

*Protecting Our Water Environment*



*Metropolitan Water Reclamation District of Greater Chicago*

***MONITORING AND RESEARCH  
DEPARTMENT***

*REPORT NO. 12-29*

*TUNNEL AND RESERVOIR PLAN*

*MAINSTREAM TUNNEL SYSTEM*

*2011 ANNUAL GROUNDWATER MONITORING REPORT*

*July 2012*

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July 11, 2012

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

Dear Ms. Willhite:

Subject: Tunnel and Reservoir Plan, Mainstream Tunnel System, 2011 Annual  
Groundwater Monitoring Report

Enclosed are three copies of "Tunnel and Reservoir Plan, Mainstream Tunnel System,  
2011 Annual Groundwater Monitoring Report."

Very truly yours,

Thomas C. Granato, Ph.D.  
Director  
Monitoring and Research

TCG:DGM:lf

Enclosures

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TUNNEL AND RESERVOIR PLAN  
MAINSTREAM TUNNEL SYSTEM  
2011 ANNUAL GROUNDWATER MONITORING REPORT

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## 2011 MONITORING RESULTS

### Introduction

This report contains 2011 data for the Tunnel and Reservoir Plan Mainstream Tunnel System compiled from monitoring of groundwater elevations in observation wells, and monitoring of groundwater quality and other pertinent data in monitoring wells. The observation wells are all monitored once every two months while the monitoring wells are monitored at varying frequencies. Monitoring wells QM-53, QM-56, QM-58, QM-61, QM-66, QM-68 through QM-74, QM-76, QM-77, and QM-81 are sampled three times per year (Illinois Environmental Protection Agency [IEPA] memoranda July 9, 2004, and February 23, 2006). Monitoring wells QM-62 through QM-65, QM-67, QM-75, QM-78 through QM-80, and QM-82 are sampled six times per year (IEPA memorandum July 9, 2004). Sampling of monitoring wells QM-51, QM-52, QM-54, QM-55, QM-57, and QM-60 was discontinued with the approval of the IEPA (memorandum dated May 4, 1994). Monitoring well QM-59 has been dry since February 1995 and is no longer being monitored. The observation and monitoring wells are located along the length of the Mainstream Tunnel System between Morton Grove and Hodgkins, Illinois. Observation well OM-17 is no longer being sampled because the well is broken, and groundwater elevations can no longer be measured. The IEPA gave the Metropolitan Water Reclamation District of Greater Chicago permission to abandon this well in a letter dated December 16, 2011 ([Appendix V](#)).

### Monitoring Data

[Appendix AI](#) contains a location map of observation wells OM-1 through OM-16 and OM-18 through OM-23 located along the Mainstream Tunnel System.

[Table AII-1](#) in [Appendix AII](#) contains groundwater elevation data for the year 2011 for observation wells OM-1 through OM-16 and OM-18 through OM-23 located along the Mainstream Tunnel System. [Table AII-1](#) also contains the yearly minimum, mean, and maximum groundwater elevations of each observation well.

[Appendix AIII](#) contains a location map of monitoring wells QM-53 through QM-82 located along the Mainstream Tunnel System.

[Tables AIV-1](#) and [AIV-2](#) in [Appendix AIV](#) contain groundwater quality data for the year 2011 pertaining to monitoring wells QM-53, QM-56, QM-58, and QM-61 through QM-82 located along the Mainstream Tunnel System. Ten groundwater quality parameters were monitored: chloride (Cl), conductivity (Cond.), fecal coliform (FC), hardness (Hard.) as calcium carbonate (CaCO<sub>3</sub>), ammonia nitrogen (NH<sub>3</sub>-N), pH, sulfate (SO<sub>4</sub>), total dissolved solids (TDS), total organic carbon (TOC), and temperature (Temp.). Groundwater elevation in each monitoring well as measured at the time of sampling and the recharge time after initial drawdown are also provided in [Table AIV-2](#).

All of the monitoring wells in the Mainstream system were visited for the required number of samples. However, in some instances samples from specific monitoring wells could not

be collected for various reasons. Monitoring wells QM-56 and QM-58 could not be sampled during 2011, because construction in the area blocked access to both wells. Monitoring wells QM-62, QM-65, QM-66, and QM-82 could not be sampled during 2011, because the pumps were inoperable. Work orders have been issued to repair all of the pumps.

## Summary of Data

**Observation Well Groundwater Elevation Data.** In Figure 1, the 2011 groundwater elevation data for observation wells OM-1 through OM-16 and OM-18 through OM-23 of the Mainstream Tunnel System have been plotted. In this figure, minimum, mean, and maximum groundwater elevations of all the observation wells are plotted to show fluctuations in groundwater elevations during 2011. Table AII-1 in Appendix AII contains the groundwater elevation data for the year 2011 for the observation wells located in the Mainstream Tunnel System.

**Monitoring Well Data.** Tables 1 through 4 contain summary statistics of the groundwater quality parameters for the year 2011 for the monitoring wells in the Mainstream Tunnel System. These statistics are computed from the 2011 data collected from each monitoring well. The summary statistics include minimum, mean, maximum, standard deviation (Stdv), median, and coefficient of variation (COV) for eight groundwater quality parameters analyzed during 2011. These eight water quality parameters are Cl, Cond., Hard., NH<sub>3</sub>-N, pH, SO<sub>4</sub>, TDS, and TOC. For a ninth parameter, FC, the summary statistics include minimum, geometric mean (Geo. Mean), maximum, and median. The statistical analyses of the data were conducted using Microsoft<sup>®</sup> Excel functions.



