RESEARCH AND DEVELOPMENT DEPARTMENT

REPORT NO. 08-52

TUNNEL AND RESERVOIR PLAN
MAINSTREAM TUNNEL SYSTEM
2007 ANNUAL GROUNDWATER MONITORING REPORT

SEPTEMBER 2008

Protecting Our Water Environment

Metropolitan Water Reclamation District of Greater Chicago

100 EAST ERIE STREET CHICAGO, ILLINOIS 60611-3154 312·751·5600

Louis Kollias, P.E., BCEE
Director of Research and Development

312·751·5190

September 19, 2008

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, 2007 Annual Groundwater Monitoring Report

Enclosed are three copies of "Tunnel and Reservoir Plan, Mainstream Tunnel System, 2007 Annual Groundwater Monitoring Report."

Very truly yours,

Louis Kollias
Director
Research and Development

LK:HZ:lmf
Enclosures
cc w/enc: Ms. Sally K. Swanson (USEPA Region V—WC15J) (2)
Mr. Sobanski
Dr. Granato
Dr. O'Connor
Dr. Zhang
Mr. MacDonald
Library
cc w/o enc: Mr. Jamjun
Mr. Cohen

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
2007 ANNUAL GROUNDWATER MONITORING REPORT

Research and Development Department
Louis Kollias, Director

September 2008

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

This report contains 2007 data for the Tunnel and Reservoir Plan Mainstream Tunnel System compiled from monitoring of groundwater level elevations in observation wells, and monitoring of groundwater quality in water quality monitoring wells. The observation wells are all sampled once every two months while the monitoring wells are sampled at varying frequency. 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 water quality 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). Water quality monitoring well QM–59 has been dry since February 1995 and is no longer being monitored. The observation wells and water quality monitoring wells are located along the length of the Mainstream Tunnel between Morton Grove and Hodgkins.

Monitoring Data

Appendix AI contains a location map of observation wells OM–1 through OM–23 located along the Mainstream Tunnel System.

Table AII–1 in Appendix AII contains groundwater level elevation data for the year 2007 for observation wells OM–1 through OM–23 located along the Mainstream Tunnel System. Table AII–1 also contains the yearly minimum, mean, and maximum water level elevations of each observation well.

Appendix AIII contains a location map of water quality monitoring wells QM–53 through QM–82 located along the Mainstream Tunnel System.

Tables AIV–1 and AIV–2 of Appendix AIV contain water quality data for the year 2007 pertaining to water quality monitoring wells QM–53 through QM–82 located along the Mainstream Tunnel System.

All of the wells in the Mainstream system were visited for the required number of samples. However, in some instances the samples could not be collected. Water quality monitoring well QM–58 could not be sampled on April 19, 2007, or June 14, 2007, because there was insufficient water in the well to collect a sample. Water quality monitoring well QM–62 could not be sampled in 2007 because the pump could not be activated because of a structural problem with the well. A decision is being made on the well's future. Water quality monitoring well QM–63 could not be sampled on May 9, 2007, because the pump was inoperable due to electrical problems, or on December 19, 2007, because a heavy snow bank blocked access to the well. Water quality monitoring well QM–65 could not be sampled on August 28, 2007, because the pump was inoperable due to electrical problems. Water quality monitoring well QM–66 could not be

sampled in 2007 because there was insufficient water in the well to collect a sample. Water quality monitoring well QM–70 could not be sampled in 2007 because the pump was inoperable due to electrical problems. The elevation of groundwater observation well OM–2 could not be measured on February 23, 2007, or December 21, 2007, because access to the well was blocked by snow. The elevation of groundwater observation well OM–8 could not be measured on June 1, 2007, because access to the well was blocked by cement truck. The elevation of groundwater observation well OM–20 could not be measured on April 13, 2007, because access to the well was blocked by snow.

Summary of Data

Observation Wells Water Level Elevation Data. In Figure 1, the 2007 groundwater level elevation data for the observation wells (OM–1 through OM–23) of the Mainstream Tunnel System have been plotted. In this figure, minimum, mean, and maximum water level elevations of all the observation wells are plotted to show fluctuations in water level elevations during 2007. Table AII–1 in Appendix AII contains the groundwater level elevation data for the year 2007 for the observation wells located in the Mainstream Tunnel System.

Water Quality Monitoring Wells Data. Tables 1 through 5 contain summary statistics of the water quality parameters for the year 2007 for water quality monitoring wells QM–53 through QM–82 in the Mainstream Tunnel System. These statistics are computed from the 2007 data collected from each water quality monitoring well. The summary statistics include minimum, mean, maximum, standard deviation (Std. Dev.), median and coefficient of variation (Coeff. Var.) for all nine water quality parameters analyzed during 2007. The nine water quality parameters are: chloride (Cl), conductivity (Cond.), fecal coliform (FC), hardness as $CaCO_3$ (Hard.), ammonia as NH_4^+–N, pH, sulfate (SO_4), total dissolved solids (TDS), and total organic carbon (TOC).

TABLE 1: SUMMARY STATISTICS OF THE 2007 DATA FOR THE WATER QUALITY MONITORING WELLS IN THE MAINSTREAM TUNNEL SYSTEM: WELLS QM–53, QM–56, QM–58, QM–61, AND QM–62

Parameter		Well Number				
		QM–53	QM–56	QM–58	QM–61	QM–62
Cl	Minimum	15	38	19	53	|
mg/L	Mean	15	39	19	59	|
	Maximum	15	40	19	70	|
	Std. Dev.	0	1	0	10	|
	Median	15	39	19	53	|
	Coeff. Var.	0	3	0	17	|
						|
Cond.	Minimum	210	291	362	322	|
µmhos/cm	Mean	216	321	362	328	
	Maximum	228	366	362	336	W
	Std. Dev.	10	40	0	7	E
	Median	210	306	362	326	L
	Coeff. Var.	5	12	0	2	L
FC[1]	Minimum	1	1	1	1	N
cfu/100 mL	Geo. Mean	1	1	1	132	O
	Maximum	1	1	1	20,000	T
	Geo. Std. Dev.	0	0	0	142	
	Median	1	1	1	114	S
	Coeff. Var.	0	0	0	108	A
						M
Hard.	Minimum	122	124	256	123	P
mg/L	Mean	128	126	256	126	L
	Maximum	135	129	256	130	E
	Std. Dev.	7	3	0	4	D
	Median	127	124	256	126	
	Coeff. Var.	5	2	0	3	|
						|
NH_4^+–N	Minimum	0.02	0.41	1.03	0.20	|
mg/L	Mean	0.05	0.43	1.03	0.24	|
	Maximum	0.08	0.46	1.03	0.32	|
	Std. Dev.	0.03	0.03	0.00	0.07	|
	Median	0.05	0.43	1.03	0.21	|
	Coeff. Var.	60.00	5.81	0.00	27.36	|

TABLE 1 (Continued): SUMMARY STATISTICS OF THE 2007 DATA FOR THE WATER QUALITY MONITORING WELLS IN THE MAINSTREAM TUNNEL SYSTEM: WELLS QM–53, QM–56, QM–58, QM–61, AND QM–62

