

*Protecting Our Water Environment*



*Metropolitan Water Reclamation District of Greater Chicago*

***MONITORING AND RESEARCH  
DEPARTMENT***

***REPORT NO. 12-30***

***TUNNEL AND RESERVOIR PLAN***

***CALUMET 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, Calumet Tunnel System, 2011 Annual  
Groundwater Monitoring Report

Enclosed are three copies of "Tunnel and Reservoir Plan, Calumet 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  
CALUMET TUNNEL SYSTEM  
2011 ANNUAL GROUNDWATER MONITORING REPORT

## TABLE OF CONTENTS

	<u>Page</u>
LIST OF TABLES	ii
LIST OF FIGURES	iii
INTRODUCTION	1
MONITORING DATA	2
SUMMARY OF DATA	3
Observation Well Groundwater Elevation Data	3
Monitoring Well Groundwater Quality Data	3
APPENDICES	
Location Map of Observation Wells OC-1 Through OC-11 in the Calu- met Tunnel System	AI
2011 Groundwater Elevation Data for Observation Wells OC-1 Through OC-11 in the Calumet Tunnel System	AII
Location Map of Monitoring Wells QC-1, QC-2, QC-2.1, QC-2.2, and QC-3 Through QC-37 in the Calumet Tunnel System	AIII
2011 Groundwater Quality Data for Monitoring Wells QC-1, QC-2, QC- 2.1, QC-2.2, QC-4 through QC-7, and QC-9 Through QC-37 in the Ca- lumet Tunnel System	AIV

## LIST OF TABLES

Table No		Page
1	Summary Statistics of the 2011 Groundwater Quality Data for the Monitoring Wells in the Calumet Tunnel System: Monitoring Wells QC-2, QC-2.1, QC-2.2, QC-4, and QC-5	5
2	Summary Statistics of the 2011 Groundwater Quality Data for the Monitoring Wells in the Calumet Tunnel System: Monitoring Wells QC-6, QC-7, and QC-9 Through QC-11	7
3	Summary Statistics of the 2011 Groundwater Quality Data for the Monitoring Wells in the Calumet Tunnel System: Monitoring Wells QC-12 Through QC-16	9
4	Summary Statistics of the 2011 Groundwater Quality Data for the Monitoring Wells in the Calumet Tunnel System: Monitoring Wells QC-17 Through QC-21	11
5	Summary Statistics of the 2011 Groundwater Quality Data for the Monitoring Wells in the Calumet Tunnel System: Monitoring Wells QC-22 Through QC-26	13
6	Summary Statistics of the 2011 Groundwater Quality Data for the Monitoring Wells in the Calumet Tunnel System: Monitoring Wells QC-27 Through QC-30	15
7	Summary Statistics of the 2011 Groundwater Quality Data for the Monitoring Wells in the Calumet Tunnel System: Monitoring Wells QC-31, QC-35, and QC-36	17
AII-1	2011 Groundwater Elevation Data for Observation Wells OC-1 through OC-11 in the Calumet Tunnel System	AII-1
AIV-1	2011 Chloride, Fecal Coliform, Sulfate, Ammonia Nitrogen, Total Organic Carbon, and Total Dissolved Solids Data for Monitoring Wells QC-1, QC-2, QC-2.1, QC-2.2, QC-4 through QC-7, and QC-9 through QC-37 in the Calumet Tunnel System	AIV-1
AIV-2	2011 Hardness, Conductivity, pH, Temperature, Elevation, and Recharge Data for Monitoring Wells QC-1, QC-2, QC-2.1, QC-2.2, QC-4 through QC-7, and QC-9 through QC-37 in the Calumet Tunnel System	AIV-7

## LIST OF FIGURES

<u>Figure No.</u>		<u>Page</u>
1	2011 Minimum, Mean, and Maximum Groundwater Elevations for the Calumet Tunnel System Observation Wells	4
AI-1	Calumet Tunnel System Location Map of Observation Wells	AI-1
AIII-1	Calumet Tunnel System Location Map of Monitoring Wells	AIII-1

## INTRODUCTION

This report contains 2011 data for the Tunnel and Reservoir Plan Calumet Tunnel System compiled from monitoring groundwater elevations in observation wells and monitoring groundwater quality in monitoring wells. The observation and monitoring wells are located along the Calumet Tunnel System. The tunnel between Crawford Avenue and the Calumet Water Reclamation Plant has four monitoring wells (QC-1, QC-2, QC-2.1, and QC-2.2) and 11 observation wells (OC-1 through OC-11). The tunnel between 140th Street and Indiana Avenue has 17 monitoring wells (QC-3 through QC-19). The tunnel on the Torrence Avenue leg has nine monitoring wells (QC-20 through QC-28). The tunnel along the Little Calumet leg has nine monitoring wells (QC-29 through QC-37). Monitoring well QC-3, located along the tunnel between 140th Street and Indiana Avenue, is no longer being sampled, because of construction being directed by the Village of South Holland. The Metropolitan Water Reclamation District of Greater Chicago has been given permission by the Illinois Environmental Protection Agency (IEPA) to abandon monitoring well QC-3 (IEPA memorandum April 22, 2008).

Monitoring wells QC-1, QC-2, and QC-29 through QC-37 are sampled six times per year (IEPA memorandum July 9, 2004). Monitoring wells QC-2.1, QC-2.2, QC-4 through QC-7 (QC-8.1 is a dry well), and QC-9 through QC-28 are sampled three times per year (IEPA memorandum July 9, 2004, and February 23, 2006). Groundwater elevation readings are taken at the monitoring wells at the same frequency. Groundwater elevations are measured in observation wells OC-1 through OC-11 once every two weeks.

## MONITORING DATA

Appendix AI contains a location map of observation wells OC-1 through OC-11 located along the Calumet Tunnel System.

Table AII-1 in Appendix AII contains groundwater elevation data for 2011 for observation wells OC-1 through OC-11 shown in Appendix AI. 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 QC-1, QC-2, QC-2.1, QC-2.2, QC-3 through QC-7, QC-8.1, and QC-9 through QC-37 located along the Calumet Tunnel System.

Tables AIV-1 and AIV-2 in Appendix AIV contain the 2011 groundwater quality monitoring data for monitoring wells QC-1, QC-2, QC-2.1, QC-2.2, QC-4 through QC-7, and QC-9 through QC-37 along the Calumet Tunnel System shown in Appendix AIII. Monitoring well QC-3 has been abandoned due to construction, and monitoring well QC-8.1 is a dry well.

All of the monitoring wells in the Calumet system were visited for the required number of samples. However, in some instances the samples could not be collected. Monitoring well QC-1 could not be monitored during 2011 because the pump was inoperable. A work order has been issued to repair the pump. Monitoring well QC-30 could not be sampled on June 23, 2011, because construction blocked access to the well. Monitoring wells QC-32 through QC-34 and QC-37 could not be sampled during 2011, because there was insufficient water in these wells to collect a sample. Monitoring well QC-35 could not be sampled on April 14, 2011, June 23, 2011, August 26, 2011, and October 28, 2011, because there was insufficient water in the well to collect a sample. Monitoring well QC-36 could not be sampled on April 14, 2011, June 23, 2011, August 26, 2011, October 28, 2011, and December 2, 2011, because there was insufficient water in the well to collect a sample.



