21	14	5.6	7	NA
QM-66	Minimum	9.5	85	1,282	<1	165	216	0.18	9	<1
	Mean	9.6	145	1,321	<1	168	224	0.18	10	<1
	Maximum	9.7	205	1,360	<1	170	231	0.18	11	<1
	Std. Dev.	0.1	85	55	0.0	4	11	0.00	1	NA
	Median	9.6	145	1,321	<1	168	224	0.18	10	<1
	Coeff. of Var. (%)	1.3	58	4	0.0	2	5	0.00	14	NA
QM-67	Minimum	7.2	96	606	3	163	6	12	218	58
	Mean	7.4	123	718	4	292	12	13	261	201
	Maximum	7.6	148	908	5	615	29	15	327	780
	Std. Dev.	0.1	19	111	0.8	171	9	1	39	NA
	Median	7.4	126	707	4	229	8	13	256	320
	Coeff. of Var. (%)	1.8	15	15	20	58	73	9	15	NA
QM-68	Minimum	7.4	29	200	1	32	38	0.65	210	<1
	Mean	7.5	49	363	1	84	39	0.68	278	30
	Maximum	7.7	76	468	2	151	40	0.70	337	4,900
	Std. Dev.	0.1	20	143	0.3	44	1	0.03	64	NA
	Median	7.5	41	422	1	79	39	0.68	287	1,300
	Coeff. of Var. (%)	1.3	41	39	22	52	2	3.7	23	NA

TABLE 2 (Continued): DESCRIPTIVE STATISTICS FOR GROUNDWATER DATA OF MONITORING WELLS QM-53 THROUGH QM-82 IN THE MAINSTREAM TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2015

Well	Statistic	pH	EC[1]	TDS[1]	TOC[1]	Cl^-	SO_4^{2-}	NH_3-N	Hardness	Fecal Coliform[2]
			mS/m	mg/L						MPN/100 mL
QM-69	Minimum	7.5	42	274	1	35	38	0.82	149	<1
	Mean	7.9	46	290	1	36	40	0.86	152	<1
	Maximum	8.1	52	312	1	36	43	0.89	154	<1
	Std. Dev.	0.3	5	20	0.1	1	3	0.04	3	NA
	Median	8.0	45	284	1	36	38	0.87	152	<1
	Coeff. of Var. (%)	3.9	11	7	6	2	7	4.2	2	NA
QM-70	Minimum	7.3	36	280	<1	49	50	0.39	156	<1
	Mean	8.2	44	299	<1	50	56	0.39	158	<1
	Maximum	9.3	55	318	<1	50	63	0.40	160	<1
	Std. Dev.	1.0	10	19	0.0	1	7	0.01	2	NA
	Median	7.9	42	298	<1	50	53	0.39	157	<1
	Coeff. of Var. (%)	13	22	6	0.0	1	12	1.5	1	NA
QM-71	Minimum	7.6	46	432	<1	126	67	0.46	201	<1
	Mean	8.1	61	433	<1	127	72	0.46	204	<1
	Maximum	9.0	77	434	<1	128	78	0.46	209	1
	Std. Dev.	0.8	16	1	0.0	1	6	0.00	4	NA
	Median	7.7	59	432	<1	128	70	0.46	203	<1
	Coeff. of Var. (%)	9.8	26	0	0.0	1	8	0.00	2	NA
QM-72	Minimum	7.7	49	338	<1	123	<5	0.33	212	<1
	Mean	7.8	57	393	1	126	<5	0.37	222	<1
	Maximum	7.9	69	464	1	130	<5	0.39	234	<1
	Std. Dev.	0.1	10	65	0.0	4	0	0.03	11	NA
	Median	7.8	54	376	1	126	<5	0.38	219	<1
	Coeff. of Var. (%)	1.0	18	16	0.0	3	0	8.8	5	NA

TABLE 2 (Continued): DESCRIPTIVE STATISTICS FOR GROUNDWATER DATA OF MONITORING WELLS QM-53 THROUGH QM-82 IN THE MAINSTREAM TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2015