Parameter		Well Number				
		QM–53	QM–56	QM–58	QM–61	QM–62
pH	Minimum	7.4	7.5	7.7	7.8	|
	Mean	7.7	7.8	7.7	7.9	|
	Maximum	7.9	8.1	7.7	8.0	|
	Std. Dev.	0.3	0.3	0.0	0.1	|
	Median	7.8	7.9	7.7	7.9	
	Coeff. Var.	3.4	3.9	0.0	1.3	W
						E
SO_4	Minimum	30	11	168	11	L
mg/L	Mean	34	12	168	19	L
	Maximum	41	13	168	27	
	Std. Dev.	6	1	0	8	N
	Median	31	11	168	20	O
	Coeff. Var.	18	10	0	41	T
TDS	Minimum	164	220	464	274	S
mg/L	Mean	195	260	464	316	A
	Maximum	236	290	464	354	M
	Std. Dev.	37	36	0	40	P
	Median	184	270	464	320	L
	Coeff. Var.	19	14	0	13	E
						D
TOC	Minimum	0.4	0.5	0.9	0.7	
mg/L	Mean	0.5	0.5	0.9	1.0	|
	Maximum	0.6	0.6	0.9	1.3	|
	Std. Dev.	0.1	0.1	0.0	0.3	|
	Median	0.5	0.5	0.9	0.9	|
	Coeff. Var.	20.0	10.8	0.0	31.6	|

[1]For purposes of statistical evaluation, fecal coliform values less than 1 were set equal to 1.

TABLE 2: SUMMARY STATISTICS OF THE 2007 DATA FOR THE WATER QUALITY MONITORING WELLS IN THE MAINSTREAM TUNNEL SYSTEM: WELLS QM–63 THROUGH QM–67

Parameter		Well Number				
		QM–63	QM–64	QM–65	QM–66	QM–67
Cl	Minimum	48	51	348	|	176
mg/L	Mean	50	55	393	|	210
	Maximum	52	65	505	|	278
	Std. Dev.	2	5	64	|	37
	Median	50	53	373	|	205
	Coeff. Var.	5	9	16	|	18
					|	
Cond.	Minimum	612	334	818	|	625
µmhos/cm	Mean	1,138	497	1,144		878
	Maximum	1,604	702	1,350	W	1,182
	Std. Dev.	538	160	201	E	211
	Median	1,168	459	1,160	L	885
	Coeff. Var.	47	32	18	L	24
FC[1]	Minimum	1	1	1	N	35
cfu/100 mL	Geo. Mean	1	6	1	O	956
	Maximum	1	3,600	1	T	3,300
	Geo. Std. Dev.	0	25	0		5
	Median	1	2	1	S	1,800
	Coeff. Var.	0	24,796	0	A	120
					M	
Hard.	Minimum	766	179	539	P	253
mg/L	Mean	815	197	556	L	289
	Maximum	905	211	573	E	337
	Std. Dev.	62	10	13	D	34
	Median	794	200	558		279
	Coeff. Var.	8	5	2	|	12
					|	
NH_4^+–N	Minimum	1.63	1.58	5.81	|	7.22
mg/L	Mean	1.83	1.77	7.01	|	7.93
	Maximum	2.07	1.97	10.57	|	8.48
	Std. Dev.	0.20	0.17	2.01	|	0.43
	Median	1.82	1.78	6.15	|	7.98
	Coeff. Var.	11.12	9.61	28.68	|	5.36

TABLE 2 (Continued): SUMMARY STATISTICS OF THE 2007 DATA FOR THE WATER QUALITY MONITORING WELLS IN THE MAINSTREAM TUNNEL SYSTEM: WELLS QM–63 THROUGH QM–67

Parameter		Well Number				
		QM–63	QM–64	QM–65	QM–66	QM–67
pH	Minimum	7.7	7.6	7.1	|	7.4
	Mean	7.8	7.8	7.6	|	7.7
	Maximum	7.8	8.0	8.0	|	8.1
	Std. Dev.	0.0	0.2	0.3	|	0.3
	Median	7.8	7.8	7.7		7.8
	Coeff. Var.	0.6	2.0	4.5	W	4.0
					E	
SO_4	Minimum	768	38	175	L	10
mg/L	Mean	1,210	41	204	L	18
	Maximum	2,266	45	232		29
	Std. Dev.	707	2	21	N	7
	Median	902	41	209	O	18
	Coeff. Var.	58	5	10	T	39
TDS	Minimum	1,514	422	1,344	S	662
mg/L	Mean	1,622	491	1,418	A	767
	Maximum	1,840	574	1,610	M	860
	Std. Dev.	148	53	110	P	69
	Median	1,566	490	1,388	L	764
	Coeff. Var.	9	11	8	E	9
					D	
TOC	Minimum	1.7	1.0	4.4		2.6
mg/L	Mean	1.8	1.1	5.3	|	3.0
	Maximum	1.9	1.2	7.3	|	3.2
	Std. Dev.	0.1	0.1	1.2	|	0.3
	Median	1.9	1.1	4.9	|	3.1
	Coeff. Var.	5.2	6.9	21.9	|	8.6

[1]For purposes of statistical evaluation, fecal coliform values less than 1 were set equal to 1.

TABLE 3: SUMMARY STATISTICS OF THE 2007 DATA FOR THE WATER QUALITY MONITORING WELLS IN THE MAINSTREAM TUNNEL SYSTEM: WELLS QM–68 THROUGH QM–72

Parameter		Well Number				
		QM–68	QM–69	QM–70	QM–71	QM–72
Cl	Minimum	27	38	|	117	131
mg/L	Mean	30	38	|	127	133
	Maximum	32	38	|	135	137
	Std. Dev.	3	0	|	9	3
	Median	31	38	|	128	131
	Coeff. Var.	9	0	|	7	3
				|		
Cond.	Minimum	288	395	|	480	242
µmhos/cm	Mean	292	471		630	458
	Maximum	300	535	W	825	630
	Std. Dev.	7	71	E	177	198
	Median	289	484	L	585	501
	Coeff. Var.	2	15	L	28	43
FC[1]	Minimum	1	1	N	1	1
cfu/100 mL	Geo. Mean	2	2	O	1	1
	Maximum	12	9	T	1	1
	Geo. Std. Dev.	6	5		0	0
	Median	1	1	S	1	1
	Coeff. Var.	277	222	A	0	0
				M		
Hard.	Minimum	173	152	P	197	205
mg/L	Mean	186	155	L	203	214
	Maximum	200	159	E	207	223
	Std. Dev.	14	4	D	5	9
	Median	186	153		205	213
	Coeff. Var.	7	2	|	3	4
				|		
NH_4^+–N	Minimum	0.36	0.88	|	0.39	0.28
mg/L	Mean	0.49	0.91	|	0.43	0.31
	Maximum	0.64	0.93	|	0.51	0.35
	Std. Dev.	0.14	0.03	|	0.07	0.04
	Median	0.48	0.93	|	0.40	0.29
	Coeff. Var.	28.47	3.16	|	15.37	12.35

TABLE 3 (Continued): SUMMARY STATISTICS OF THE 2007 DATA FOR THE WATER QUALITY MONITORING WELLS IN THE MAINSTREAM TUNNEL SYSTEM: WELLS QM–68 THROUGH QM–72