FIGURE 1: 2011 MINIMUM, MEAN, AND MAXIMUM GROUNDWATER ELEVATIONS FOR THE MAINSTREAM TUNNEL SYSTEM OBSERVATION WELLS

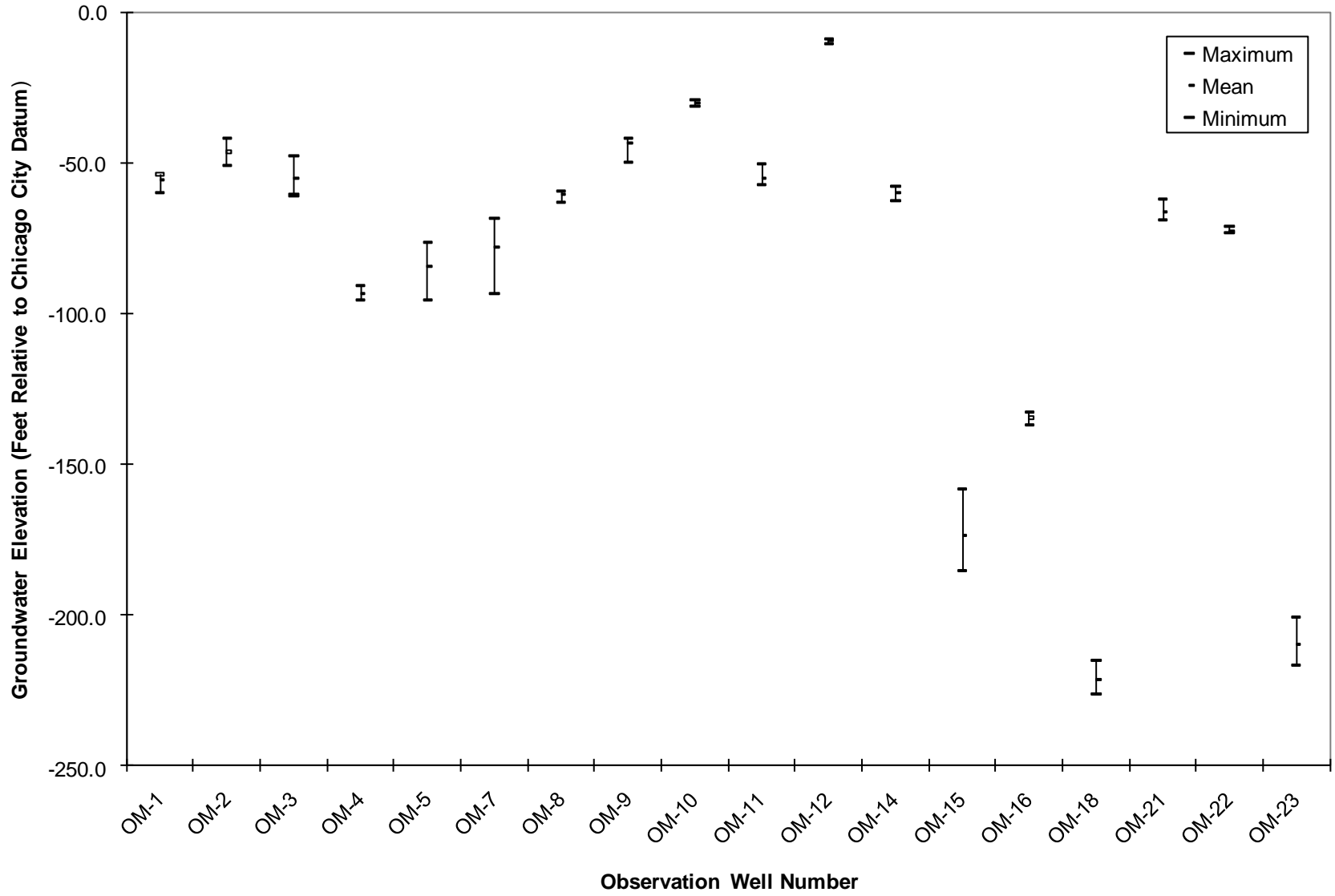


TABLE 1: GROUNDWATER QUALITY SUMMARY STATISTICS OF THE 2011 DATA FOR THE MONITORING WELLS IN THE MAINSTREAM TUNNEL SYSTEM: MONITORING WELLS QM-53, QM-61, QM-63, QM-64, AND QM-67

Parameter <sup>1</sup>		Monitoring Well Number				
		QM-53	QM-61	QM-63	QM-64	QM-67
Cl mg/L	Minimum	13	46	50	49	149
	Mean	22	51	55	55	199
	Maximum	35	60	68	65	249
	Stdv	12	8	7	6	41
	Median	17	46	53	54	199
	COV	54	16	12	11	20
FC CFU/100 mL	Minimum	1	1	2	1	45
	Geo. Mean	1	112	89	8	183
	Maximum	1	20,000	20,000	38	350
	Median	1	70	191	17	240
SO <sub>4</sub> mg/L	Minimum	33	15	506	24	15
	Mean	36	20	831	35	15
	Maximum	39	25	968	43	15
	Stdv	3	5	183	6	0
	Median	35	20	904	35	15
	COV	10	24	22	18	0
NH <sub>3</sub> -N mg/L	Minimum	0.10	0.32	1.74	1.63	9.74
	Mean	0.10	0.39	1.96	1.86	10.37
	Maximum	0.10	0.44	2.10	2.02	11.61
	Stdv	0.00	0.06	0.13	0.14	0.78
	Median	0.10	0.41	1.98	1.88	9.93
	COV	0.00	16.01	6.65	7.68	7.56
TOC mg/L	Minimum	1.0	1.0	1.4	1.3	1.0
	Mean	1.8	1.3	2.6	1.5	2.6
	Maximum	3.5	2.0	3.7	1.5	3.3
	Stdv	1.4	0.6	0.8	0.1	0.9
	Median	1.0	1.0	2.6	1.5	3.0
	COV	78.7	43.3	30.5	5.6	35.6

TABLE 1 (Continued): GROUNDWATER QUALITY SUMMARY STATISTICS OF THE 2011 DATA FOR THE MONITORING WELLS IN THE MAINSTREAM TUNNEL SYSTEM: MONITORING WELLS QM-53, QM-61, QM-63, QM-64, AND QM-67

Parameter <sup>1</sup>	Monitoring Well Number					
	QM-53	QM-61	QM-63	QM-64	QM-67	
TDS mg/L	Minimum	190	288	1,534	370	598
	Mean	241	321	1,777	426	677
	Maximum	330	378	2,004	458	768
	Stdv	78	50	153	30	68
	Median	202	296	1,782	432	678
	COV	32	16	9	7	10
Hard. mg/L	Minimum	134	116	632	189	218
	Mean	137	121	909	207	244
	Maximum	140	125	988	223	273
	Stdv	3	5	138	11	25
	Median	137	123	962	206	243
	COV	2	4	15	6	10
Cond. µmhos/cm	Minimum	212	299	645	429	749
	Mean	216	358	941	513	821
	Maximum	220	433	1,245	711	1,024
	Stdv	4	69	201	106	105
	Median	216	341	918	491	779
	COV	2	19	21	21	13
pH unit	Minimum	8.0	7.2	7.0	7.5	7.1
	Mean	8.1	7.4	7.4	7.6	7.5
	Maximum	8.3	7.6	7.8	7.8	8.6
	Stdv	0.1	0.2	0.3	0.1	0.5
	Median	8.1	7.3	7.3	7.6	7.4
	COV	1.6	3.2	4.3	1.7	7.0

<sup>1</sup>For purpose of statistical evaluation, any value less than the appropriate limit of quantification (LOQ) was set equal to the value of the LOQ. Additionally, any FC concentration lower than the lower detection limit was set equal to the lower detection limit, and any FC concentration greater than the upper detection limit was set equal to the upper detection limit.

TABLE 2: GROUNDWATER QUALITY SUMMARY STATISTICS OF THE 2011 DATA FOR THE MONITORING WELLS IN THE MAINSTREAM TUNNEL SYSTEM: MONITORING WELLS QM-68 THROUGH QM-72

Parameter <sup>1</sup>		Monitoring Well Number				
		QM-68	QM-69	QM-70	QM-71	QM-72
Cl mg/L	Minimum	28	36	48	48	121
	Mean	29	36	51	102	131
	Maximum	29	36	55	131	139
	Stdv	1	0	4	47	9
	Median	29	36	49	128	133
	COV	2	0	7	46	7
FC CFU/100 mL	Minimum	1	1	1	1	1
	Geo. Mean	21	1	1	1	1
	Maximum	100	1	1	1	1
	Median	92	1	1	1	1
SO <sub>4</sub> mg/L	Minimum	32	40	51	53	15
	Mean	36	42	52	62	15
	Maximum	38	44	53	68	15
	Stdv	3	2	1	8	0
	Median	37	41	53	65	15
	COV	8	5	1	12	0
NH <sub>3</sub> -N mg/L	Minimum	0.52	0.84	0.37	0.24	0.25
	Mean	0.55	0.87	0.44	0.34	0.31
	Maximum	0.61	0.89	0.57	0.43	0.35
	Stdv	0.05	0.03	0.11	0.10	0.05
	Median	0.53	0.89	0.39	0.34	0.33
	COV	8.91	3.31	24.85	28.23	17.07
TOC mg/L	Minimum	1.0	1.1	1.0	1.0	1.0
	Mean	1.0	1.2	1.0	1.0	1.0
	Maximum	1.0	1.3	1.1	1.0	1.0
	Stdv	0.0	0.1	0.1	0.0	0.0
	Median	1.0	1.3	1.0	1.0	1.0
	COV	0.0	9.4	5.6	0.0	0.0