## SUMMARY OF DATA

### Observation Well Groundwater Elevation Data

In Figure 1, the 2011 groundwater elevation data for the observation wells (OC-1 through OC-11) of the Calumet Tunnel System have been plotted. In this figure, yearly minimum, mean, and maximum groundwater elevations of all 11 observation wells are plotted to show fluctuations in the groundwater elevations during 2011. Table AII-1 in Appendix AII contains the entire groundwater elevation data for 2011 for all the observation wells in the Calumet Tunnel System.

### Monitoring Well Groundwater Quality Data

Tables 1 through 7 contain summary statistics of the groundwater quality parameters for 2011 for monitoring wells QC-2, QC-2.1, QC-2.2, QC-4 through QC-6, QC-9 through QC-31, QC-35, and QC-36 in the Calumet Tunnel System. The summary statistics include minimum, mean, maximum, standard deviation (Stdv.), median and coefficient of variation (COV) for eight groundwater quality parameters analyzed during 2011. The eight groundwater quality parameters are: chloride (Cl), conductivity (Cond.), hardness as calcium carbonate (Hard.), ammonia nitrogen (NH<sub>3</sub>-N), pH, sulfate (SO<sub>4</sub>), total dissolved solids (TDS), and total organic carbon (TOC). The summary statistics for a ninth groundwater quality parameter, fecal coliform (FC), are minimum, geometric mean (Geo. Mean), maximum, and median. The statistical analysis of the data was conducted using Microsoft<sup>®</sup> Excel functions.

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

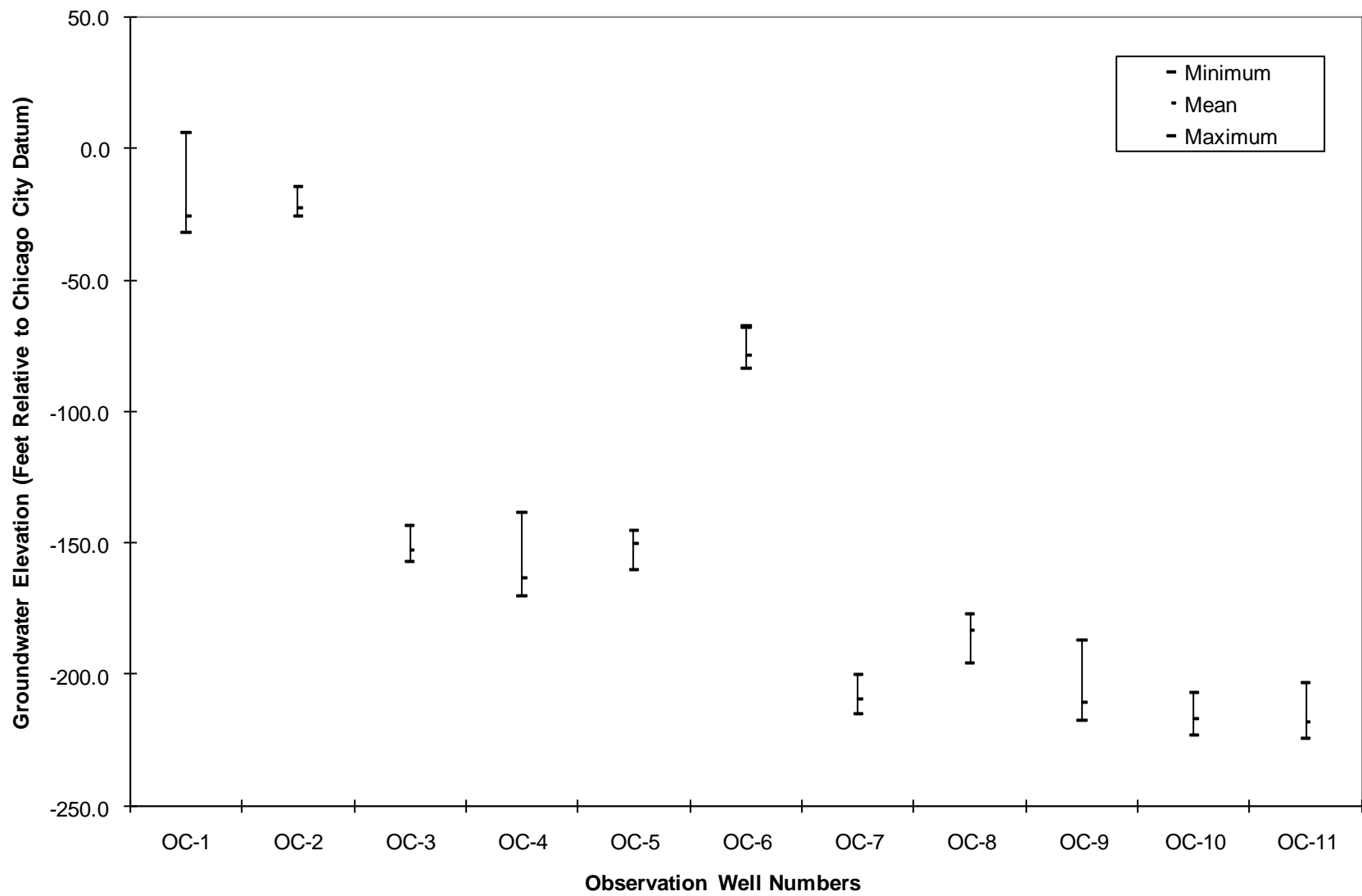


TABLE 1: SUMMARY STATISTICS OF THE 2011 GROUNDWATER QUALITY DATA FOR THE MONITORING WELLS IN THE CALUMET TUNNEL SYSTEM: MONITORING WELLS QC-2, QC-2.1, QC-2.2, QC-4, AND QC-5

Parameter <sup>1</sup>		Monitoring Well Number				
		QC-2	QC-2.1	QC-2.2	QC-4	QC-5
Cl mg/L	Minimum	34.0	18.0	13.0	10.0	30.0
	Mean	37.3	28.7	20.0	10.0	31.0
	Maximum	40.0	35.0	32.0	10.0	32.0
	Stdv	2.3	9.3	10.4	0.0	1.0
	Median	38.0	33.0	15.0	10.0	31.0
	COV	6.3	32.4	52.2	0.0	3.2
FC CFU/100 mL	Minimum	1	1	1	1	1
	Geo. Mean	33	1	3	4	1
	Maximum	220	1	41	60	1
	Median	55	1	1	1	1
SO <sub>4</sub> mg/L	Minimum	22	15	19	15	15
	Mean	26	15	23	15	15
	Maximum	31	15	25	15	15
	Stdv	3	0	3	0	0
	Median	25	15	24	15	15
	COV	13	0	15	0	0
NH <sub>3</sub> -N mg/L	Minimum	0.36	0.29	0.18	0.12	0.11
	Mean	0.53	0.51	0.30	0.16	0.13
	Maximum	0.72	0.68	0.45	0.21	0.17
	Stdv	0.16	0.20	0.14	0.05	0.03
	Median	0.51	0.56	0.27	0.14	0.12
	COV	30.73	39.17	45.83	30.16	24.11
TOC mg/L	Minimum	1.00	1.00	1.20	1.00	1.20
	Mean	1.42	1.10	1.27	1.00	1.27
	Maximum	1.60	1.20	1.30	1.00	1.30
	Stdv	0.24	0.10	0.06	0.00	0.06
	Median	1.50	1.10	1.30	1.00	1.30
	COV	16.95	9.09	4.56	0.00	4.56