Parameter		Well Number				
		QM–68	QM–69	QM–70	QM–71	QM–72
pH	Minimum	7.8	7.6	|	7.8	7.2
	Mean	7.8	8.0	|	7.9	7.5
	Maximum	7.9	8.3	|	8.0	7.9
	Std. Dev.	0.1	0.4	|	0.1	0.4
	Median	7.8	8.2		7.8	7.5
	Coeff. Var.	0.7	4.7	W	1.5	4.7
				E		
SO_4	Minimum	30	40	L	62	1
mg/L	Mean	34	43	L	67	1
	Maximum	37	46		71	2
	Std. Dev.	4	3	N	5	1
	Median	36	42	O	67	1
	Coeff. Var.	11	7	T	7	43
TDS	Minimum	284	324	S	496	436
mg/L	Mean	294	333	A	506	453
	Maximum	310	350	M	512	466
	Std. Dev.	14	14	P	9	16
	Median	288	326	L	510	458
	Coeff. Var.	5	4	E	2	3
				D		
TOC	Minimum	0.5	0.9		0.7	0.5
mg/L	Mean	0.6	0.9	|	0.8	0.6
	Maximum	0.6	1.0	|	0.8	0.8
	Std. Dev.	0.1	0.1	|	0.1	0.2
	Median	0.6	0.9	|	0.8	0.6
	Coeff. Var.	10.2	6.2	|	7.5	24.1

[1]For purposes of statistical evaluation, fecal coliform values less than 1 were set equal to 1.

TABLE 4: SUMMARY STATISTICS OF THE 2007 DATA FOR THE WATER QUALITY MONITORING WELLS IN THE MAINSTREAM TUNNEL SYSTEM: WELLS QM–73 THROUGH QM–77

Parameter		Well Number				
		QM–73	QM–74	QM–75	QM–76	QM–77
Cl	Minimum	37	48	12	12	11
mg/L	Mean	43	50	13	12	11
	Maximum	48	52	14	13	11
	Std. Dev.	6	2	1	1	0
	Median	43	49	13	12	11
	Coeff. Var.	13	4	6	5	0
Cond.	Minimum	372	280	196	340	184
µmhos/cm	Mean	416	341	272	416	217
	Maximum	475	404	339	525	258
	Std. Dev.	53	62	53	97	38
	Median	400	340	258	384	210
	Coeff. Var.	13	18	20	23	17
FC[1]	Minimum	1	1	1	1	1
cfu/100 mL	Geo. Mean	1	1	1	1	1
	Maximum	1	1	1	1	1
	Geo. Std. Dev.	0	0	0	0	0
	Median	1	1	1	1	1
	Coeff. Var.	0	0	0	0	0
Hard.	Minimum	143	90	50	53	40
mg/L	Mean	148	93	60	56	42
	Maximum	151	95	64	58	43
	Std. Dev.	4	3	5	3	2
	Median	150	93	61	58	42
	Coeff. Var.	3	3	8	5	4
NH_4^+–N	Minimum	0.23	0.14	0.20	0.22	0.11
mg/L	Mean	0.23	0.18	0.25	0.28	0.16
	Maximum	0.24	0.21	0.34	0.36	0.22
	Std. Dev.	0.01	0.04	0.05	0.07	0.06
	Median	0.23	0.19	0.24	0.25	0.16
	Coeff. Var.	2.47	20.03	21.68	26.64	33.72

TABLE 4 (Continued): SUMMARY STATISTICS OF THE 2007 DATA FOR THE WATER QUALITY MONITORING WELLS IN THE MAINSTREAM TUNNEL SYSTEM: WELLS QM–73 THROUGH QM–77

Parameter		Well Number				
		QM–73	QM–74	QM–75	QM–76	QM–77
pH	Minimum	7.8	7.9	7.4	7.4	7.5
	Mean	7.8	8.0	7.9	8.0	7.8
	Maximum	7.8	8.2	8.3	8.5	8.0
	Std. Dev.	0.0	0.2	0.4	0.6	0.3
	Median	7.8	8.0	7.9	8.1	7.9
	Coeff. Var.	0.0	1.9	4.8	7.0	3.4
SO_4^2	Minimum	1	0.4	8	61	1
mg/L	Mean	2	1	10	67	33
	Maximum	3	2	12	75	96
	Std. Dev.	1	1	1	7	55
	Median	3	1	10	66	2
	Coeff. Var.	49	71	14	11	165
TDS	Minimum	298	236	194	330	156
mg/L	Mean	309	245	228	344	183
	Maximum	318	252	262	360	204
	Std. Dev.	10	8	24	15	25
	Median	310	248	231	342	190
	Coeff. Var.	3	3	10	4	13
TOC	Minimum	1.0	1.2	0.5	0.6	0.7
mg/L	Mean	1.1	1.4	0.7	0.8	1.3
	Maximum	1.3	1.7	0.9	0.9	2.4
	Std. Dev.	0.2	0.3	0.1	0.2	0.9
	Median	1.1	1.2	0.7	0.8	0.9
	Coeff. Var.	13.5	21.1	20.5	19.9	69.7

[1]For purposes of statistical evaluation, fecal coliform values less than 1 were set equal to 1.
[2]For purposes of statistical evaluation, sulfate values less than 0.4 mg/L were set equal to 0.4 mg/L.

TABLE 5: SUMMARY STATISTICS OF THE 2007 DATA FOR THE WATER QUALITY MONITORING WELLS IN THE MAINSTREAM TUNNEL SYSTEM: WELLS QM–78 THROUGH QM–82