TABLE 2 (Continued): GROUNDWATER QUALITY SUMMARY STATISTICS OF THE 2011 DATA FOR THE MONITORING WELLS IN THE MAINSTREAM TUNNEL SYSTEM: MONITORING WELLS QM-68 THROUGH QM-72

Parameter <sup>1</sup>		Monitoring Well Number				
		QM-68	QM-69	QM-70	QM-71	QM-72
TDS mg/L	Minimum	296	290	320	314	346
	Mean	321	305	328	426	398
	Maximum	344	326	340	518	466
	Stdv	24	19	11	103	62
	Median	324	298	324	446	382
	COV	8	6	3	24	15
Hard. mg/L	Minimum	186	149	155	159	215
	Mean	188	154	158	182	217
	Maximum	190	158	161	195	219
	Stdv	2	5	3	20	2
	Median	188	154	157	191	216
	COV	1	3	2	11	1
Cond. µmhos/cm	Minimum	280	317	367	487	331
	Mean	304	359	396	631	392
	Maximum	323	411	443	895	424
	Stdv	22	48	41	229	54
	Median	310	349	377	511	422
	COV	7	13	10	36	14
pH unit	Minimum	7.2	7.8	7.6	7.7	7.6
	Mean	7.5	8.0	7.7	7.8	7.7
	Maximum	7.9	8.2	7.8	8.0	7.8
	Stdv	0.4	0.2	0.1	0.2	0.1
	Median	7.5	8.1	7.6	7.8	7.8
	COV	4.7	2.9	1.7	2.1	1.4

<sup>1</sup>For purpose of statistical evaluation, any value less than the appropriate limit of quantification (LOQ) was set equal to the value of the LOQ. Additionally, any FC concentration lower than the lower detection limit was set equal to the lower detection limit, and any FC concentration greater than the upper detection limit was set equal to the upper detection limit.

TABLE 3: GROUNDWATER QUALITY SUMMARY STATISTICS OF THE 2011 DATA FOR THE MONITORING WELLS IN THE MAINSTREAM TUNNEL SYSTEM: MONITORING WELLS QM-73 THROUGH QM-77

Parameter <sup>1</sup>		Monitoring Well Number				
		QM-73	QM-74	QM-75	QM-76	QM-77
Cl mg/L	Minimum	32	48	10	10	10
	Mean	34	51	13	11	10
	Maximum	36	54	15	12	11
	Stdv	2	3	2	1	1
	Median	35	52	13	10	10
	COV	6	6	13	11	6
FC CFU/100 mL	Minimum	1	1	1	1	5
	Geo. Mean	1	1	2	3	63
	Maximum	1	1	20	19	730
	Median	1	1	1	1	70
SO <sub>4</sub> mg/L	Minimum	15	15	15	60	15
	Mean	15	15	15	69	15
	Maximum	15	15	15	85	15
	Stdv	0	0	0	14	0
	Median	15	15	15	61	15
	COV	0	0	0	21	0
NH <sub>3</sub> -N mg/L	Minimum	0.15	0.12	0.10	0.10	0.10
	Mean	0.19	0.17	0.22	0.15	0.11
	Maximum	0.26	0.22	0.28	0.18	0.12
	Stdv	0.06	0.05	0.07	0.04	0.01
	Median	0.16	0.18	0.25	0.17	0.11
	COV	32.01	29.04	30.65	29.06	9.09
TOC mg/L	Minimum	1.1	1.4	1.0	1.0	1.0
	Mean	1.2	1.5	1.0	1.0	1.0
	Maximum	1.3	1.6	1.0	1.1	1.0
	Stdv	0.1	0.1	0.0	0.1	0.0
	Median	1.2	1.4	1.0	1.0	1.0
	COV	8.3	7.9	0.0	5.6	0.0

TABLE 3 (Continued): GROUNDWATER QUALITY SUMMARY STATISTICS OF THE 2011 DATA FOR THE MONITORING WELLS IN THE MAINSTREAM TUNNEL SYSTEM: MONITORING WELLS QM-73 THROUGH QM-77

Parameter <sup>1</sup>		Monitoring Well Number				
		QM-73	QM-74	QM-75	QM-76	QM-77
TDS mg/L	Minimum	268	242	202	334	150
	Mean	274	258	237	370	185
	Maximum	284	286	316	432	248
	Stdv	9	24	41	54	55
	Median	270	246	224	344	156
	COV	3	9	17	15	30
Hard. mg/L	Minimum	146	100	59	62	41
	Mean	151	101	63	67	42
	Maximum	154	102	70	70	43
	Stdv	5	1	4	4	1
	Median	154	101	62	68	42
	COV	3	1	6	6	2
Cond. µmhos/cm	Minimum	323	298	243	326	190
	Mean	369	337	284	403	205
	Maximum	444	404	333	511	228
	Stdv	66	58	37	96	20
	Median	341	308	284	372	197
	COV	18	17	13	24	10
pH unit	Minimum	7.5	7.8	7.3	7.7	7.1
	Mean	7.8	8.0	7.7	7.9	7.8
	Maximum	8.1	8.1	8.1	8.4	8.3
	Stdv	0.3	0.2	0.3	0.4	0.7
	Median	7.9	8.1	7.8	7.8	8.1
	COV	3.6	2.3	3.9	4.6	8.4

<sup>1</sup>For purpose of statistical evaluation, any value less than the appropriate limit of quantification (LOQ) was set equal to the value of the LOQ. Additionally, any FC concentration lower than the lower detection limit was set equal to the lower detection limit, and any FC concentration greater than the upper detection limit was set equal to the upper detection limit.

TABLE 4: GROUNDWATER QUALITY SUMMARY STATISTICS OF THE 2011 DATA  
FOR THE MONITORING WELLS IN THE MAINSTREAM TUNNEL SYSTEM:  
MONITORING WELLS QM-78 THROUGH QM-81

Parameter <sup>1</sup>		Monitoring Well Number			
		QM-78	QM-79	QM-80	QM-81
Cl mg/L	Minimum	10	15	10	17
	Mean	18	16	13	18
	Maximum	55	17	14	20
	Stdv	18	1	2	2
	Median	11	17	13	18
	COV	99	6	13	8
FC CFU/100 mL	Minimum	1	1	1	1
	Geo. Mean	1	1	1	1
	Maximum	6	11	6	2
	Median	1	1	1	1
SO <sub>4</sub> mg/L	Minimum	39	15	15	15
	Mean	44	17	15	15
	Maximum	49	19	15	15
	Stdv	4	1	0	0
	Median	44	17	15	15
	COV	9	8	0	0
NH <sub>3</sub> -N mg/L	Minimum	0.10	0.10	0.10	0.10
	Mean	0.10	0.10	0.10	0.10
	Maximum	0.10	0.10	0.10	0.10
	Stdv	0.00	0.00	0.00	0.00
	Median	0.10	0.10	0.10	0.10
	COV	0.00	0.00	0.00	0.00
TOC mg/L	Minimum	1.0	1.0	1.0	1.0
	Mean	1.0	1.0	1.0	1.0
	Maximum	1.0	1.0	1.2	1.0
	Stdv	0.0	0.0	0.1	0.0
	Median	1.0	1.0	1.0	1.0
	COV	0.0	0.0	7.9	0.0