TABLE 1 (Continued): SUMMARY STATISTICS OF THE 2011 GROUNDWATER QUALITY DATA FOR THE MONITORING WELLS IN THE CALUMET TUNNEL SYSTEM: MONITORING WELLS QC-2, QC-2.1, QC-2.2, QC-4, AND QC-5

Parameter <sup>1</sup>		Monitoring Well Number				
		QC-2	QC-2.1	QC-2.2	QC-4	QC-5
TDS mg/L	Minimum	354	454	352	422	552
	Mean	362	500	381	439	585
	Maximum	372	524	436	468	644
	Stdv	9	40	47	25	51
	Median	362	522	356	428	558
	COV	3	8	12	6	9
Hard. mg/L	Minimum	87	39	40	10	9
	Mean	91	54	51	14	17
	Maximum	94	64	67	17	33
	Stdv	3	13	14	4	14
	Median	91	58	45	14	9
	COV	3	24	28	26	82
Cond. µmhos/cm	Minimum	346	632	412	407	637
	Mean	419	655	450	522	666
	Maximum	573	673	512	595	721
	Stdv	88	21	54	100	48
	Median	386	659	426	563	640
	COV	21	3	12	19	7
pH unit	Minimum	7.7	7.6	7.9	8.2	8.3
	Mean	7.9	7.9	8.2	8.4	8.5
	Maximum	8.1	8.1	8.7	8.8	8.8
	Stdv	0.2	0.3	0.4	0.3	0.2
	Median	7.9	7.8	8.1	8.3	8.4
	COV	1.9	3.4	4.8	3.2	2.7

<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. Any FC concentration less than the detection limit was set equal to the detection limit.

TABLE 2: SUMMARY STATISTICS OF THE 2011 GROUNDWATER QUALITY DATA FOR THE MONITORING WELLS IN THE CALUMET TUNNEL SYSTEM: MONITORING WELLS QC-6, QC-7, AND QC-9 THROUGH QC-11

Parameter <sup>1</sup>		Monitoring Well Number				
		QC-6	QC-7	QC-9	QC-10	QC-11
Cl mg/L	Minimum	13.0	10.0	10.0	27.0	18.0
	Mean	14.3	13.3	10.0	29.3	20.0
	Maximum	15.0	18.0	10.0	31.0	22.0
	Stdv	1.2	4.2	0.0	2.1	2.0
	Median	15.0	12.0	10.0	30.0	20.0
	COV	8.1	31.2	0.0	7.1	10.0
FC CFU/100 mL	Minimum	1	1	1	1	1
	Geo. Mean	1	1	1	1	1
	Maximum	1	1	1	1	1
	Median	1	1	1	1	1
SO <sub>4</sub> mg/L	Minimum	15	15	29	15	15
	Mean	15	15	31	31	15
	Maximum	15	15	35	64	15
	Stdv	0	0	4	28	0
	Median	15	15	30	15	15
	COV	0	0	11	90	0
NH <sub>3</sub> -N mg/L	Minimum	0.30	0.18	0.10	0.11	0.10
	Mean	0.31	0.22	0.28	0.12	0.13
	Maximum	0.32	0.27	0.53	0.13	0.15
	Stdv	0.01	0.05	0.22	0.01	0.03
	Median	0.31	0.21	0.21	0.11	0.13
	COV	3.23	20.83	79.78	9.90	19.87
TOC mg/L	Minimum	1.40	1.00	1.00	1.00	1.00
	Mean	1.47	1.37	1.33	1.00	1.00
	Maximum	1.50	1.60	1.70	1.00	1.00
	Stdv	0.06	0.30	0.35	0.00	0.00
	Median	1.50	1.50	1.30	1.00	1.00
	COV	3.94	23.52	26.34	0.00	0.00

TABLE 2 (Continued): SUMMARY STATISTICS OF THE 2011 GROUNDWATER QUALITY DATA FOR THE MONITORING WELLS IN THE CALUMET TUNNEL SYSTEM: MONITORING WELLS QC-6, QC-7, AND QC-9 THROUGH QC-11

Parameter <sup>1</sup>	Monitoring Well Number					
	QC-6	QC-7	QC-9	QC-10	QC-11	
TDS mg/L	Minimum	442	400	328	386	276
	Mean	476	451	343	407	295
	Maximum	520	536	366	420	308
	Stdv	40	74	20	18	17
	Median	466	416	334	414	302
	COV	8	16	6	4	6
Hard. mg/L	Minimum	15	11	62	12	20
	Mean	19	13	63	13	20
	Maximum	26	17	64	14	21
	Stdv	6	3	1	1	1
	Median	16	11	64	13	20
	COV	32	27	2	8	3
Cond. µmhos/cm	Minimum	509	420	291	440	383
	Mean	529	471	359	458	498
	Maximum	553	550	455	473	565
	Stdv	22	69	85	17	100
	Median	525	443	333	463	546
	COV	4	15	24	4	20
pH unit	Minimum	8.4	8.2	7.8	7.8	7.6
	Mean	8.5	8.3	8.0	8.1	8.0
	Maximum	8.6	8.4	8.2	8.7	8.7
	Stdv	0.1	0.1	0.2	0.5	0.5
	Median	8.6	8.3	8.2	7.9	7.9
	COV	1.5	1.3	2.9	5.8	6.8

<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. Any FC concentration less than the detection limit was set equal to the detection limit.

TABLE 3: SUMMARY STATISTICS OF THE 2011 GROUNDWATER QUALITY DATA FOR THE MONITORING WELLS IN THE CALUMET TUNNEL SYSTEM: MONITORING WELLS QC-12 THROUGH QC-16