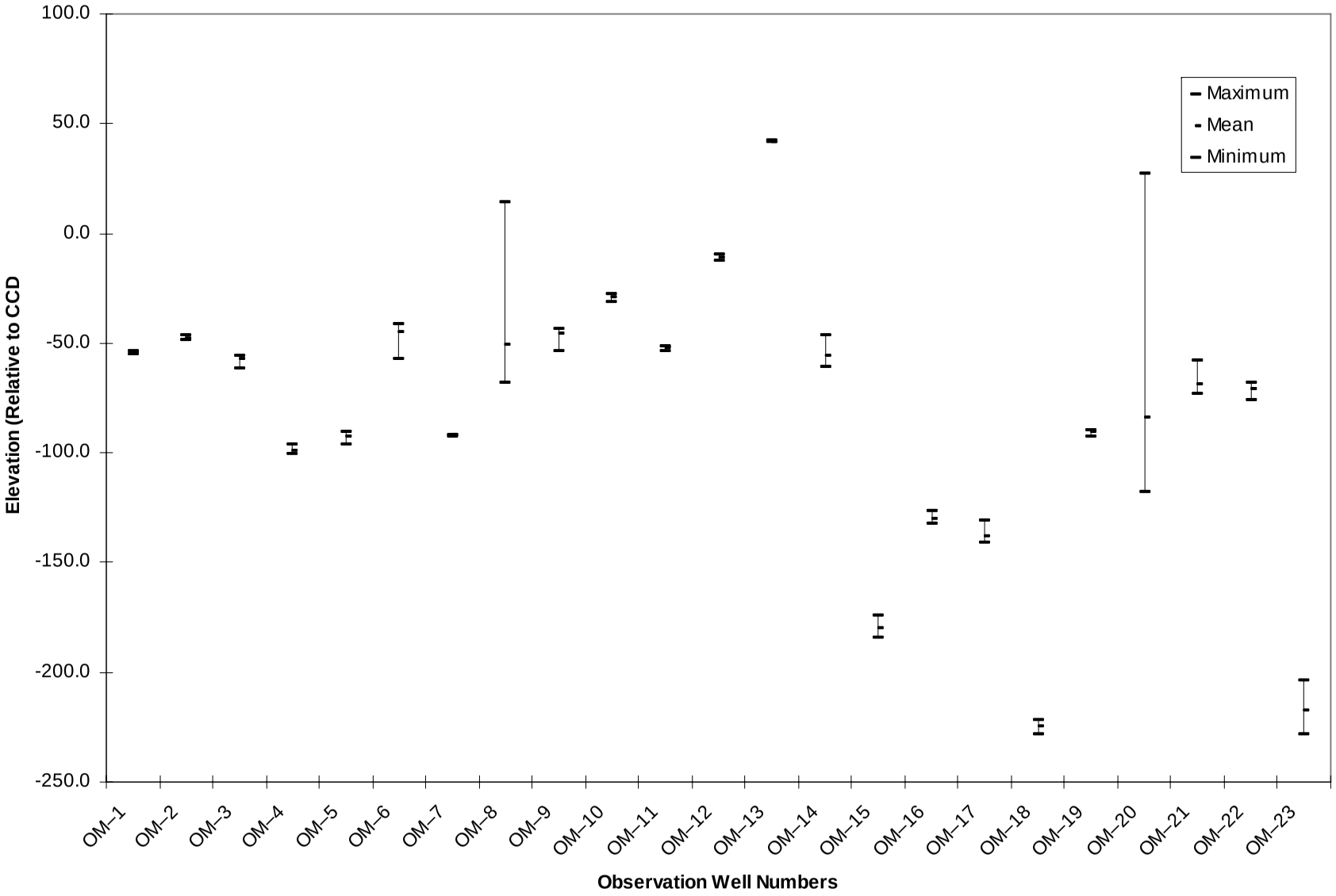
Parameter		Well Number				
		QM–78	QM–79	QM–80	QM–81	QM–82
Cl	Minimum	12	19	14	20	28
mg/L	Mean	25	22	15	21	30
	Maximum	52	27	16	22	32
	Std. Dev.	18	3	1	1	2
	Median	14	21	15	21	30
	Coeff. Var.	73	14	5	5	6
Cond.	Minimum	320	319	214	271	298
µmhos/cm	Mean	400	406	267	313	365
	Maximum	503	522	368	356	445
	Std. Dev.	70	76	59	43	59
	Median	392	384	239	311	350
	Coeff. Var.	17	19	22	14	16
FC[1]	Minimum	1	1	1	1	1
cfu/100 mL	Geo. Mean	1	1	1	1	1
	Maximum	1	2	1	1	1
	Geo. Std. Dev.	0	1	0	0	0
	Median	1	1	1	1	1
	Coeff. Var.	0	36	0	0	0
Hard.	Minimum	10	8	20	28	13
mg/L	Mean	10	10	21	28	14
	Maximum	11	10	21	29	14
	Std. Dev.	0	1	1	1	1
	Median	10	10	21	28	14
	Coeff. Var.	4	8	2	2	4
NH_4^+–N[2]	Minimum	0.02	0.02	0.02	0.05	0.02
mg/L	Mean	0.04	0.04	0.03	0.06	0.03
	Maximum	0.07	0.10	0.05	0.07	0.06
	Std. Dev.	0.02	0.03	0.01	0.01	0.02
	Median	0.04	0.03	0.02	0.05	0.03
	Coeff. Var.	51.29	77.46	46.91	20.38	52.54

TABLE 5 (Continued): SUMMARY STATISTICS OF THE 2007 DATA FOR THE WATER QUALITY MONITORING WELLS IN THE MAINSTREAM TUNNEL SYSTEM: WELLS QM–78 THROUGH QM–82

Parameter		Well Number				
		QM–78	QM–79	QM–80	QM–81	QM–82
pH	Minimum	7.4	7.7	7.5	7.4	7.5
	Mean	8.2	8.2	8.1	7.9	8.2
	Maximum	9.1	9.0	8.8	8.4	8.8
	Std. Dev.	0.7	0.6	0.5	0.5	0.5
	Median	8.1	8.0	8.0	7.8	8.1
	Coeff. Var.	8.3	7.4	6.7	6.4	6.3
SO_4	Minimum	43	14	1	9	6
mg/L	Mean	47	17	4	10	9
	Maximum	52	23	7	12	12
	Std. Dev.	4	3	2	2	2
	Median	47	17	4	10	9
	Coeff. Var.	8	20	59	15	26
TDS	Minimum	310	198	182	212	270
mg/L	Mean	367	315	1,456	232	892
	Maximum	474	380	7,690	248	3,956
	Std. Dev.	68	61	3,054	18	1,501
	Median	339	326	208	236	283
	Coeff. Var.	19	19	210	8	168
TOC	Minimum	0.2	0.5	0.2	0.4	0.8
mg/L	Mean	0.2	0.6	0.3	0.5	1.0
	Maximum	0.3	0.9	0.4	0.6	1.1
	Std. Dev.	0.1	0.2	0.1	0.1	0.1
	Median	0.2	0.6	0.4	0.5	1.0
	Coeff. Var.	0.0	25.8	31.0	20.0	12.5

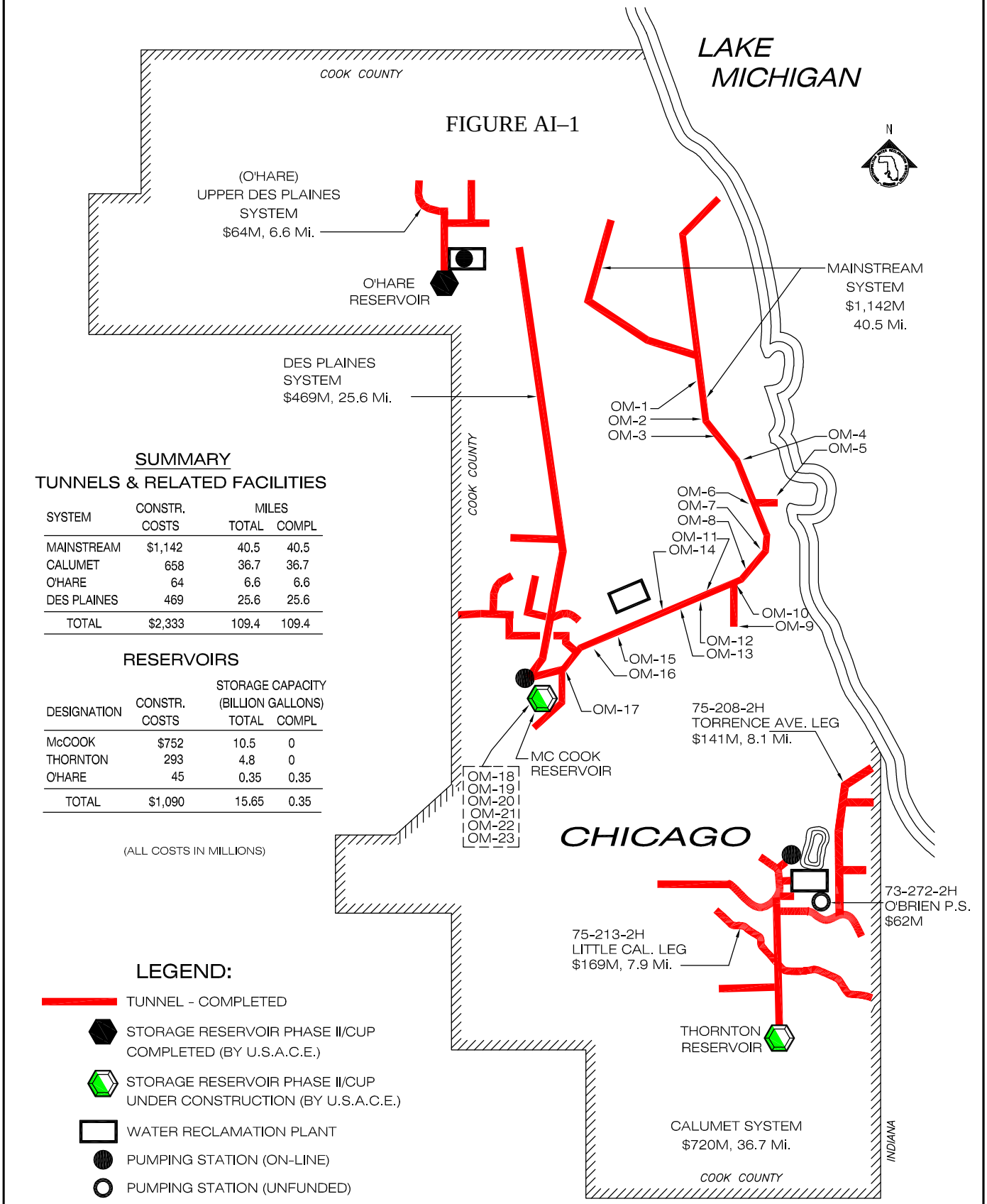
[1]For purposes of statistical evaluation, fecal coliform values less than 1 were set equal to 1.
[1]For purposes of statistical evaluation, ammonium nitrogen values less than 0.02 mg/L were set equal to 0.02 mg/L.