TABLE 4 (Continued): GROUNDWATER QUALITY SUMMARY STATISTICS OF THE 2011 DATA FOR THE MONITORING WELLS IN THE MAINSTREAM TUNNEL SYSTEM: MONITORING WELLS QM-78 THROUGH QM-81

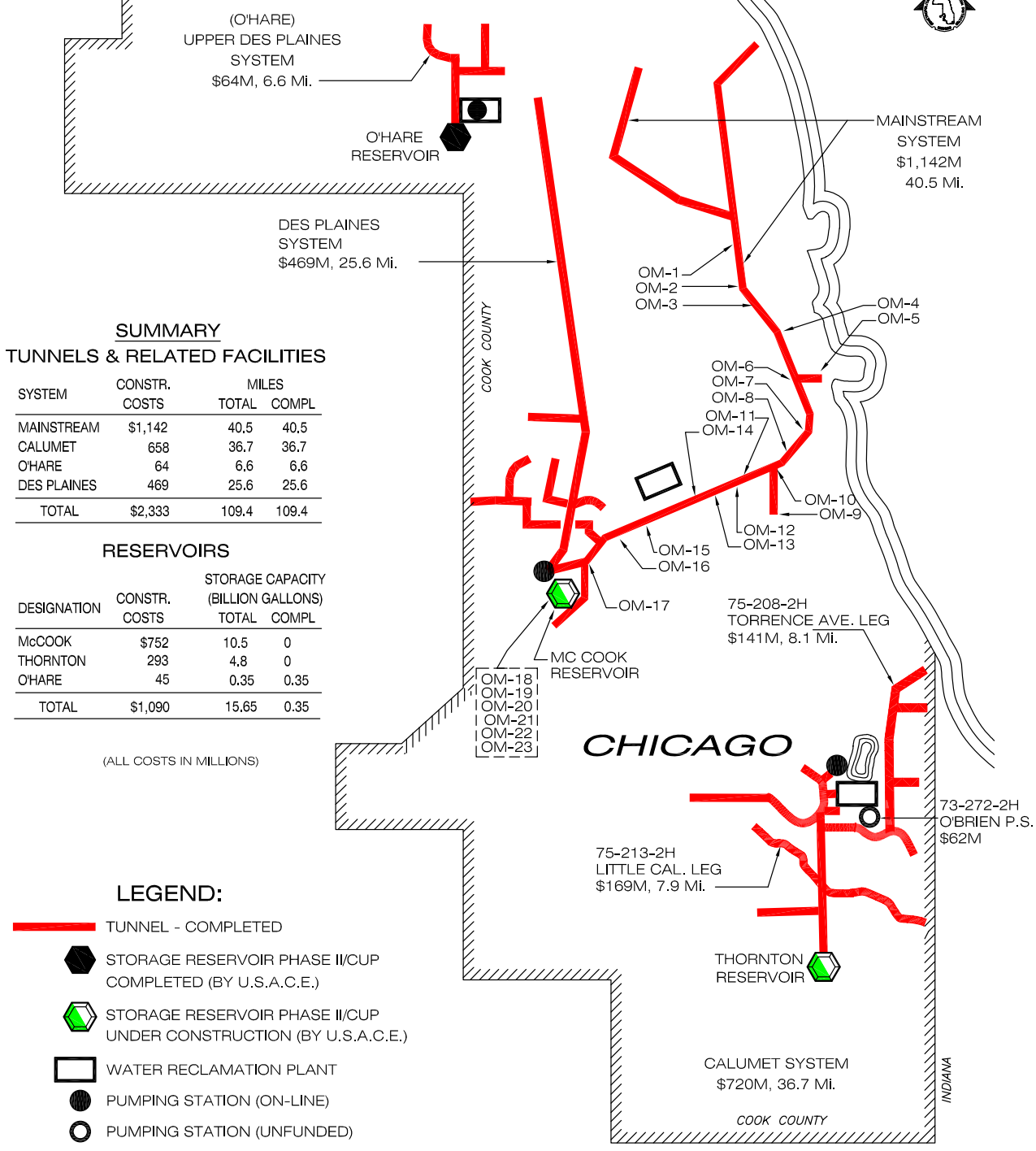
Parameter <sup>1</sup>		Monitoring Well Number			
		QM-78	QM-79	QM-80	QM-81
TDS mg/L	Minimum	276	268	174	222
	Mean	314	316	202	257
	Maximum	390	428	280	320
	Stdv	46	57	39	55
	Median	298	297	190	228
	COV	15	18	19	21
Hard. mg/L	Minimum	10	9	21	30
	Mean	11	11	21	33
	Maximum	12	12	22	35
	Stdv	1	1	0	3
	Median	10	11	21	33
	COV	8	10	2	8
Cond. µmhos/cm	Minimum	296	283	224	275
	Mean	337	341	240	289
	Maximum	404	397	276	318
	Stdv	37	36	20	25
	Median	334	343	234	275
	COV	11	11	8	9
pH unit	Minimum	8.3	8.5	7.9	8.0
	Mean	8.6	8.7	8.1	8.1
	Maximum	9.1	9.1	8.4	8.2
	Stdv	0.3	0.2	0.2	0.1
	Median	8.6	8.7	8.1	8.2
	COV	3.3	2.1	2.5	1.7

<sup>1</sup>For purpose of statistical evaluation, any value less than the appropriate limit of quantification (LOQ) was set equal to the value of the LOQ. Additionally, any FC concentration lower than the lower detection limit was set equal to the lower detection limit, and any FC concentration greater than the upper detection limit was set equal to the upper detection limit.

**APPENDIX AI**

**LOCATION MAP OF OBSERVATION WELLS OM-1 THROUGH OM-16 AND OM-18  
THROUGH OM-23 IN THE MAINSTREAM TUNNEL SYSTEM**

FIGURE AI-1



**MAINSTREAM TUNNEL SYSTEM LOCATION  
MAP OF OBSERVATION WELLS**

METROPOLITAN WATER RECLAMATION  
DISTRICT OF GREATER CHICAGO

APPENDIX AII

2011 GROUNDWATER ELEVATION DATA FOR OBSERVATION WELLS OM-1 THROUGH  
OM-16 AND OM-18 THROUGH OM-23 IN THE MAINSTREAM TUNNEL SYSTEM

TABLE AII-1: 2011 GROUNDWATER ELEVATION\* DATA FOR OBSERVATION WELLS OM-1 THROUGH OM-16  
AND OM-18 THROUGH OM-23 IN THE MAINSTREAM TUNNEL SYSTEM