Parameter <sup>1</sup>		Monitoring Well Number				
		QC-12	QC-13	QC-14	QC-15	QC-16
Cl mg/L	Minimum	35.0	50.0	110.0	12.0	22.0
	Mean	37.3	55.0	124.3	12.7	22.7
	Maximum	39.0	58.0	134.0	14.0	23.0
	Stdv	2.1	4.4	12.7	1.2	0.6
	Median	38.0	57.0	129.0	12.0	23.0
	COV	5.6	7.9	10.2	9.1	2.5
FC CFU/100 mL	Minimum	1	1	1	1	1
	Geo. Mean	1	1	1	1	1
	Maximum	1	1	1	1	1
	Median	1	1	1	1	1
SO <sub>4</sub> mg/L	Minimum	264	35	15	15	61
	Mean	295	37	15	15	66
	Maximum	347	41	15	15	70
	Stdv	45	3	0	0	5
	Median	274	35	15	15	66
	COV	15	9	0	0	7
NH <sub>3</sub> -N mg/L	Minimum	0.36	0.16	0.16	0.15	0.10
	Mean	0.40	0.19	0.23	0.18	0.10
	Maximum	0.46	0.21	0.26	0.22	0.10
	Stdv	0.05	0.03	0.06	0.04	0.00
	Median	0.39	0.19	0.26	0.17	0.10
	COV	12.72	13.48	25.47	20.03	0.00
TOC mg/L	Minimum	1.00	1.00	2.50	1.00	1.00
	Mean	1.00	1.00	2.77	1.23	1.07
	Maximum	1.00	1.00	3.20	1.70	1.20
	Stdv	0.00	0.00	0.38	0.40	0.12
	Median	1.00	1.00	2.60	1.00	1.00
	COV	0.00	0.00	13.68	32.77	10.83

TABLE 3 (Continued): SUMMARY STATISTICS OF THE 2011 GROUNDWATER QUALITY DATA FOR THE MONITORING WELLS IN THE CALUMET TUNNEL SYSTEM: MONITORING WELLS QC-12 THROUGH QC-16

Parameter <sup>1</sup>		Monitoring Well Number				
		QC-12	QC-13	QC-14	QC-15	QC-16
TDS mg/L	Minimum	848	440	676	296	506
	Mean	893	458	705	323	524
	Maximum	934	470	764	356	544
	Stdv	43	16	51	30	19
	Median	898	464	676	318	522
	COV	5	3	7	9	4
Hard. mg/L	Minimum	149	36	122	15	84
	Mean	166	40	130	15	86
	Maximum	191	43	141	15	87
	Stdv	22	4	10	0	2
	Median	159	40	128	15	86
	COV	13	9	7	0	2
Cond. µmhos/cm	Minimum	815	443	448	347	367
	Mean	835	495	732	418	522
	Maximum	845	588	999	470	740
	Stdv	17	80	276	64	194
	Median	844	456	749	436	461
	COV	2	16	38	15	37
pH unit	Minimum	7.4	7.8	7.5	7.8	7.5
	Mean	7.8	7.9	7.7	8.1	7.8
	Maximum	8.0	7.9	7.9	8.4	8.1
	Stdv	0.3	0.1	0.2	0.3	0.3
	Median	8.0	7.9	7.8	8.2	7.9
	COV	4.1	1.0	2.6	4.0	3.5

<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. Any FC concentration less than the detection limit was set equal to the detection limit.



TABLE 4: SUMMARY STATISTICS OF THE 2011 GROUNDWATER QUALITY DATA FOR THE MONITORING WELLS IN THE CALUMET TUNNEL SYSTEM: MONITORING WELLS QC-17 THROUGH QC-21

Parameter <sup>1</sup>		Monitoring Well Number				
		QC-17	QC-18	QC-19	QC-20	QC-21
Cl mg/L	Minimum	10.0	10.0	10.0	18.0	17.0
	Mean	12.0	10.0	10.0	23.0	18.7
	Maximum	15.0	10.0	10.0	33.0	20.0
	Stdv	2.6	0.0	0.0	8.7	1.5
	Median	11.0	10.0	10.0	18.0	19.0
	COV	22.0	0.0	0.0	37.7	8.2
FC CFU/100 mL	Minimum	1	1	1	1	1
	Geo. Mean	4	1	1	1	1
	Maximum	51	1	1	1	1
	Median	1	1	1	1	1
SO <sub>4</sub> mg/L	Minimum	174	28	142	15	15
	Mean	180	30	147	50	43
	Maximum	185	31	150	108	61
	Stdv	6	2	5	51	24
	Median	181	30	150	28	52
	COV	3	5	3	101	57
NH <sub>3</sub> -N mg/L	Minimum	0.25	0.11	0.19	0.12	0.10
	Mean	0.28	0.13	0.26	0.15	0.13
	Maximum	0.31	0.15	0.30	0.17	0.18
	Stdv	0.03	0.02	0.06	0.03	0.04
	Median	0.28	0.13	0.28	0.15	0.12
	COV	10.71	15.38	22.83	17.16	31.22
TOC mg/L	Minimum	1.00	1.00	1.00	1.00	2.50
	Mean	1.17	1.00	1.00	1.03	6.23
	Maximum	1.40	1.00	1.00	1.10	8.90
	Stdv	0.21	0.00	0.00	0.06	3.33
	Median	1.10	1.00	1.00	1.00	7.30
	COV	17.84	0.00	0.00	5.59	53.43

TABLE 4 (Continued): SUMMARY STATISTICS OF THE 2011 GROUNDWATER QUALITY DATA FOR THE MONITORING WELLS IN THE CALUMET TUNNEL SYSTEM: MONITORING WELLS QC-17 THROUGH QC-21

Parameter <sup>1</sup>		Monitoring Well Number				
		QC-17	QC-18	QC-19	QC-20	QC-21
TDS mg/L	Minimum	500	362	432	252	346
	Mean	545	430	452	408	473
	Maximum	570	540	464	606	582
	Stdv	39	96	17	181	119
	Median	566	388	460	366	490
	COV	7	22	4	44	25
Hard. mg/L	Minimum	152	7	103	20	49
	Mean	174	26	106	80	69
	Maximum	198	56	111	158	84
	Stdv	23	27	5	71	18
	Median	172	14	103	63	75
	COV	13	103	4	88	26
Cond. µmhos/cm	Minimum	441	333	423	361	324
	Mean	519	421	433	497	504
	Maximum	623	557	453	730	679
	Stdv	94	119	17	203	178
	Median	493	373	423	401	510
	COV	18	28	4	41	35
pH unit	Minimum	7.3	8.3	7.7	7.2	7.6
	Mean	7.5	8.9	8.3	7.9	7.7
	Maximum	7.7	9.3	8.9	8.3	7.9
	Stdv	0.2	0.5	0.6	0.6	0.1
	Median	7.4	9.0	8.4	8.1	7.7
	COV	3.3	5.7	7.4	7.4	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. Any FC concentration less than the detection limit was set equal to the detection limit.