FIGURE 1: 2007 MINIMUM, MEAN, AND MAXIMUM WATER LEVEL ELEVATIONS FOR THE MAINSTREAM TUNNEL SYSTEM OBSERVATION WELLS



APPENDIX AI

LOCATION MAP OF GROUNDWATER OBSERVATION WELLS OM–1 THROUGH OM–23 IN THE MAINSTREAM TUNNEL SYSTEM



MAINSTREAM TUNNEL SYSTEM LOCATION MAP OF GROUNDWATER OBSERVATION WELLS

METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO

I:\DMAC\MAINSTREAMObservationUpdated.dwg, 08/16/06 at 14.19

APPENDIX AII

2007 GROUNDWATER LEVEL ELEVATION DATA FOR OBSERVATION WELLS OM–1 THROUGH OM–23 IN THE MAINSTREAM TUNNEL SYSTEM

TABLE AII–1: 2007 GROUNDWATER LEVEL ELEVATION* DATA FOR OBSERVATION WELLS OM–1 THROUGH OM–23 IN THE MAINSTREAM TUNNEL SYSTEM

Date	Observation Well											
	OM–1	OM–2	OM–3	OM–4	OM–5	OM–6	OM–7	OM–8	OM–9	OM–10	OM–11	OM–12
	feet											
2/23/07	-53.8	**	-55.7	-96.6	-92.5	-43.4	-92.6	-68.2	-44.8	-30.0	-53.4	-10.7
4/13/07	-54.8	-48.7	-55.7	-99.6	-92.5	-42.4	-91.6	13.8	-44.8	-29.0	-51.4	-10.7
6/1/07	-54.8	-48.7	-56.7	-99.6	-91.5	-42.4	-91.6	***	-44.8	-30.0	-52.4	-9.7
8/3/07	-54.8	-47.7	-55.7	-99.6	-90.5	-57.4	-91.6	-65.2	-53.8	-29.0	-51.4	-11.7
10/12/07	-53.8	-46.7	-57.7	-100.6	-91.5	-41.4	-91.6	-68.2	-44.8	-31.0	-53.4	-12.7
12/21/07	-53.8	**	-61.7	-100.6	-96.5	-43.4	-91.6	-66.2	-43.8	-28.0	-51.4	-9.7
Minimum	-54.8	-48.7	-61.7	-100.6	-96.5	-57.4	-92.6	-68.2	-53.8	-31.0	-53.4	-12.7
Mean	-54.3	-48.0	-57.2	-99.4	-92.5	-45.1	-91.8	-50.8	-46.1	-29.5	-52.2	-10.9
Maximum	-53.8	-46.7	-55.7	-96.6	-90.5	-41.4	-91.6	13.8	-43.8	-28.0	-51.4	-9.7

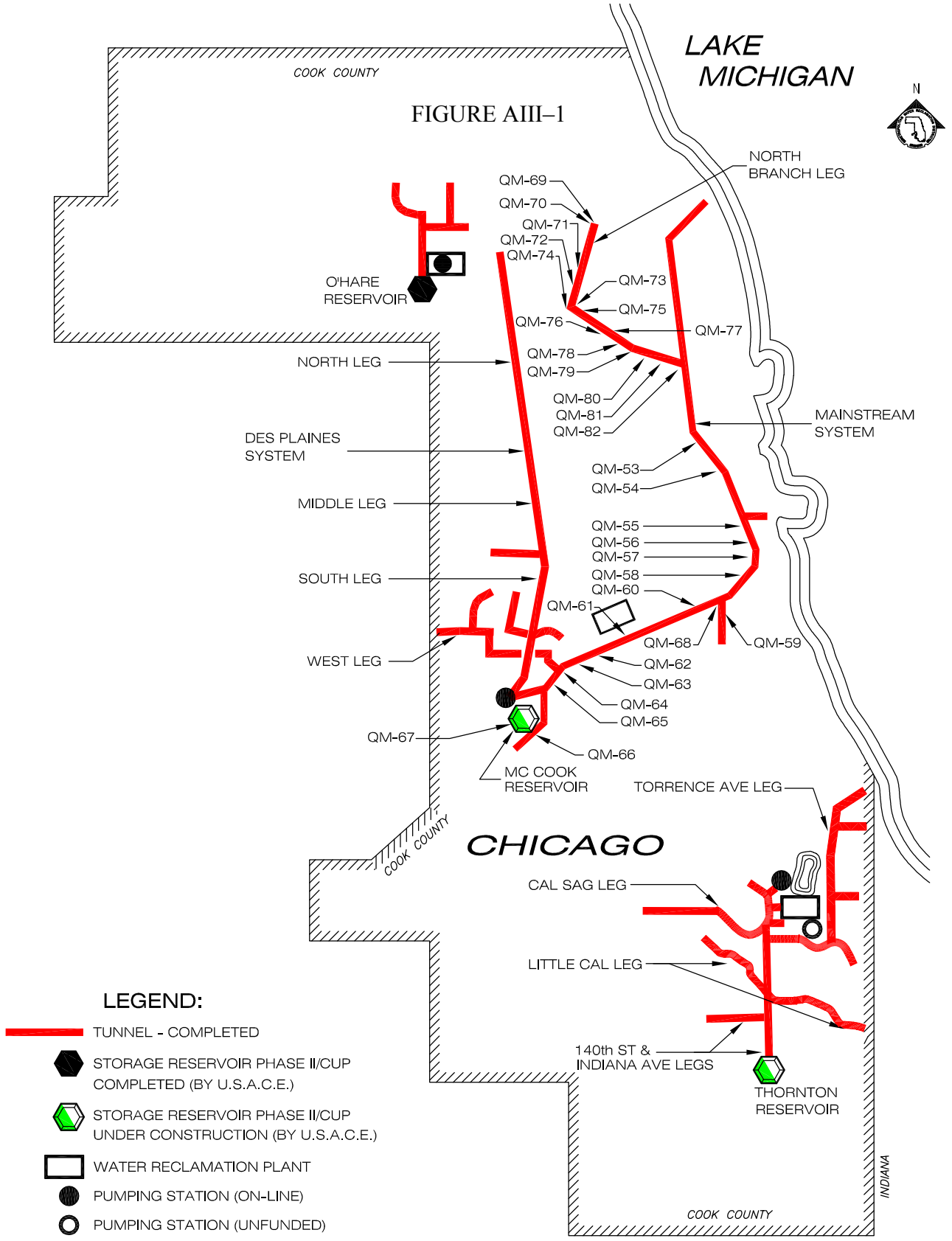
TABLE AII–1 (Continued): 2007 GROUNDWATER LEVEL ELEVATION* DATA FOR OBSERVATION WELLS OM–1 THROUGH OM–23 IN THE MAINSTREAM TUNNEL SYSTEM