Well	Statistic	pH	EC[1]	TDS[1]	TOC[1]	Cl^-	SO_4^{2-}	NH_3-N	Hardness	Fecal Coliform[2]
			mS/m	mg/L						MPN/100 mL
QM-73	Minimum	7.3	30	228	<1	35	<5	0.22	151	<1
	Mean	8.0	39	243	1	35	7	0.28	155	<1
	Maximum	8.9	51	266	1	36	10	0.31	157	<1
	Std. Dev.	0.8	11	20	0.1	1	3	0.05	3	NA
	Median	7.7	37	236	1	35	5	0.30	156	<1
	Coeff. of Var. (%)	10	28	8	6	2	43	17.8	2	NA
QM-74	Minimum	7.4	34	196	1	58	<5	0.12	107	<1
	Mean	7.6	42	213	2	59	<5	0.19	112	<1
	Maximum	7.9	47	242	2	60	5	0.23	114	<1
	Std. Dev.	0.2	7	25	0.4	1	0	0.06	4	NA
	Median	7.6	45	200	2	59	5	0.22	114	<1
	Coeff. of Var. (%)	3.1	17	12	27	2	0	32	4	NA
QM-75	Minimum	6.9	27	158	<1	12	8	0.16	62	<1
	Mean	7.7	34	191	1	13	12	0.22	66	<1
	Maximum	8.7	38	216	1	17	18	0.27	70	<2
	Std. Dev.	0.7	5	27	0.0	2	4	0.04	3	NA
	Median	7.8	36	194	1	13	11	0.23	65	<1
	Coeff. of Var. (%)	9.5	15	14	0.0	15	33	20	4	NA
QM-76	Minimum	7.3	33	264	<1	12	50	0.20	51	<1
	Mean	7.5	45	297	1	13	65	0.24	60	<1
	Maximum	7.6	55	320	1	14	80	0.26	66	<1
	Std. Dev.	0.1	11	29	0.0	1	15	0.03	8	NA
	Median	7.5	49	308	1	12	64	0.25	63	<1
	Coeff. of Var. (%)	1.9	25	10	0.0	9	23	14	13	NA

TABLE 2 (Continued): DESCRIPTIVE STATISTICS FOR GROUNDWATER DATA OF MONITORING WELLS QM-53 THROUGH QM-82 IN THE MAINSTREAM TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2015

Well	Statistic	pH	EC[1]	TDS[1]	TOC[1]	Cl^-	SO_4^{2-}	NH_3-N	Hardness	Fecal Coliform[2]
			mS/m	mg/L						MPN/100 mL
QM-77	Minimum	7.3	20	118	<1	10	<5	0.13	44	<1
	Mean	7.4	23	131	<1	11	<5	0.13	46	6
	Maximum	7.7	25	152	<1	13	<5	0.13	48	33
	Std. Dev.	0.3	3	18	0.0	2	0	0.00	2	NA
	Median	7.3	24	124	<1	10	<5	0.13	45	7
	Coeff. of Var. (%)	3.5	12	14	0.0	16	0	0.00	5	NA
QM-78	Minimum	8.5	32	220	<1	10	40	<0.10	9	<1
	Mean	8.7	39	248	<1	10	42	0.11	10	<1
	Maximum	9.0	46	262	<1	11	47	0.16	11	1
	Std. Dev.	0.2	6	15	0.0	1	2	0.02	1	NA
	Median	8.6	39	251	<1	10	42	0.10	10	<1
	Coeff. of Var. (%)	1.9	16	6	0.0	5	6	22	8	NA
QM-79	Minimum	8.3	33	246	<1	14	15	<0.10	12	<1
	Mean	8.6	40	263	<1	15	18	0.10	13	<1
	Maximum	9.1	48	310	<1	16	19	0.16	14	<1
	Std. Dev.	0.3	6	24	0.0	1	1	0.01	1	NA
	Median	8.6	40	256	<1	15	18	0.10	14	<1
	Coeff. of Var. (%)	3.1	16	9	0.0	5	8	10	6	NA
QM-80	Minimum	8.0	23	126	<1	12	<5	<0.10	22	<1
	Mean	8.3	28	169	<1	12	<5	<0.10	22	<1
	Maximum	8.8	32	228	<1	13	<5	<0.10	22	<1
	Std. Dev.	0.3	4	34	0.0	1	0	0.00	0	NA
	Median	8.3	30	163	<1	12	<5	<0.10	22	<1
	Coeff. of Var. (%)	3.7	12	20	0.0	4	0	0.00	0	NA