TABLE 5: SUMMARY STATISTICS OF THE 2011 GROUNDWATER QUALITY DATA FOR THE MONITORING WELLS IN THE CALUMET TUNNEL SYSTEM: MONITORING WELLS QC-22 THROUGH QC-26

Parameter <sup>1</sup>		Monitoring Well Number				
		QC-22	QC-23	QC-24	QC-25	QC-26
Cl mg/L	Minimum	16.0	19.0	28.0	14.0	10.0
	Mean	16.3	20.7	29.0	14.3	17.3
	Maximum	17.0	23.0	30.0	15.0	32.0
	Stdv	0.6	2.1	1.0	0.6	12.7
	Median	16.0	20.0	29.0	14.0	10.0
	COV	3.5	10.1	3.4	4.0	73.3
FC CFU/100 mL	Minimum	1	1	1	1	1
	Geo. Mean	1	1	1	1	1
	Maximum	1	1	1	1	1
	Median	1	1	1	1	1
SO <sub>4</sub> mg/L	Minimum	15	15	15	15	15
	Mean	15	15	15	20	15
	Maximum	15	15	15	30	15
	Stdv	0	0	0	9	0
	Median	15	15	15	15	15
	COV	0	0	0	44	0
NH <sub>3</sub> -N mg/L	Minimum	0.19	0.10	0.12	0.12	0.10
	Mean	0.20	0.10	0.13	0.15	0.10
	Maximum	0.21	0.10	0.14	0.17	0.10
	Stdv	0.01	0.00	0.01	0.03	0.00
	Median	0.20	0.10	0.13	0.15	0.10
	COV	5.00	0.00	7.69	17.16	0.00
TOC mg/L	Minimum	1.70	1.00	1.00	1.00	1.00
	Mean	1.83	1.13	1.00	1.00	1.00
	Maximum	1.90	1.40	1.00	1.00	1.00
	Stdv	0.12	0.23	0.00	0.00	0.00
	Median	1.90	1.00	1.00	1.00	1.00
	COV	6.30	20.38	0.00	0.00	0.00

TABLE 5 (Continued): SUMMARY STATISTICS OF THE 2011 GROUNDWATER QUALITY DATA FOR THE MONITORING WELLS IN THE CALUMET TUNNEL SYSTEM: MONITORING WELLS QC-22 THROUGH QC-26

Parameter <sup>1</sup>		Monitoring Well Number				
		QC-22	QC-23	QC-24	QC-25	QC-26
TDS mg/L	Minimum	172	310	224	208	270
	Mean	299	372	324	280	351
	Maximum	414	470	490	352	474
	Stdv	121	86	145	72	108
	Median	310	336	258	280	308
	COV	41	23	45	26	31
Hard. mg/L	Minimum	34	6	13	20	6
	Mean	40	10	22	32	24
	Maximum	46	17	40	48	58
	Stdv	6	6	16	15	29
	Median	41	7	13	27	8
	COV	15	61	71	46	123
Cond. µmhos/cm	Minimum	270	356	296	194	306
	Mean	345	428	329	262	362
	Maximum	406	499	381	332	468
	Stdv	70	72	45	69	91
	Median	361	428	311	259	313
	COV	20	17	14	26	25
pH unit	Minimum	7.2	8.6	8.1	7.9	7.5
	Mean	7.7	8.9	8.5	8.0	8.4
	Maximum	8.0	9.1	8.9	8.3	9.0
	Stdv	0.4	0.2	0.4	0.2	0.8
	Median	7.8	9.0	8.5	8.0	8.7
	COV	5.2	2.8	4.7	2.5	9.5

<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. Any FC concentration less than the detection limit was set equal to the detection limit.

TABLE 6: SUMMARY STATISTICS OF THE 2011 GROUNDWATER QUALITY DATA FOR THE MONITORING WELLS IN THE CALUMET TUNNEL SYSTEM: MONITORING WELLS QC-27 THROUGH QC-30

Parameter <sup>1</sup>		Monitoring Well Number			
		QC-27	QC-28	QC-29	QC-30
Cl mg/L	Minimum	25.0	10.0	176.0	10.0
	Mean	30.0	12.0	197.8	13.4
	Maximum	33.0	13.0	228.0	27.0
	Stdv	4.4	1.7	20.8	7.6
	Median	32.0	13.0	195.0	10.0
	COV	14.5	14.4	10.5	56.7
FC CFU/100 mL	Minimum	1	1	1	1
	Geo. Mean	1	1	1	1
	Maximum	1	1	1	1
	Median	1	1	1	1
SO <sub>4</sub> mg/L	Minimum	15	15	150	51
	Mean	15	15	170	85
	Maximum	15	15	190	175
	Stdv	0	0	18	51
	Median	15	15	169	72
	COV	0	0	11	60
NH <sub>3</sub> -N mg/L	Minimum	0.13	0.10	0.69	0.10
	Mean	0.14	0.10	0.74	0.25
	Maximum	0.15	0.10	0.77	0.77
	Stdv	0.01	0.00	0.03	0.29
	Median	0.14	0.10	0.76	0.13
	COV	7.14	0.00	4.55	117.88
TOC mg/L	Minimum	1.00	1.20	1.00	1.00
	Mean	1.00	1.23	1.37	1.06
	Maximum	1.00	1.30	1.70	1.20
	Stdv	0.00	0.06	0.25	0.09
	Median	1.00	1.20	1.40	1.00
	COV	0.00	4.68	18.32	8.44

TABLE 6 (Continued): SUMMARY STATISTICS OF THE 2011 GROUNDWATER QUALITY DATA FOR THE MONITORING WELLS IN THE CALUMET TUNNEL SYSTEM: MONITORING WELLS QC-27 THROUGH QC-30

Parameter <sup>1</sup>		Monitoring Well Number			
		QC-27	QC-28	QC-29	QC-30
TDS mg/L	Minimum	236	236	828	320
	Mean	284	307	961	417
	Maximum	348	408	1,102	548
	Stdv	58	90	99	101
	Median	268	278	955	358
	COV	20	29	10	24
Hard. mg/L	Minimum	24	17	306	42
	Mean	24	20	388	98
	Maximum	25	22	518	234
	Stdv	1	3	74	80
	Median	24	21	371	58
	COV	2	13	19	81
Cond. µmhos/cm	Minimum	279	282	845	342
	Mean	312	321	987	392
	Maximum	369	390	1,233	445
	Stdv	49	60	155	40
	Median	289	292	942	397
	COV	16	19	16	10
pH unit	Minimum	7.6	7.6	7.0	6.9
	Mean	8.0	8.3	7.3	7.8
	Maximum	8.3	8.8	7.9	8.4
	Stdv	0.4	0.6	0.3	0.6
	Median	8.2	8.5	7.4	7.9
	COV	4.4	7.2	4.7	7.4

<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. Any FC concentration less than the detection limit was set equal to the detection limit.

TABLE 7: SUMMARY STATISTICS OF THE 2011 GROUNDWATER QUALITY DATA FOR THE MONITORING WELLS IN THE CALUMET TUNNEL SYSTEM: MONITORING WELLS QC-31, QC-35, AND QC-36

Parameter <sup>1</sup>		Monitoring Well Number		
		QC-31	QC-35	QC-36
Cl mg/L	Minimum	10.0	32.0	36.0
	Mean	12.3	34.5	36.0
	Maximum	15.0	37.0	36.0
	Stdv	2.0	3.5	N/C
	Median	13.0	34.5	36.0
	COV	15.9	10.2	N/C
FC CFU/100 mL	Minimum	1	1	2
	Geo. Mean	1	1	2
	Maximum	1	1	2
	Median	1	1	2
SO <sub>4</sub> mg/L	Minimum	164	90	15
	Mean	177	93	15
	Maximum	198	95	15
	Stdv	12	4	N/C
	Median	175	93	15
	COV	7	4	N/C
NH <sub>3</sub> -N mg/L	Minimum	0.59	0.10	0.10
	Mean	0.94	0.10	0.10
	Maximum	1.06	0.10	0.10
	Stdv	0.18	0.00	N/C
	Median	1.02	0.10	0.10
	COV	18.97	0.00	N/C
TOC mg/L	Minimum	1.00	1.00	1.20
	Mean	1.20	1.10	1.20
	Maximum	1.90	1.20	1.20
	Stdv	0.35	0.14	N/C
	Median	1.05	1.10	1.20
	COV	29.34	12.9	N/C