Date	Observation Well										
	OM–13	OM–14	OM–15	OM–16	OM–17	OM–18	OM–19	OM–20	OM–21	OM–22	OM–23
	feet										
2/23/07	41.4	-55.8	-174.3	-126.7	-137.0	-223.0	-92.5	27.1	-67.9	-71.3	-203.7
4/13/07	42.4	-46.8	-184.3	-130.7	-140.0	-221.5	-89.5	**	-57.9	-68.3	-228.7
6/1/07	42.4	-57.8	-181.3	-130.7	-141.0	-228.0	-89.5	-115.9	-70.9	-70.3	-217.7
8/3/07	41.4	-55.8	-184.3	-132.7	-131.0	-224.0	-90.5	-101.9	-71.9	-69.3	-214.7
10/12/07	41.4	-60.8	-178.3	-130.7	-140.0	-228.0	-89.5	-117.9	-72.9	-71.3	-214.7
12/21/07	41.4	-58.8	-178.3	-128.7	-139.0	-225.0	-90.5	-111.9	-71.9	-76.3	-227.7
Minimum	41.4	-60.8	-184.3	-132.7	-141.0	-228.0	-92.5	-117.9	-72.9	-76.3	-228.7
Mean	41.7	-56.0	-180.1	-130.0	-138.0	-224.9	-90.3	-84.1	-68.9	-71.1	-217.9
Maximum	42.4	-46.8	-174.3	-126.7	-131.0	-221.5	-89.5	27.1	-57.9	-68.3	-203.7

*Relative to Chicago City Datum.
**Access to well blocked by snow.
***Access to well blocked by cement truck.

APPENDIX AIII

LOCATION MAP OF GROUNDWATER QUALITY
MONITORING WELLS QM–53 THROUGH QM–82
IN THE MAINSTREAM TUNNEL SYSTEM



MAINSTREAM TUNNEL SYSTEM LOCATION MAP OF GROUNDWATER QUALITY MONITORING WELLS

METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO

I:\DMAC\MAINSTREAMMonitor Updated.dwg, 08/16/06 at 14.40

APPENDIX AIV

2007 GROUNDWATER QUALITY MONITORING DATA FOR WELLS QM–53 THROUGH QM–82 IN THE MAINSTREAM TUNNEL SYSTEM

TABLE AIV–1: 2007 pH, CONDUCTIVITY, TEMPERATURE, HARDNESS, AMMONIA NITROGEN, AND CHLORIDE DATA FOR WATER QUALITY MONITORING WELLS QM–53 THROUGH QM–82 IN THE MAINSTREAM TUNNEL SYSTEM

Well	Date of Sampling	pH[1]	Cond.[1] µmhos/cm	Temp. °C	Hard. mg/L	NH_4^+–N mg/L	Cl mg/L
QM–53	2/28/07	7.9	210	11	127	0.02	15
QM–53	5/8/07	7.8	210	12	122	0.05	15
QM–53	7/26/07	7.4	228	13	135	0.08	15
QM–56	2/28/07	8.1	291	12	129	0.41	39
QM–56	5/8/07	7.9	306	14	124	0.43	40
QM–56	7/26/07	7.5	366	14	124	0.46	38
QM–58	4/19/07			Well could not be sampled			
QM–58	6/14/07			Well could not be sampled			
QM–58	11/8/07	7.7	362	13	256	1.03	19
QM–61	2/28/07	7.8	326	12	123	0.21	53
QM–61	5/8/07	8.0	336	14	130	0.20	70
QM–61	8/23/07	7.9	322	14	126	0.32	53
QM–62	1/18/07			Well could not be sampled			
QM–62	3/14/07			Well could not be sampled			
QM–62	5/21/07			Well could not be sampled			
QM–62	7/21/07			Well could not be sampled			
QM–62	9/1/07			Well could not be sampled			
QM–62	11/1/07			Well could not be sampled			
QM–63	1/23/07	7.7	1600	12	766	1.70	48
QM–63	3/14/07	7.8	1604	14	787	1.93	48
QM–63	5/9/07			Well could not be sampled			
QM–63	7/26/07	7.8	735	14	905	2.07	52
QM–63	10/31/07	7.8	612	14	801	1.63	52
QM–63	12/19/07			Well could not be sampled			
QM–64	1/23/07	7.8	674	13	200	1.94	53
QM–64	3/14/07	7.8	702	14	199	1.85	53
QM–64	6/6/07	7.7	507	14	200	1.58	65
QM–64	8/23/07	7.6	411	16	195	1.60	52
QM–64	11/15/07	7.6	334	13	179	1.70	51
QM–64	12/11/07	8.0	352	12	211	1.97	54

TABLE AIV–1 (Continued): 2007 pH, CONDUCTIVITY, TEMPERATURE, HARDNESS, AMMONIA NITROGEN, AND CHLORIDE DATA FOR WATER QUALITY MONITORING WELLS QM–53 THROUGH QM–82 IN THE MAINSTREAM TUNNEL SYSTEM

Well	Date of Sampling	pH[1]	Cond.[1] µmhos/cm	Temp. °C	Hard. mg/L	NH_4^+–N mg/L	Cl mg/L
QM–65	3/8/07	7.8	1140	13	573	10.57	505
QM–65	6/14/07	8.0	1160	14	539	6.15	373
QM–65	7/26/07	7.7	1253	14	549	6.54	378
QM–65	8/28/07	Well could not be sampled					
QM–65	10/31/07	7.5	818	13	558	5.81	348
QM–65	12/19/07	7.1	1350	12	562	5.97	360
QM–66	3/8/07	Well could not be sampled					
QM–66	6/14/07	Well could not be sampled					
QM–66	8/30/07	Well could not be sampled					
QM–67	3/8/07	8.1	824	12	324	7.22	211
QM–67	6/14/07	7.9	945	15	337	7.76	278
QM–67	7/26/07	7.4	1182	15	285	8.16	215
QM–67	8/30/07	8.0	625	14	272	8.48	176
QM–67	10/31/07	7.6	678	14	253	7.90	181
QM–67	12/19/07	7.4	1012	13	263	8.05	198
QM–68	3/8/07	7.9	289	12	200	0.36	32
QM–68	6/14/07	7.8	300	14	186	0.48	31
QM–68	8/30/07	7.8	288	13	173	0.64	27
QM–69	6/7/07	8.3	395	13	153	0.88	38
QM–69	8/23/07	8.2	535	14	159	0.93	38
QM–69	10/25/07	7.6	484	11	152	0.93	38
QM–70	3/8/07	Well could not be sampled					
QM–70	6/14/07	Well could not be sampled					
QM–70	8/23/07	Well could not be sampled					
QM–71	3/8/07	8.0	585	10	205	0.40	128
QM–71	6/14/07	7.8	480	12	197	0.39	135
QM–71	8/23/07	7.8	825	13	207	0.51	117
QM–72	3/8/07	7.2	630	11	213	0.29	137
QM–72	6/7/07	7.9	501	13	205	0.28	131
QM–72	12/13/07	7.5	242	11	223	0.35	131