Date	Observation Well Number										
	OM-1	OM-2	OM-3	OM-4	OM-5	OM-6	OM-7	OM-8	OM-9	OM-10	OM-11
1/7/11	-55.8	-45.7	-49.7	-95.6	-80.5	-40.4	-76.6	-61.2	-42.8	-31.0	-55.4
3/11/11	-54.8	-47.7	-60.7	-90.6	-82.5	-42.4	-76.6	-60.2	-42.8	**	-57.4
5/20/11	-53.8	-41.7	-47.7	-93.6	-76.5	-42.4	-68.6	-59.2	-41.8	**	-50.4
7/22/11	**	-47.7	-60.7	-92.6	-95.5	-40.4	-76.6	-59.2	-41.8	**	-55.4
9/23/11	-53.8	-44.7	-52.7	-93.6	-80.5	-45.4	-76.6	-59.2	-41.8	-30.0	-57.4
11/4/11	-59.8	-50.7	-59.7	-95.6	-90.5	-54.4	-93.6	-63.2	-49.8	-29.0	-55.4
Minimum	-59.8	-50.7	-60.7	-95.6	-95.5	-54.4	-93.6	-63.2	-49.8	-31.0	-57.4
Mean	-55.6	-46.4	-55.2	-93.6	-84.3	-44.2	-78.1	-60.4	-43.5	-30.0	-55.2
Maximum	-53.8	-41.7	-47.7	-90.6	-76.5	-40.4	-68.6	-59.2	-41.8	-29.0	-50.4

TABLE AII-1 (Continued): 2011 GROUNDWATER ELEVATION\* DATA FOR OBSERVATION WELLS OM-1 THROUGH OM-16 AND OM-18 THROUGH OM-23 IN THE MAINSTREAM TUNNEL SYSTEM

Date	Observation Well Number										
	OM-12	OM-13	OM-14	OM-15	OM-16	OM-18	OM-19	OM-20	OM-21	OM-22	OM-23
1/7/11	-8.7	41.4	-58.8	-185.3	-132.7	-222.0	-86.5	-95.9	-68.9	-72.3	-214.7
3/11/11	-9.7	41.4	-59.8	-176.3	-134.7	-220.0	-84.5	-79.9	-61.9	-73.3	-200.7
5/20/11	-9.7	***	**	-164.3	-133.7	-215.0	-82.5	-78.9	-62.9	-73.3	-209.7
7/22/11	-8.7	***	-62.8	-178.3	-134.7	-224.0	****	-73.9	-67.9	-71.3	-211.7
9/23/11	*****	41.4	-57.8	-158.3	-134.7	-222.0	****	-75.9	-68.9	-73.3	-205.7
11/4/11	-10.7	***	-60.8	-180.3	-136.7	-226.0	****	-103.9	-67.9	-72.3	-216.7
Minimum	-10.7	41.4	-62.8	-185.3	-136.7	-226.0	-86.5	-103.9	-68.9	-73.3	-216.7
Mean	-9.5	41.4	-60.0	-173.8	-134.5	-221.5	-84.5	-84.7	-66.4	-72.6	-209.9
Maximum	-8.7	41.4	-57.8	-158.3	-132.7	-215.0	-82.5	-73.9	-61.9	-71.3	-200.7

\*Elevation in feet relative to Chicago City Datum.

\*\*No access due to locked gate.

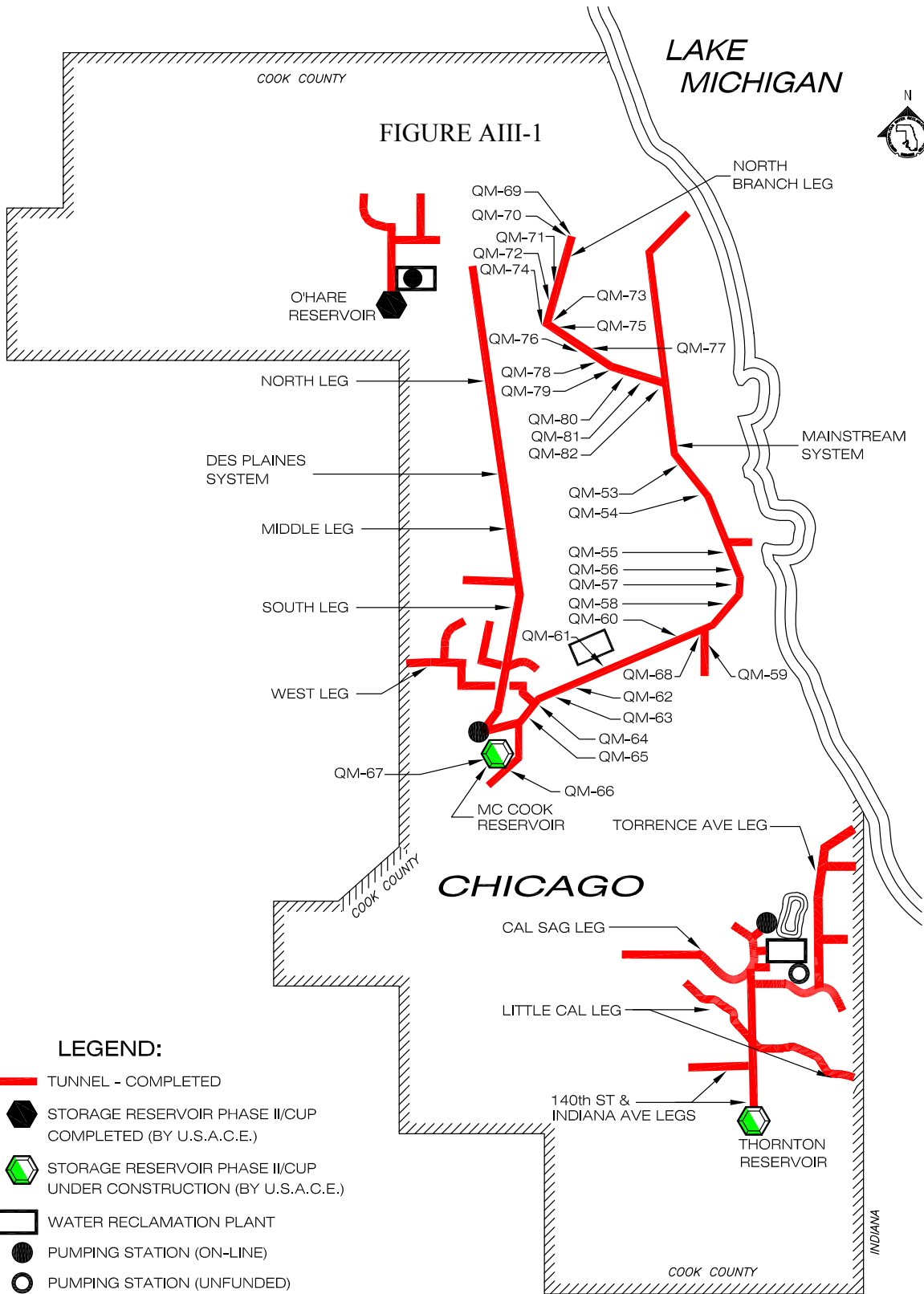
\*\*\*Unable to take reading.

\*\*\*\*Natural prairie blocked access to well.

\*\*\*\*\*No access due to construction traffic.