TABLE 2 (Continued): DESCRIPTIVE STATISTICS FOR GROUNDWATER DATA OF MONITORING WELLS QM-53 THROUGH QM-82 IN THE MAINSTREAM TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2015

Well	Statistic	pH	EC[1]	TDS[1]	TOC[1]	Cl^-	SO_4^{2-}	NH_3-N	Hardness	Fecal Coliform[2]
			mS/m	mg/L						MPN/100 mL
QM-81	Minimum	8.1	30	204	<1	20	10	<0.10	32	<1
	Mean	8.3	33	227	<1	20	12	0.13	34	<1
	Maximum	8.4	37	266	<1	20	13	0.16	36	<1
	Std. Dev.	0.1	3	34	0.0	0.0	2	0.04	2	NA
	Median	8.3	32	212	<1	20	11	0.13	34	1
	Coeff. of Var. (%)	1.5	11	15	0.0	0.0	15	33	6	NA
QM-82	Minimum	8.1	32	198	<1	27	6	<0.10	16	<1
	Mean	8.4	39	249	1	29	17	<0.10	17	<1
	Maximum	9.0	47	268	1	30	38	<0.10	18	<1
	Std. Dev.	0.3	6	26	0.0	1	12	0.00	1	NA
	Median	8.4	39	258	1	29	11	<0.10	16	<1
	Coeff. of Var. (%)	3.8	15	11	0.0	4	72	0.00	5	NA

[1]EC = electrical conductivity; TDS = total dissolved solids; TOC = total dissolved organic carbon.

[2]Geometric mean calculated.

[3]Not applicable.

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 2015

	Observation Well No.										
Date[1]	OM-1	OM-2	OM-3	OM-4	OM-5	OM-6	OM-7	OM-8	OM-9	OM-10	OM-11
	Elevation (ft)[2]										
01/23/15	NA[3]	-21	-49	-88	-71	-37	-65	-50	-35	NA	-54
02/06/15	NA	NA	NA	-90	-70	NA	NA	-54	NA	NA	NA
03/13/15	-49	-41	-47	-90	-71	-39	-68	-54	-36	-29	NA
04/24/15	NA	-40	-52	-89	-71	-41	-67	-54	-38	NA	-55
05/08/15	-49	-40	-45	-90	-70	-36	-66	-53	-36	-29	-55
06/19/15	-47	-38	-45	-89	-70	-36	-66	-53	-37	-28	-55
07/31/15	-45	-36	-44	-89	-70	-38	-66	-74	-35	-30	-56
08/31/15	-44	-38	-44	-87	-71	NA	-67	-72	-35	-30	-57
09/30/15	-48	-40	NA	-88	-71	NA	-64	-55	-35	-29	-57
10/23/15	NA	-40	-45	-89	-70	-45	-66	-55	-36	-29	-56
11/25/15	NA	-38	-42	-87	-68	-47	-68	-53	-35	-28	-54
12/11/15	NA	-40	-44	-88	-69	-40	-65	-52	-35	-28	-56