TABLE AIV–1 (Continued): 2007 pH, CONDUCTIVITY, TEMPERATURE, HARDNESS, AMMONIA NITROGEN, AND CHLORIDE DATA FOR WATER QUALITY MONITORING WELLS QM–53 THROUGH QM–82 IN THE MAINSTREAM TUNNEL SYSTEM

Well	Date of Sampling	pH[1]	Cond.[1] µmhos/cm	Temp. °C	Hard. mg/L	NH_4^+–N mg/L	Cl mg/L
QM–73	3/8/07	7.8	475	11	151	0.23	37
QM–73	6/28/07	7.8	400	13	143	0.24	43
QM–73	12/13/07	7.8	372	11	150	0.23	48
QM–74	3/8/07	8.2	404	11	95	0.19	48
QM–74	6/28/07	8.0	340	12	90	0.14	49
QM–74	8/30/07	7.9	280	12	93	0.21	52
QM–75	1/31/07	7.5	327	10	50	0.29	13
QM–75	3/8/07	8.3	258	11	61	0.20	14
QM–75	4/12/07	8.3	258	11	61	0.34	12
QM–75	6/14/07	7.9	251	12	62	0.20	13
QM–75	8/9/07	7.9	196	13	64	0.24	14
QM–75	10/25/07	7.4	339	12	59	0.24	13
QM–76	1/31/07	7.4	525	10	58	0.25	12
QM–76	4/12/07	8.5	384	11	58	0.36	12
QM–76	8/9/07	8.1	340	13	53	0.22	13
QM–77	1/31/07	7.5	258	10	43	0.16	11
QM–77	4/12/07	8.0	184	10	42	0.22	11
QM–77	8/9/07	7.9	210	13	40	0.11	11
QM–78	3/1/07	9.1	390	11	10	0.05	44
QM–78	3/29/07	8.1	320	11	10	0.02	52
QM–78	5/3/07	7.5	503	12	10	0.03	15
QM–78	6/28/07	8.8	393	12	10	< 0.02	13
QM–78	8/9/07	8.1	336	12	11	0.06	12
QM–78	10/25/07	7.4	456	11	10	0.07	13
QM–79	3/1/07	9.0	390	11	10	< 0.02	19
QM–79	3/29/07	7.9	319	11	10	< 0.02	20
QM–79	5/3/07	7.7	522	11	10	< 0.02	24
QM–79	8/9/07	8.1	357	12	10	0.04	20
QM–79	10/25/07	7.7	470	12	10	0.04	21
QM–79	12/13/07	9.0	377	10	8	0.10	27

TABLE AIV–1 (Continued): 2007 pH, CONDUCTIVITY, TEMPERATURE, HARDNESS, AMMONIA NITROGEN, AND CHLORIDE DATA FOR WATER QUALITY MONITORING WELLS QM–53 THROUGH QM–82 IN THE MAINSTREAM TUNNEL SYSTEM

Well	Date of Sampling	pH[1]	Cond.[1] µmhos/cm	Temp. °C	Hard. mg/L	NH_4^+–N mg/L	Cl mg/L
QM–80	3/1/07	8.7	242	12	21	< 0.02	14
QM–80	3/29/07	8.0	214	12	21	< 0.02	15
QM–80	5/3/07	7.6	308	12	21	0.02	15
QM–80	8/9/07	8.0	236	12	20	0.04	14
QM–80	10/25/07	7.5	368	12	20	0.05	15
QM–80	12/13/07	8.8	234	11	21	0.02	16
QM–81	6/7/07	8.4	311	15	28	0.05	22
QM–81	8/9/07	7.8	271	12	29	0.07	20
QM–81	10/25/07	7.4	356	12	28	0.05	21
QM–82	3/1/07	8.7	357	11	14	< 0.02	29
QM–82	3/29/07	7.9	298	12	14	0.02	29
QM–82	5/3/07	7.5	445	13	13	0.02	32
QM–82	8/9/07	8.2	319	13	14	0.05	30
QM–82	10/25/07	7.8	429	13	13	0.06	32
QM–82	12/13/07	8.8	342	11	14	0.03	28

[1]Unfiltered samples, all others were filtered through 0.45 µm membrane.

TABLE AIV–2: 2007 SULFATE, TOTAL ORGANIC CARBON, TOTAL DISSOLVED SOLIDS, FECAL COLIFORM, WATER ELEVATION, AND RECHARGE DATA FOR WATER QUALITY MONITORING WELLS QM–53 THROUGH QM–82 IN THE MAINSTREAM TUNNEL SYSTEM

Well	Date of Sampling	SO_4 mg/L	TOC mg/L	TDS mg/L	FC[1] cfu/100 mL	Water Elevation[2] Feet	Recharge[3] Hours
QM–53	2/28/07	31	0.6	164	<1	-39	<4
QM–53	5/8/07	41	0.4	184	<1	-39	<4
QM–53	7/26/07	30	0.5	236	<1	-39	<4
QM–56	2/28/07	11	0.6	220	<1	-77	<4
QM–56	5/8/07	13	0.5	270	1	-78	<4
QM–56	7/26/07	11	0.5	290	<1	-76	<4
QM–58	4/19/07			Well could not be sampled			
QM–58	6/14/07			Well could not be sampled			
QM–58	11/8/07	168	0.9	464	<1	-109	<4
QM–61	2/28/07	11	0.9	274	<1	-178	<4
QM–61	5/8/07	27	0.7	354	114	-180	<4
QM–61	8/23/07	20	1.3	320	>20,000	-154	<4
QM–62	1/18/07			Well could not be sampled			
QM–62	3/14/07			Well could not be sampled			
QM–62	5/21/07			Well could not be sampled			
QM–62	7/21/07			Well could not be sampled			
QM–62	9/1/07			Well could not be sampled			
QM–62	11/1/07			Well could not be sampled			
QM–63	1/23/07	2,266	1.9	1,514	<1	-190	<4
QM–63	3/14/07	768	1.8	1,574	<1	-193	<4
QM–63	5/9/07			Well could not be sampled			
QM–63	7/26/07	882	1.9	1,840	<1	-178	<4
QM–63	10/31/07	922	1.7	1,558	<1	-172	<4
QM–63	12/19/07			Well could not be sampled			
QM–64	1/23/07	38	1.1	506	6	-169	<4
QM–64	3/14/07	41	1.1	574	2	-173	<4
QM–64	6/6/07	41	1.1	514	<1	-165	<4
QM–64	8/23/07	41	1.2	422	3,600	-152	<4