APPENDIX AIII

LOCATION MAP OF MONITORING WELLS QM-53 THROUGH QM-82 IN THE  
MAINSTREAM TUNNEL SYSTEM



**MAINSTREAM TUNNEL SYSTEM LOCATION  
MAP OF MONITORING WELLS**

METROPOLITAN WATER RECLAMATION  
DISTRICT OF GREATER CHICAGO



APPENDIX AIV

2011 MONITORING DATA FOR MONITORING  
WELLS QM-53 THROUGH QM-82 IN THE MAINSTREAM TUNNEL SYSTEM

TABLE AIV-1: 2011 CHLORIDE, FECAL COLIFORM, SULFATE, AMMONIA NITROGEN, TOTAL ORGANIC CARBON, AND TOTAL DISSOLVED SOLIDS DATA FOR MONITORING WELLS QM-53 THROUGH QM-82 IN THE MAINSTREAM TUNNEL SYSTEM

Monitoring Well Number	Date of Sampling	Cl <sup>1</sup> mg/L	FC <sup>1,2</sup> CFU/100 mL	SO <sub>4</sub> <sup>1</sup> mg/L	NH <sub>3</sub> -N <sup>1</sup> mg/L	TOC <sup>1</sup> mg/L	TDS <sup>1</sup> mg/L
QM-53	3/23/11	35	<1	39	BLOQ	BLOQ	190
QM-53	5/5/11	13	<1	33	BLOQ	BLOQ	202
QM-53	7/29/11	17	<1	35	BLOQ	3.5	330
QM-56	3/23/11		Well could not be sampled <sup>3</sup>				
QM-56	5/5/11		Well could not be sampled <sup>3</sup>				
QM-56	7/29/11		Well could not be sampled <sup>3</sup>				
QM-58	3/23/11		Well could not be sampled <sup>3</sup>				
QM-58	5/5/11		Well could not be sampled <sup>3</sup>				
QM-58	7/29/11		Well could not be sampled <sup>3</sup>				
QM-61	1/6/11	46	<1	BLOQ	0.32	BLOQ	288
QM-61	7/7/11	60	70	20	0.44	1.0	378
QM-61	11/9/11	46	>20,000	25	0.41	2.0	296
QM-62	1/6/11		Well could not be sampled <sup>3</sup>				
QM-62	4/20/11		Well could not be sampled <sup>3</sup>				
QM-62	5/25/11		Well could not be sampled <sup>3</sup>				
QM-62	7/7/11		Well could not be sampled <sup>3</sup>				
QM-62	9/23/11		Well could not be sampled <sup>3</sup>				
QM-62	11/9/11		Well could not be sampled <sup>3</sup>				
QM-63	3/23/11	52	5	736	1.91	2.2	1,758
QM-63	5/5/11	50	620	852	2.10	2.4	1,732
QM-63	7/29/11	68	>20,000	506	1.74	3.7	1,534
QM-63	9/16/11	53	11	955	1.93	2.7	2,004
QM-63	11/30/11	53	370	967	2.06	1.4	1,806
QM-63	12/15/11	53	2	968	2.02	3.1	1,830
QM-64	1/6/11	50	<1	36	1.98	1.5	430
QM-64	4/20/11	51	30	31	1.63	1.3	442
QM-64	5/25/11	56	38	38	1.86	1.5	434
QM-64	7/7/11	65	38	34	2.02	1.5	458

TABLE AIV-1 (Continued): 2011 CHLORIDE, FECAL COLIFORM, SULFATE, AMMONIA NITROGEN, TOTAL ORGANIC CARBON, AND TOTAL DISSOLVED SOLIDS DATA FOR MONITORING WELLS QM-53 THROUGH QM-82 IN THE MAINSTREAM TUNNEL SYSTEM

Monitoring Well Number	Date of Sampling	Cl <sup>1</sup> mg/L	FC <sup>1,2</sup> CFU/100 mL	SO <sub>4</sub> <sup>1</sup> mg/L	NH <sub>3</sub> -N <sup>1</sup> mg/L	TOC <sup>1</sup> mg/L	TDS <sup>1</sup> mg/L
QM-64	9/23/11	57	2	24	1.77	1.5	370
QM-64	11/9/11	49	4	43	1.89	1.5	420
QM-65	1/6/11		Well could not be sampled <sup>3</sup>				
QM-65	4/20/11		Well could not be sampled <sup>3</sup>				
QM-65	5/25/11		Well could not be sampled <sup>3</sup>				
QM-65	7/7/11		Well could not be sampled <sup>3</sup>				
QM-65	9/23/11		Well could not be sampled <sup>3</sup>				
QM-65	11/9/11		Well could not be sampled <sup>3</sup>				
QM-66	3/23/11		Well could not be sampled <sup>3</sup>				
QM-66	8/12/11		Well could not be sampled <sup>3</sup>				
QM-66	11/10/11		Well could not be sampled <sup>3</sup>				
QM-67	3/23/11	214	140	BLOQ	11.09	3.3	694
QM-67	5/5/11	249	45	BLOQ	11.61	2.9	768
QM-67	7/29/11	235	350	BLOQ	9.93	BLOQ	732
QM-67	9/16/11	183	210	BLOQ	9.74	3.1	662
QM-67	11/30/11	161	300	BLOQ	9.89	1.9	598
QM-67	12/15/11	149	270	BLOQ	9.93	3.1	606
QM-68	5/5/11	28	92	32	0.61	BLOQ	296
QM-68	7/29/11	29	100	37	0.52	BLOQ	344
QM-68	9/16/11	29	<1	38	0.53	BLOQ	324
QM-69	3/23/11	36	<1	40	0.84	1.1	290
QM-69	8/12/11	36	<1	44	0.89	1.3	326
QM-69	11/10/11	36	<1	41	0.89	1.3	298
QM-70	3/24/11	55	<1	53	0.57	1.1	320
QM-70	8/12/11	49	<1	51	0.37	1.0	340
QM-70	11/10/11	48	<1	52	0.39	BLOQ	324

TABLE AIV-1 (Continued): 2011 CHLORIDE, FECAL COLIFORM, SULFATE, AMMONIA NITROGEN, TOTAL ORGANIC CARBON, AND TOTAL DISSOLVED SOLIDS DATA FOR MONITORING WELLS QM-53 THROUGH QM-82 IN THE MAINSTREAM TUNNEL SYSTEM

Monitoring Well Number	Date of Sampling	Cl <sup>1</sup> mg/L	FC <sup>1,2</sup> CFU/100 mL	SO <sub>4</sub> <sup>1</sup> mg/L	NH <sub>3</sub> -N <sup>1</sup> mg/L	TOC <sup>1</sup> mg/L	TDS <sup>1</sup> mg/L
QM-71	3/24/11	48	<1	53	0.24	1.0	314
QM-71	8/12/11	128	<1	68	0.43	BLOQ	518
QM-71	11/10/11	131	<1	65	0.34	BLOQ	446
QM-72	3/24/11	121	<1	BLOQ	0.25	BLOQ	346
QM-72	7/21/11	133	<1	BLOQ	0.35	BLOQ	466
QM-72	11/10/11	139	<1	BLOQ	0.33	BLOQ	382
QM-73	3/24/11	36	<1	BLOQ	0.15	1.3	270
QM-73	5/12/11	32	<1	BLOQ	0.16	1.1	284
QM-73	7/21/11	35	<1	BLOQ	0.26	1.2	268
QM-74	3/24/11	52	<1	BLOQ	0.12	1.6	242
QM-74	5/12/11	48	<1	BLOQ	0.18	1.4	246
QM-74	7/21/11	54	<1	BLOQ	0.22	1.4	286
QM-75	1/27/11	12	<1	BLOQ	0.26	BLOQ	226
QM-75	3/24/11	13	1	BLOQ	0.10	1.0	212
QM-75	5/12/11	BLOQ	20	BLOQ	0.19	1.0	222
QM-75	7/21/11	13	<1	BLOQ	0.28	BLOQ	316
QM-75	11/3/11	15	<1	BLOQ	0.27	BLOQ	246
QM-75	12/15/11	13	3	BLOQ	0.23	BLOQ	202
QM-76	3/24/11	12	<1	85	BLOQ	1.0	344
QM-76	5/12/11	BLOQ	<1	60	0.18	1.1	334
QM-76	7/28/11	BLOQ	19	61	0.17	BLOQ	432
QM-77	3/24/11	11	5	BLOQ	BLOQ	BLOQ	150
QM-77	5/12/11	BLOQ	70	BLOQ	0.11	BLOQ	156
QM-77	7/28/11	BLOQ	730	BLOQ	0.12	BLOQ	248
QM-78	1/27/11	12	<1	42	BLOQ	BLOQ	292
QM-78	3/24/11	11	<1	45	BLOQ	BLOQ	276
QM-78	5/12/11	BLOQ	<1	41	BLOQ	BLOQ	276
QM-78	7/28/11	BLOQ	6	39	BLOQ	BLOQ	390