TABLE 7 (Continued): SUMMARY STATISTICS OF THE 2011 GROUNDWATER QUALITY DATA FOR THE MONITORING WELLS IN THE CALUMET TUNNEL SYSTEM: MONITORING WELLS QC-31, QC-35, AND QC-36

Parameter <sup>1</sup>		Monitoring Well Number		
		QC-31	QC-35	QC-36
TDS mg/L	Minimum	530	910	794
	Mean	562	920	794
	Maximum	576	930	794
	Stdv	17	14	N/C
	Median	568	920	794
	COV	3	2	N/C
	Hard. mg/L	Minimum	208	20
Mean		230	21	12
Maximum		240	22	12
Stdv		14	1	N/C
Median		238	21	12
COV		6	7	N/C
Cond. µmhos/cm		Minimum	495	950
	Mean	592	1,013	920
	Maximum	748	1,075	920
	Stdv	103	88	N/C
	Median	543	1,013	920
	COV	17	9	N/C
	pH unit	Minimum	7.3	8.4
Mean		7.7	8.5	8.6
Maximum		8.0	8.6	8.6
Stdv		0.3	0.1	N/C
Median		7.8	8.5	8.6
COV		3.8	1.4	N/C

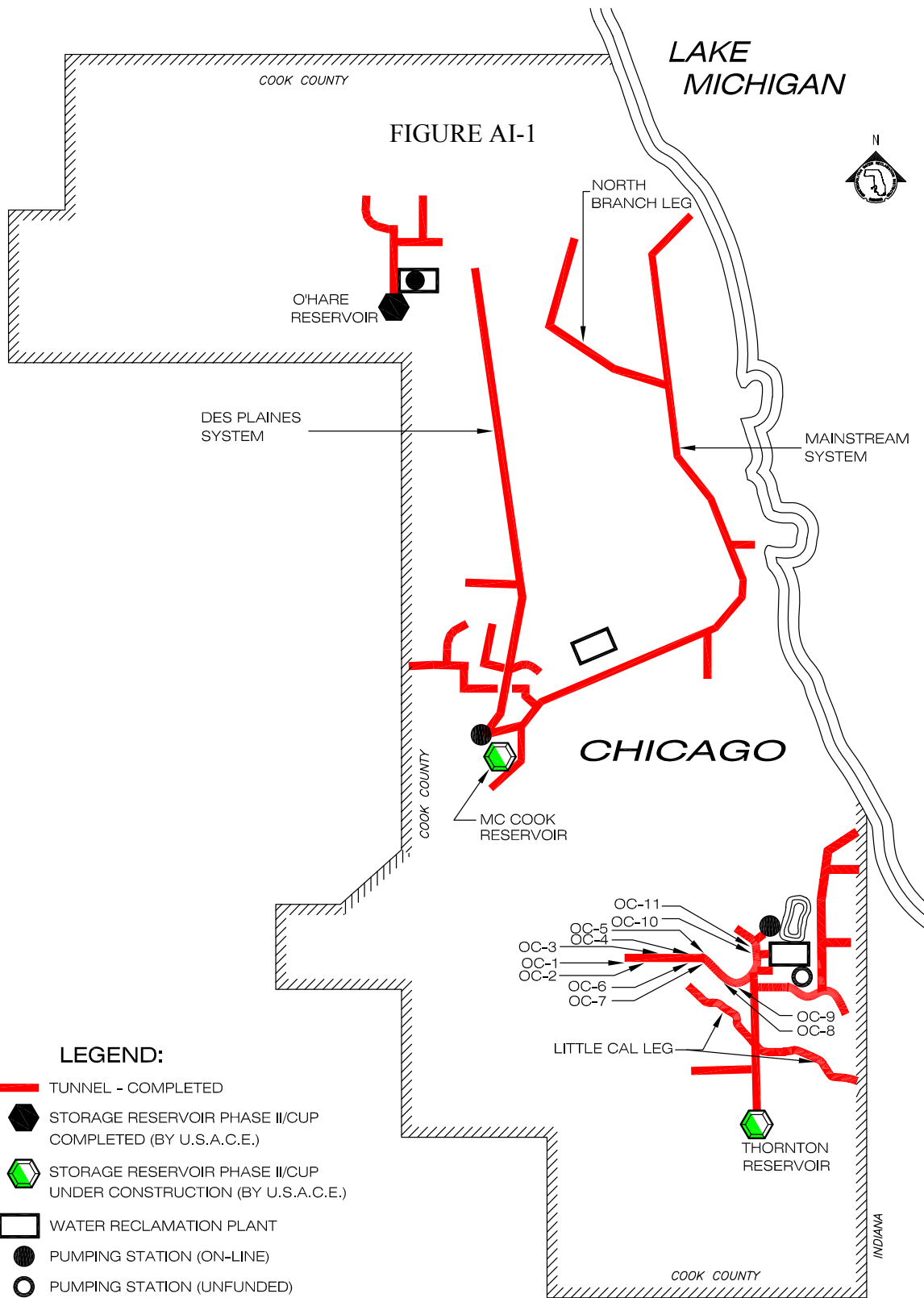
<sup>1</sup>For purpose of statistical evaluation, any value less than the appropriate limit of quantification (LOQ) was set equal to the value of the LOQ. Any FC concentration less than the detection limit was set equal to the detection limit.

<sup>2</sup>N/C stands for no calculation due to single value.