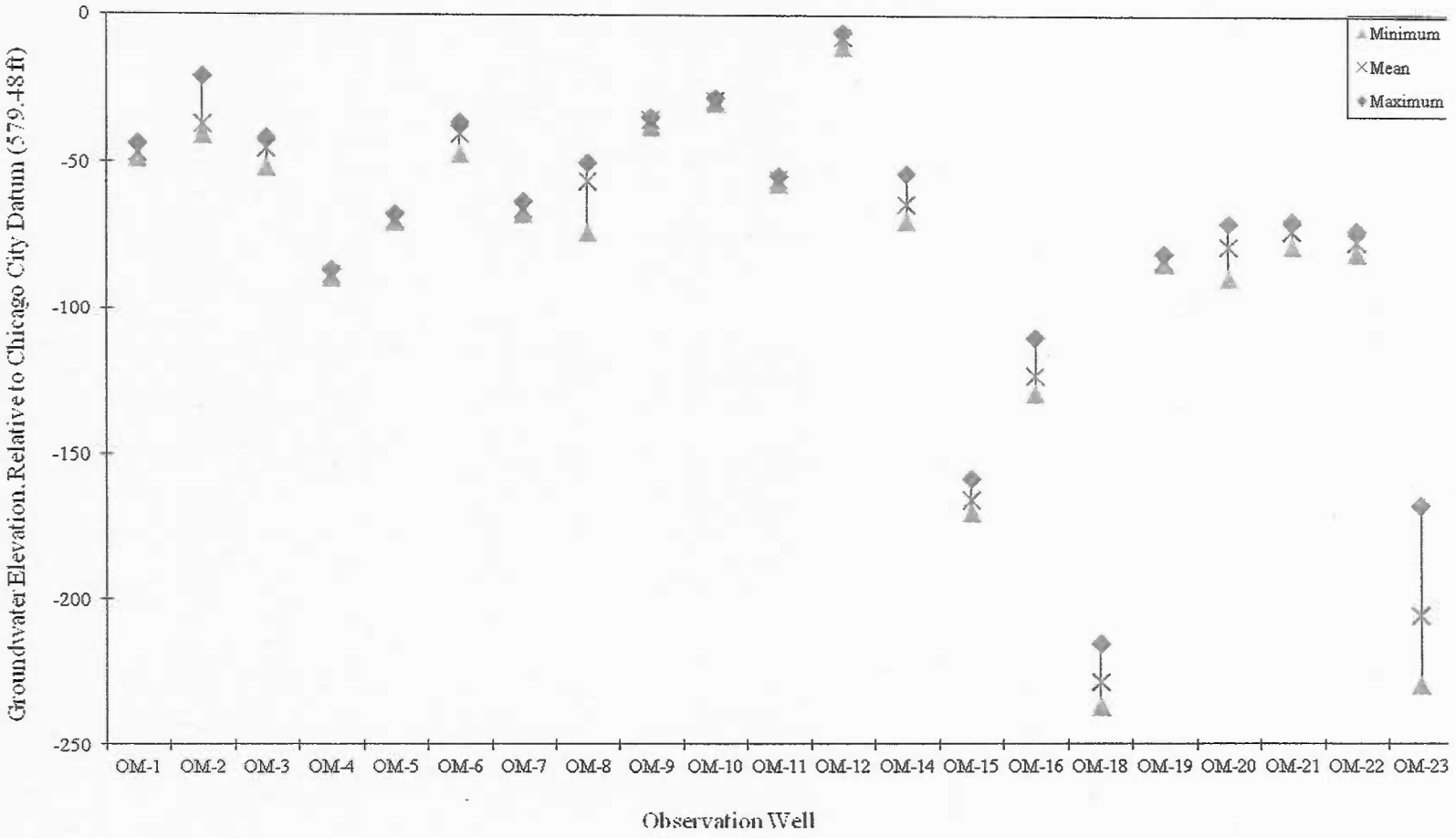
TABLE 3 (Continued): GROUNDWATER ELEVATIONS FOR OBSERVATION WELLS OM-1 THROUGH OM-23 IN THE MAINSTREAM TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN MEASURED DURING 2015