TABLE AIV-1 (Continued): 2011 CHLORIDE, FECAL COLIFORM, SULFATE, AMMONIA NITROGEN, TOTAL ORGANIC CARBON, AND TOTAL DISSOLVED SOLIDS DATA FOR MONITORING WELLS QM-53 THROUGH QM-82 IN THE MAINSTREAM TUNNEL SYSTEM

Monitoring Well Number	Date of Sampling	Cl <sup>1</sup> mg/L	FC <sup>1,2</sup> CFU/100 mL	SO <sub>4</sub> <sup>1</sup> mg/L	NH <sub>3</sub> -N <sup>1</sup> mg/L	TOC <sup>1</sup> mg/L	TDS <sup>1</sup> mg/L
QM-78	11/3/11	11	<1	48	BLOQ	BLOQ	304
QM-78	12/15/11	55	<1	49	BLOQ	BLOQ	348
QM-79	1/27/11	17	<1	17	BLOQ	BLOQ	314
QM-79	3/24/11	17	<1	18	BLOQ	BLOQ	268
QM-79	5/12/11	15	<1	17	BLOQ	BLOQ	298
QM-79	7/28/11	15	11	BLOQ	BLOQ	BLOQ	428
QM-79	11/3/11	17	<1	17	BLOQ	BLOQ	296
QM-79	12/15/11	17	<1	19	BLOQ	BLOQ	292
QM-80	1/27/11	14	<1	BLOQ	BLOQ	BLOQ	188
QM-80	3/24/11	13	<1	BLOQ	BLOQ	BLOQ	174
QM-80	5/12/11	11	<1	BLOQ	BLOQ	BLOQ	186
QM-80	7/28/11	BLOQ	6	BLOQ	BLOQ	1.2	280
QM-80	11/3/11	14	<1	BLOQ	BLOQ	BLOQ	194
QM-80	12/15/11	13	<1	BLOQ	BLOQ	BLOQ	192
QM-81	3/24/11	20	<1	BLOQ	BLOQ	BLOQ	228
QM-81	5/12/11	18	<1	BLOQ	BLOQ	BLOQ	222
QM-81	7/28/11	17	2	BLOQ	BLOQ	BLOQ	320
QM-82	1/27/11		Well could not be sampled <sup>3</sup>				
QM-82	3/24/11		Well could not be sampled <sup>3</sup>				
QM-82	5/12/11		Well could not be sampled <sup>3</sup>				
QM-82	7/28/11		Well could not be sampled <sup>3</sup>				
QM-82	11/3/11		Well could not be sampled <sup>3</sup>				
QM-82	12/15/11		Well could not be sampled <sup>3</sup>				

BLOQ = Below limit of quantification (LOQ).

<sup>1</sup>The LOQ is 10 mg/L for Cl, 15 mg/L for SO<sub>4</sub>, 0.10 mg/L for NH<sub>3</sub>-N, 1.0 mg/L for TOC, and 60 mg/L for TDS. The detection limit for the FC analysis using the membrane filter method varies based on the actual sample analyzed.

<sup>2</sup>Unfiltered samples; all others were filtered through 0.45-µm membrane.

<sup>3</sup>Monitoring well not sampled due to reasons provided in text.

TABLE AIV-2: 2011 HARDNESS, CONDUCTIVITY, pH, TEMPERATURE, GROUNDWATER ELEVATION, AND RECHARGE DATA FOR MONITORING WELLS QM-51 THROUGH QM-82 IN THE MAINSTREAM TUNNEL SYSTEM

Monitoring Well Number	Date of Sampling	Hard. mg/L	Cond. <sup>1</sup> μmhos/cm	pH <sup>1</sup> Unit	Temp. °C	Elevation <sup>2</sup> Feet	Recharge <sup>3</sup> Hours
QM-53	3/23/11	134	216	8.3	10.6	-39.4	<4
QM-53	5/5/11	137	220	8.1	11.7	-39.4	<4
QM-53	7/29/11	140	212	8.0	13.4	-42.4	<4
QM-56	3/23/11			Well could not be sampled <sup>4</sup>			
QM-56	5/5/11			Well could not be sampled <sup>4</sup>			
QM-56	7/29/11			Well could not be sampled <sup>4</sup>			
QM-58	3/23/11			Well could not be sampled <sup>4</sup>			
QM-58	5/5/11			Well could not be sampled <sup>4</sup>			
QM-58	7/29/11			Well could not be sampled <sup>4</sup>			
QM-61	1/6/11	116	299	7.2	12.2	-175.8	<4
QM-61	7/7/11	123	433	7.6	14.0	-128.8	<4
QM-61	11/9/11	125	341	7.3	13.5	-176.8	<4
QM-62	1/6/11			Well could not be sampled <sup>4</sup>			
QM-62	4/20/11			Well could not be sampled <sup>4</sup>			
QM-62	5/25/11			Well could not be sampled <sup>4</sup>			
QM-62	7/7/11			Well could not be sampled <sup>4</sup>			
QM-62	9/23/11			Well could not be sampled <sup>4</sup>			
QM-62	11/9/11			Well could not be sampled <sup>4</sup>			
QM-63	3/23/11	984	863	7.7	12.5	-187.1	<4
QM-63	5/5/11	926	953	7.8	13.8	-185.1	<4
QM-63	7/29/11	632	1,055	7.1	14.5	-68.1	<4
QM-63	9/16/11	941	645	7.0	13.2	-75.1	<4
QM-63	11/30/11	983	1,245	7.3	13.1	-166.1	<4
QM-63	12/15/11	988	883	7.3	13.1	-171.1	<4
QM-64	1/6/11	202	460	7.7	12.3	-172.3	<4
QM-64	4/20/11	189	432	7.7	13.1	-165.3	<4
QM-64	5/25/11	223	522	7.5	13.9	-167.3	<4
QM-64	7/7/11	214	711	7.5	15.5	-167.3	<4

TABLE AIV-2 (Continued): 2011 HARDNESS, CONDUCTIVITY, pH, TEMPERATURE, GROUNDWATER ELEVATION, AND RECHARGE DATA FOR MONITORING WELLS QM-51 THROUGH QM-82 IN THE MAINSTREAM TUNNEL SYSTEM