APPENDIX AI

LOCATION MAP OF OBSERVATION WELLS  
OC-1 THROUGH OC-11  
IN THE CALUMET TUNNEL SYSTEM



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

METROPOLITAN WATER RECLAMATION  
DISTRICT OF GREATER CHICAGO

APPENDIX AII

2011 GROUNDWATER ELEVATION DATA  
FOR OBSERVATION WELLS OC-1 THROUGH OC-11  
IN THE CALUMET TUNNEL SYSTEM

TABLE AII-1: 2011 GROUNDWATER ELEVATION\* DATA FOR OBSERVATION WELLS OC-1 THROUGH OC-11 IN THE CALUMET TUNNEL SYSTEM

Date	Observation Wells					
	OC-1	OC-2	OC-3	OC-4	OC-5	OC-6
1/7/11	**	-20.6	-149.3	-157.2	-145.3	-73.7
1/14/11	-26.8	-22.6	-149.3	-169.2	-152.3	-81.7
1/28/11	-24.8	-21.6	-143.3	-138.2	-147.3	-78.7
2/17/11	-30.8	-21.6	-157.3	***	***	-67.7
2/25/11	-27.8	-20.6	-150.3	-157.2	-146.3	-79.7
3/11/11	-27.8	-21.6	-150.3	***	***	-73.7
3/18/11	-25.8	-22.6	-147.3	***	***	-77.7
4/1/11	-26.8	-23.6	-146.3	-150.2	-149.3	-77.7
4/8/11	-25.8	-22.6	-156.3	-167.2	-152.3	-79.7
4/15/11	-28.8	-24.6	-157.3	-168.2	-152.3	-78.7
4/29/11	-25.8	-22.6	-154.3	-163.2	-150.3	-78.7
5/13/11	-25.8	-22.6	-154.3	-167.2	-152.3	-80.7
5/27/11	-25.8	-21.6	-149.3	-162.2	-147.3	-81.7
6/3/11	-25.8	-23.6	-155.3	-168.2	-151.3	-80.7
6/10/11	6.2	-14.6	-155.3	-164.2	-151.3	-80.7
6/24/11	-25.8	-21.6	-147.3	-151.2	-148.3	-78.7
7/1/11	-24.8	-23.6	-156.3	-168.2	-150.3	-80.7
7/22/11	-28.8	-21.6	-154.3	-150.2	-154.3	-81.7
8/12/11	-25.8	-22.6	-156.3	-169.2	-153.3	-71.7
8/19/11	-28.8	-24.6	-151.3	-163.2	-150.3	-78.7
8/29/11	-22.8	-24.6	-152.3	-167.2	-147.3	-78.7
9/16/11	-24.8	-23.6	-152.3	-167.2	-150.3	-80.7
9/29/11	-26.8	-23.6	-154.3	-168.2	-150.3	-81.7
10/7/11	-27.8	-23.6	-151.3	-166.2	-145.3	-79.7
10/21/11	-25.8	-22.6	-156.3	-168.2	-152.3	-78.7
11/1/11	-25.8	-24.6	-153.3	-170.2	-160.3	-80.7
11/4/11	-21.8	-20.6	-153.3	-165.2	-150.3	-81.7
11/25/11	-23.8	-25.6	-155.3	-165.2	-147.3	-83.7
12/2/11	-31.8	-25.6	-155.3	-164.2	-152.3	-80.7
12/9/11	-28.8	-22.6	-153.3	-166.2	-147.3	-74.7
12/23/11	-30.8	-24.6	-156.3	-163.2	****	-80.7
Minimum	-31.8	-25.6	-157.3	-170.2	-160.3	-83.7
Mean	-25.6	-22.7	-152.7	-163.1	-150.3	-78.9
Maximum	6.2	-14.6	-143.3	-138.2	-145.3	-67.7

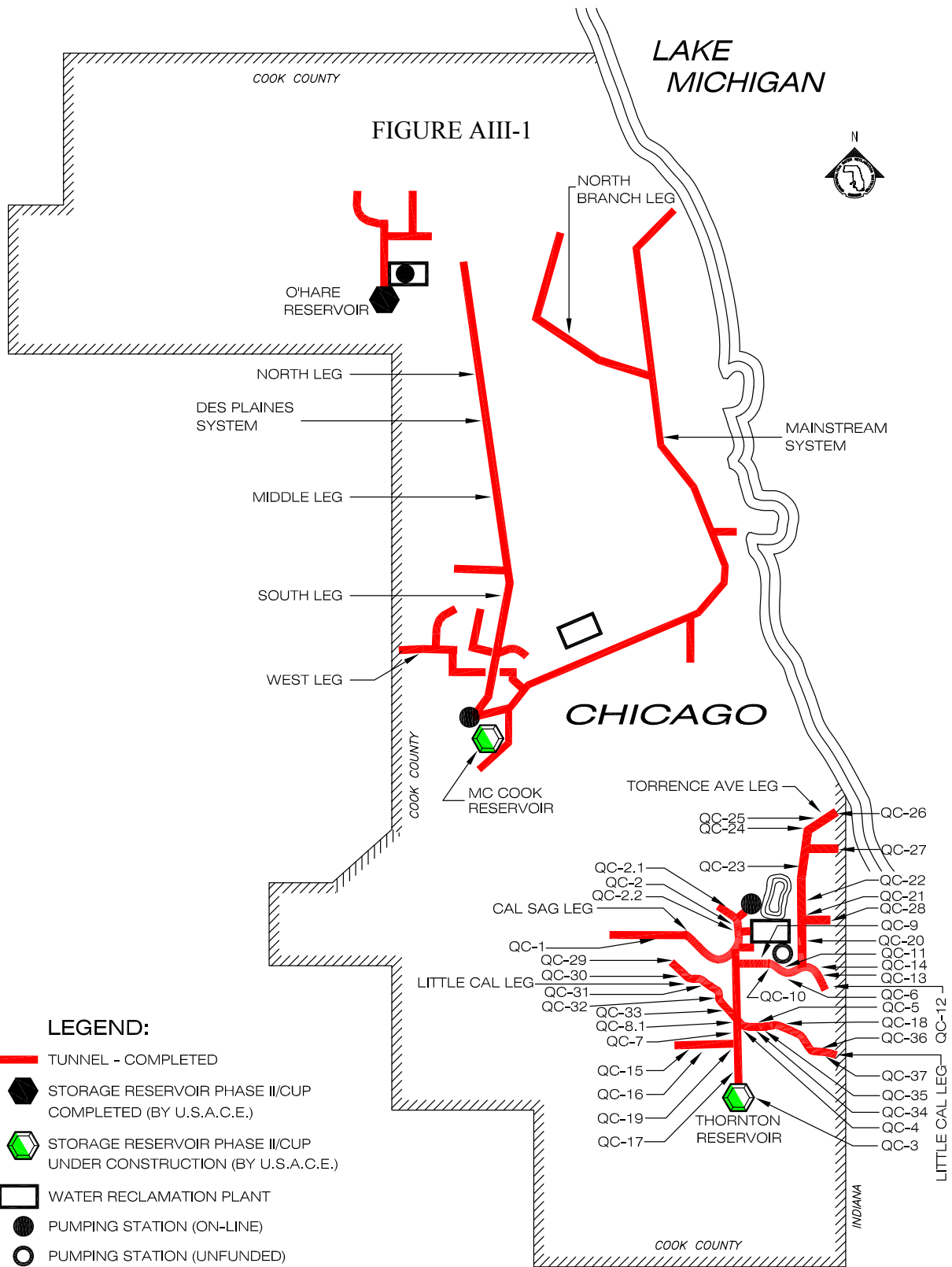
TABLE AII-1 (Continued): 2011 GROUNDWATER ELEVATION\* DATA FOR OBSERVATION WELLS OC-1 THROUGH OC-11 IN THE CALUMET TUNNEL SYSTEM