Date[1]	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 (ft)[2]										
01/16/15	NA	NA	-68	-167	-129	-233	NA	-80	-76	-79	-229
02/27/15	NA	NA	NA	-165	-128	-231	-82	-79	-74	-81	-230
03/27/15	-11	NA	-67	-168	-130	-231	-85	-81	-75	-77	-223
04/03/15	NA	NA	-68	-170	-130	-231	-85	-73	-79	-80	-199
05/22/15	NA	NA	-68	-170	-123	-226	-85	-75	-73	-77	-205
06/26/15	-7.7	NA	-69	-168	-119	-224	NA	-73	-71	-75	-207
07/10/15	NA	NA	-66	-167	-120	-215	NA	-71	-71	-75	-213
08/21/15	-5.7	NA	-56	-165	-111	-229	NA	-76	-73	-76	-168
09/18/15	-6.7	NA	-54	-162	-120	-227	NA	-83	-73	-76	-192
10/02/15	NA	NA	-55	-158	-122	-224	NA	-76	-70	-73	-190
11/13/15	NA	NA	-69	-163	-128	-234	NA	-89	-75	-78	-209
12/04/15	NA	NA	-70	-164	-126	-237	NA	-90	-73	-75	-210

[1]Date measurements were taken.
[2]Relative to Chicago city datum (579.48' above mean sea level) at intersection of State and Madison Streets.
[3]No reading. Well inaccessible due to closure of business, locked gates, snow accumulation, or heavy truck traffic; OM-13 broken. .

elevations were calculated relative to the Chicago city datum (579.48 ft above mean sea level) at the intersection of Madison and State Streets (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). Generally, these fluctuations appeared to be minimal throughout the year. However, OM-2, -8, -18, and -23 appeared to experience significant fluctuations of 20, 24, 22, and 62 ft, respectively, during the year, which could indicate the possibility of exfiltration during the year .

FIGURE 3: MINIMUM, MEAN, AND MAXIMUM WATER ELEVATIONS FOR OBSERVATION WELLS OM-1 THROUGH OM-23 IN THE MAINSTREAM TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN MEASURED DURING 2015



APPENDIX A

DECEMBER 16, 2011, LETTER FROM THE ILLINOIS ENVIRONMENTAL PROTECTION AGENCY TO THE METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO AUTHORIZING ABANDONMENT OF OBSERVATION WELL OM-17 IN THE MAINSTREAM TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

1021 NORTH GRAND AVENUE EAST, P.O. BOX 19276, SPRINGFIELD, ILLINOIS 62794-9276 • (217) 782-3397
PAT QUINN, GOVERNOR JOHN J. KIM, INTERIM DIRECTOR

217/785-4787

December 16, 2011

Dear Dr. Granato, Director
Monitoring and Research
Metropolitan Water Reclamation District of Greater Chicago
100 East Erie Street
Chicago, IL 60611-3154

The purpose of this letter is to respond to the letter sent to Marcia Willhite, Chief of the Bureau of Water (BOW). Ms. Willhite requested on December 12, 2011 that the Groundwater Section review and respond to your request to abandon groundwater observation well OM 17.

Accordingly, the Groundwater Section, Division of Public Water Supplies, BOW has reviewed and approves of your request to properly abandon groundwater observation well OM 17.

I trust that this will meet you needs should you have any further questions or concerns please feel free to contact me or Bill Buscher, Manager, Hydrogeology and Compliance Unit, Groundwater Section at 217/785-4787.

Sincerely,

Richard P. Cobb, P.G.
Deputy Division Manager
Division of Public Water Supplies
Bureau of Water

DIRECTOR OF ...ER
2011 DEC 22 PM 4:01
...CHGO.

4302 N. Main St., Rockford, IL 61103 (815)987-7760
595 S. State, Elgin, IL 60123 (847)608-3131
2125 S. First St., Champaign, IL 61820 (217)278-5800
2009 Mall St., Collinsville, IL 62234 (618)346-5120

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