TABLE AIV–2 (Continued): 2007 SULFATE, TOTAL ORGANIC CARBON, TOTAL DISSOLVED SOLIDS, FECAL COLIFORM, WATER ELEVATION, AND RECHARGE DATA FOR WATER QUALITY MONITORING WELLS QM–53 THROUGH QM–82 IN THE MAINSTREAM TUNNEL SYSTEM

Well	Date of Sampling	SO_4 mg/L	TOC mg/L	TDS mg/L	FC[1] cfu/100 mL	Water Elevation[2] Feet	Recharge[3] Hours
QM–64	11/15/07	42	1.0	474	<1	-169	<4
QM–64	12/11/07	45	1.0	458	<1	-167	<4
QM–65	3/8/07	175	7.3	1,610	<1	-204	<48
QM–65	6/14/07	209	4.7	1,352	<1	-195	<48
QM–65	7/26/07	194	5.1	1,388	<1	-189	<48
QM–65	8/28/07			Well could not be sampled			
QM–65	10/31/07	232	4.9	1,394	<1	-196	<48
QM–65	12/19/07	209	4.4	1,344	<1	-193	<48
QM–66	3/8/07			Well could not be sampled			
QM–66	6/14/07			Well could not be sampled			
QM–66	8/30/07			Well could not be sampled			
QM–67	3/8/07	29	3.2	818	2,000	-169	<48
QM–67	6/14/07	19	2.6	860	35	-173	<48
QM–67	7/26/07	17	3.2	780	1,600	-156	<48
QM–67	8/30/07	10	3.2	662	3,300	-161	<48
QM–67	10/31/07	11	2.9	736	2,400	-165	<48
QM–67	12/19/07	22	2.8	748	860	-166	<48
QM–68	3/8/07	37	0.6	310	<1	-138	<48
QM–68	6/14/07	36	0.5	284	<1	-139	<48
QM–68	8/30/07	30	0.6	288	12	-116	<48
QM–69	6/7/07	46	0.9	324	<1	-35	<48
QM–69	8/23/07	40	1.0	350	9	-35	<48
QM–69	10/25/07	42	0.9	326	<1	-38	<48
QM–70	3/8/07			Well could not be sampled			
QM–70	6/14/07			Well could not be sampled			
QM–70	8/23/07			Well could not be sampled			

TABLE AIV–2 (Continued): 2007 SULFATE, TOTAL ORGANIC CARBON, TOTAL DISSOLVED SOLIDS, FECAL COLIFORM, WATER ELEVATION, AND RECHARGE DATA FOR WATER QUALITY MONITORING WELLS QM–53 THROUGH QM–82 IN THE MAINSTREAM TUNNEL SYSTEM

Well	Date of Sampling	SO_4 mg/L	TOC mg/L	TDS mg/L	FC[1] cfu/100 mL	Water Elevation[2] Feet	Recharge[3] Hours
QM–71	3/8/07	67	0.8	496	<1	-55	<48
QM–71	6/14/07	71	0.8	510	<1	-55	<48
QM–71	8/23/07	62	0.7	512	1	-57	<48
QM–72	3/8/07	1	0.8	436	<1	-74	<48
QM–72	6/7/07	1	0.6	458	<1	-74	<48
QM–72	12/13/07	2	0.5	466	<1	-72	<48
QM–73	3/8/07	1	1.1	310	<1	-150	<48
QM–73	6/28/07	3	1.3	318	<1	-162	<48
QM–73	12/13/07	3	1.0	298	<1	-162	<48
QM–74	3/8/07	<0.4	1.2	252	<1	-55	<48
QM–74	6/28/07	2	1.7	248	<1	-19	<48
QM–74	8/30/07	1	1.2	236	<1	-27	<48
QM–75	1/31/07	9	0.9	194	<1	-55	<48
QM–75	3/8/07	10	0.6	226	<1	-62	<48
QM–75	4/12/07	12	0.5	262	<1	-61	<48
QM–75	6/14/07	9	0.7	240	<1	-64	<48
QM–75	8/9/07	8	0.7	236	<1	-62	<48
QM–75	10/25/07	10	0.6	212	1	-64	<48
QM–76	1/31/07	66	0.8	342	<1	-180	<48
QM–76	4/12/07	75	0.6	330	<1	-182	<48
QM–76	8/9/07	61	0.9	360	<1	-187	<48
QM–77	1/31/07	2	2.4	156	1	-174	<48
QM–77	4/12/07	96	0.9	204	<1	-171	<48
QM–77	8/9/07	1	0.7	190	<1	-176	<48
QM–78	3/1/07	49	0.3	430	<1	-153	<48
QM–78	3/29/07	52	0.2	474	<1	-157	<48
QM–78	5/3/07	44	0.3	312	<1	-155	<48
QM–78	6/28/07	49	0.2	336	<1	-157	<48

TABLE AIV–2 (Continued): 2007 SULFATE, TOTAL ORGANIC CARBON, TOTAL DISSOLVED SOLIDS, FECAL COLIFORM, WATER ELEVATION, AND RECHARGE DATA FOR WATER QUALITY MONITORING WELLS QM–53 THROUGH QM–82 IN THE MAINSTREAM TUNNEL SYSTEM

Well	Date of Sampling	SO_4 mg/L	TOC mg/L	TDS mg/L	FC[1] cfu/100 mL	Water Elevation[2] Feet	Recharge[3] Hours
QM–78	8/9/07	43	0.2	342	<1	-154	<48
QM–78	10/25/07	44	0.2	310	<1	-158	<48
QM–79	3/1/07	19	0.5	324	<1	-143	<48
QM–79	3/29/07	18	0.6	322	<1	-143	<48
QM–79	5/3/07	23	0.5	340	<1	-137	<48
QM–79	8/9/07	15	0.9	198	<1	-144	<48
QM–79	10/25/07	15	0.5	328	<1	-142	<48
QM–79	12/13/07	14	0.6	380	<1	-145	<48
QM–80	3/1/07	3	0.4	208	<1	-136	<48
QM–80	3/29/07	2	0.2	196	<1	-136	<48
QM–80	5/3/07	4	0.3	208	<1	-135	<48
QM–80	8/9/07	1	0.4	7,690	<1	-137	<48
QM–80	10/25/07	4	0.2	182	<1	-136	<48
QM–80	12/13/07	7	0.4	254	<1	-138	<48
QM–81	6/7/07	12	0.5	236	<1	-131	<48
QM–81	8/9/07	9	0.6	248	<1	-132	<48
QM–81	10/25/07	10	0.4	212	<1	-135	<48
QM–82	3/1/07	9	1.1	286	<1	-185	<48
QM–82	3/29/07	8	1.0	270	<1	-189	<48
QM–82	5/3/07	12	0.9	288	<1	-186	<48
QM–82	8/9/07	6	1.1	3,956	<1	-186	<48
QM–82	10/25/07	8	0.9	280	<1	-185	<48
QM–82	12/13/07	12	0.8	270	<1	-189	<48

[1]Unfiltered samples, all others were filtered through 0.45 µm membrane.
[2]Water level elevations are relative to Chicago City Datum.
[3]Refers to elapsed time after initial drawdown before the well recovered sufficiently for sampling.