Monitoring Well Number	Date of Sampling	Hard. mg/L	Cond. <sup>1</sup> µmhos/cm	pH <sup>1</sup> Unit	Temp. °C	Elevation <sup>2</sup> Feet	Recharge <sup>3</sup> Hours
QM-64	9/23/11	206	526	7.8	14.1	-177.3	<4
QM-64	11/9/11	206	429	7.5	13.7	-160.3	<4
QM-65	1/6/11			Well could not be sampled <sup>4</sup>			
QM-65	4/20/11			Well could not be sampled <sup>4</sup>			
QM-65	5/25/11			Well could not be sampled <sup>4</sup>			
QM-65	7/7/11			Well could not be sampled <sup>4</sup>			
QM-65	9/23/11			Well could not be sampled <sup>4</sup>			
QM-65	11/9/11			Well could not be sampled <sup>4</sup>			
QM-66	3/23/11			Well could not be sampled <sup>4</sup>			
QM-66	8/12/11			Well could not be sampled <sup>4</sup>			
QM-66	11/10/11			Well could not be sampled <sup>4</sup>			
QM-67	3/23/11	273	844	7.5	12.3	-161.0	<48
QM-67	5/5/11	266	750	8.6	13.3	-163.0	<48
QM-67	7/29/11	260	1,024	7.4	14.9	-172.0	<48
QM-67	9/16/11	219	773	7.4	13.3	-177.0	<48
QM-67	11/30/11	226	784	7.1	13.2	-169.0	<48
QM-67	12/15/11	218	749	7.2	12.7	-173.0	<48
QM-68	5/5/11	186	280	7.2	12.6	-134.3	<48
QM-68	7/29/11	188	310	7.5	14.9	-110.3	<48
QM-68	9/16/11	190	323	7.9	13.5	-121.3	<48
QM-69	3/23/11	149	317	8.2	10.7	-33.6	<48
QM-69	8/12/11	158	349	8.1	13.0	-28.6	<48
QM-69	11/10/11	154	411	7.8	10.7	-43.6	<48
QM-70	3/24/11	161	443	7.6	10.5	-70.0	<48
QM-70	8/12/11	155	367	7.8	12.7	-58.0	<48
QM-70	11/10/11	157	377	7.6	11.0	-73.0	<48

TABLE AIV-2 (Continued): 2011 HARDNESS, CONDUCTIVITY, pH, TEMPERATURE, GROUNDWATER ELEVATION, AND RECHARGE DATA FOR MONITORING WELLS QM-51 THROUGH QM-82 IN THE MAINSTREAM TUNNEL SYSTEM

Monitoring Well Number	Date of Sampling	Hard. mg/L	Cond. <sup>1</sup> μmhos/cm	pH <sup>1</sup> Unit	Temp. °C	Elevation <sup>2</sup> Feet	Recharge <sup>3</sup> Hours
QM-71	3/24/11	159	895	7.7	9.9	-60.8	<48
QM-71	8/12/11	195	511	8.0	12.8	-62.8	<48
QM-71	11/10/11	191	487	7.8	10.6	-61.8	<48
QM-72	3/24/11	219	331	7.8	10.8	-81.7	<48
QM-72	7/21/11	215	424	7.6	13.7	-80.7	<48
QM-72	11/10/11	216	422	7.8	10.5	-81.7	<48
QM-73	3/24/11	154	323	7.5	11.1	-142.4	<48
QM-73	5/12/11	146	444	8.1	12.8	-167.4	<48
QM-73	7/21/11	154	341	7.9	14.7	-165.4	<48
QM-74	3/24/11	102	298	8.1	9.5	-25.7	<48
QM-74	5/12/11	100	404	8.1	11.9	-11.7	<48
QM-74	7/21/11	101	308	7.8	12.2	-12.7	<48
QM-75	1/27/11	70	267	7.3	10.3	-70.1	<48
QM-75	3/24/11	66	301	7.5	10.9	-66.1	<48
QM-75	5/12/11	61	333	8.1	12.1	-73.1	<48
QM-75	7/21/11	63	248	7.8	13.0	-74.1	<48
QM-75	11/3/11	59	243	7.9	11.2	-74.1	<48
QM-75	12/15/11	61	312	7.7	12.2	-68.1	<48
QM-76	3/24/11	70	326	8.4	10.5	-187.2	<48
QM-76	5/12/11	68	511	7.7	14.3	-187.2	<48
QM-76	7/28/11	62	372	7.8	12.3	-184.2	<48
QM-77	3/24/11	43	190	8.1	10.2	-183.8	<48
QM-77	5/12/11	41	228	8.3	12.5	-184.8	<48
QM-77	7/28/11	42	197	7.1	12.4	-168.8	<48
QM-78	1/27/11	12	296	8.3	9.4	-159.0	<48
QM-78	3/24/11	10	330	8.7	10.1	-160.0	<48
QM-78	5/12/11	10	404	9.1	12.2	-159.0	<48
QM-78	7/28/11	10	343	8.7	12.4	-155.0	<48



TABLE AIV-2 (Continued): 2011 HARDNESS, CONDUCTIVITY, pH, TEMPERATURE, GROUNDWATER ELEVATION, AND RECHARGE DATA FOR MONITORING WELLS QM-51 THROUGH QM-82 IN THE MAINSTREAM TUNNEL SYSTEM

Monitoring Well Number	Date of Sampling	Hard. mg/L	Cond. <sup>1</sup> μmhos/cm	pH <sup>1</sup> Unit	Temp. °C	Elevation <sup>2</sup> Feet	Recharge <sup>3</sup> Hours
QM-78	11/3/11	11	312	8.5	11.1	-164.0	<48
QM-78	12/15/11	10	337	8.3	11.1	-156.0	<48
QM-79	1/27/11	12	333	8.6	9.8	-147.2	<48
QM-79	3/24/11	12	340	8.7	9.5	-147.2	<48
QM-79	5/12/11	11	397	9.1	12.2	-145.2	<48
QM-79	7/28/11	9	347	8.7	11.9	-215.2	<48
QM-79	11/3/11	11	283	8.8	12.0	-150.2	<48
QM-79	12/15/11	11	349	8.5	11.7	-148.2	<48
QM-80	1/27/11	21	228	8.4	10.8	-142.4	<48
QM-80	3/24/11	21	240	8.1	11.0	-142.4	<48
QM-80	5/12/11	21	276	7.9	12.5	-142.4	<48
QM-80	7/28/11	21	224	8.2	12.5	-141.4	<48
QM-80	11/3/11	21	224	8.3	12.3	-133.4	<48
QM-80	12/15/11	22	247	8.0	12.0	-141.4	<48
QM-81	3/24/11	33	275	8.2	11.7	-135.0	<48
QM-81	5/12/11	30	318	8.2	13.0	-136.0	<48
QM-81	7/28/11	35	275	8.0	12.6	-130.0	<48
QM-82	1/27/11			Well could not be sampled <sup>4</sup>			
QM-82	3/24/11			Well could not be sampled <sup>4</sup>			
QM-82	5/12/11			Well could not be sampled <sup>4</sup>			
QM-82	7/28/11			Well could not be sampled <sup>4</sup>			
QM-82	11/3/11			Well could not be sampled <sup>4</sup>			
QM-82	12/15/11			Well could not be sampled <sup>4</sup>			

<sup>1</sup>Unfiltered samples; all others were filtered through 0.45-μm membrane.

<sup>2</sup>Groundwater elevations are relative to Chicago City Datum.

<sup>3</sup>Refers to elapsed time after initial drawdown before the monitoring well recovered sufficiently for sampling.

<sup>4</sup>Monitoring well not sampled due to reasons provided in text.

APPENDIX AV

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 your 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 IAR  
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OF WATER, CHGO.