Date	OC-7	OC-8	OC-9	OC-10	OC-11
1/7/11	-200.0	-183.9	-207.7	-208.0	-212.3
1/14/11	**	**	-213.7	-215.0	-224.3
1/28/11	-208.0	-195.9	-207.7	-220.0	-206.3
2/17/11	***	***	-211.7	-218.0	-218.3
2/25/11	-209.0	-182.9	-207.7	-212.0	-216.3
3/11/11	-207.0	***	-208.7	-215.0	-207.3
3/18/11	-207.0	-186.9	-202.7	-217.0	-203.3
4/1/11	-208.0	-188.9	-186.7	-208.0	-205.3
4/8/11	-211.0	-183.9	-213.7	-220.0	-220.3
4/15/11	-210.0	-182.9	-215.7	-221.0	-221.3
4/29/11	-209.0	-183.9	-211.7	-214.0	-220.3
5/13/11	-211.0	-179.9	-213.7	-220.0	-219.3
5/27/11	-209.0	-179.9	-214.7	-219.0	-217.3
6/3/11	-212.0	-182.9	-213.7	-219.0	-220.3
6/10/11	*****	*****	-212.7	-218.0	-220.3
6/24/11	-209.0	-183.9	-201.7	-216.0	-217.3
7/1/11	-211.0	*****	-213.7	-219.0	-221.3
7/22/11	-214.0	-179.9	-203.7	-216.0	-222.3
8/12/11	-208.0	-181.9	-210.7	-215.0	-217.3
8/19/11	-208.0	-183.9	-207.7	-214.0	-219.3
8/29/11	-215.0	-185.9	-217.7	-216.0	-224.3
9/16/11	-212.0	-181.9	-212.7	-220.0	-221.3
9/29/11	-212.0	-181.9	-213.7	-220.0	-220.3
10/7/11	-202.0	-176.9	-216.7	-216.0	-221.3
10/21/11	-210.0	-181.9	-214.7	-220.0	-220.3
11/1/11	-212.0	-181.9	-212.7	-219.0	-220.3
11/4/11	-211.0	-179.9	-212.7	-216.0	-221.3
11/25/11	-209.0	-183.9	-210.7	-221.0	-218.3
12/2/11	-208.0	-181.9	-211.7	-223.0	-220.3
12/9/11	-208.0	-179.9	-207.7	-207.0	-221.3
12/23/11	-208.0	-179.9	-210.7	-223.0	-220.3
Minimum	-215.0	-195.9	-217.7	-223.0	-224.3
Mean	-209.2	-183.0	-210.4	-216.9	-218.0
Maximum	-200.0	-176.9	-186.7	-207.0	-203.3

\*Relative to Chicago City Datum.  
 \*\*Unable to sample wells because snow was blocking access.  
 \*\*\*Muddy conditions blocked access to well.  
 \*\*\*\*Frozen lock blocked access to well.  
 \*\*\*\*\*Fallen tree blocked access to well.  
 \*\*\*\*\*Flooded area blocked access to well.

APPENDIX AIII

LOCATION MAP OF MONITORING WELLS QC-1, QC-2, QC-2.1, QC-2.2, AND QC-3  
THROUGH QC-37 IN THE CALUMET TUNNEL SYSTEM



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

METROPOLITAN WATER RECLAMATION  
DISTRICT OF GREATER CHICAGO

APPENDIX AIV

2011 GROUNDWATER QUALITY DATA FOR MONITORING WELLS  
QC-1, QC-2, QC-2.1, QC-2.2, QC-4 THROUGH QC-7, AND QC-9 THROUGH QC-37  
IN THE CALUMET TUNNEL SYSTEM



TABLE AIV-1: 2011 CHLORIDE, FECAL COLIFORM, SULFATE, AMMONIA NITROGEN, TOTAL ORGANIC CARBON, AND TOTAL DISSOLVED SOLIDS DATA FOR MONITORING WELLS QC-1, QC-2, QC-2.1, QC-2.2, QC-4 THROUGH QC-7, AND QC-9 THROUGH QC-37 IN THE CALUMET 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 mg/L
QC-1	3/3/11		Monitoring well could not be sampled <sup>3</sup>				
QC-1	4/14/11		Monitoring well could not be sampled <sup>3</sup>				
QC-1	6/9/11		Monitoring well could not be sampled <sup>3</sup>				
QC-1	8/18/11		Monitoring well could not be sampled <sup>3</sup>				
QC-1	10/27/11		Monitoring well could not be sampled <sup>3</sup>				
QC-1	12/8/11		Monitoring well could not be sampled <sup>3</sup>				
QC-2	3/3/11	39	57	22	0.43	1.3	354
QC-2	4/14/11	38	22	24	0.38	1.6	354
QC-2	6/9/11	40	220	24	0.72	1.6	370
QC-2	8/18/11	38	87	31	0.71	1.4	370
QC-2	10/27/11	35	<1	25	0.59	1.6	354
QC-2	12/8/11	34	53	29	0.36	BLOQ <sup>4</sup>	372
QC-2.1	3/3/11	35	<1	BLOQ	0.68	1.1	522
QC-2.1	6/9/11	33	<1	BLOQ	0.56	1.2	524
QC-2.1	8/18/11	18	<1	BLOQ	0.29	1.0	454
QC-2.2	3/3/11	15	<1	25	0.18	1.2	356
QC-2.2	6/9/11	13	<1	24	0.27	1.3	352
QC-2.2	8/18/11	32	41	19	0.45	1.3	436
QC-4	3/3/11	BLOQ	<1	BLOQ	0.21	BLOQ	428
QC-4	6/9/11	BLOQ	60	BLOQ	0.14	BLOQ	422
QC-4	8/18/11	BLOQ	<1	BLOQ	0.12	BLOQ	468
QC-5	3/3/11	32	<1	BLOQ	0.12	1.2	552
QC-5	6/9/11	30	<1	BLOQ	0.11	1.3	558
QC-5	9/9/11	31	<1	BLOQ	0.17	1.3	644
QC-6	3/3/11	15	<1	BLOQ	0.30	1.4	442
QC-6	6/9/11	15	<1	BLOQ	0.31	1.5	466
QC-6	9/9/11	13	<1	BLOQ	0.32	1.5	520

TABLE AIV-1 (Continued): 2011 CHLORIDE, FECAL COLIFORM, SULFATE, AMMONIA NITROGEN, TOTAL ORGANIC CARBON, AND TOTAL DISSOLVED SOLIDS DATA FOR MONITORING WELLS QC-1, QC-2, QC-2.1, QC-2.2, QC-4 THROUGH QC-7, AND QC-9 THROUGH QC-37 IN THE CALUMET 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 mg/L
QC-7	4/14/11	12	<1	BLOQ	0.18	1.6	400
QC-7	9/9/11	18	<1	BLOQ	0.21	1.5	536
QC-7	12/8/11	10	<1	BLOQ	0.27	BLOQ	416
QC-9	3/3/11	BLOQ	<1	30	BLOQ	1.0	334
QC-9	6/2/11	BLOQ	<1	28	0.53	1.7	328
QC-9	9/9/11	BLOQ	<1	35	0.21	1.3	366
QC-10	1/5/11	30	<1	64	0.13	BLOQ	414
QC-10	2/8/11	31	<1	BLOQ	0.11	BLOQ	386
QC-10	5/11/11	27	<1	BLOQ	0.11	BLOQ	420
QC-11	1/5/11	20	<1	BLOQ	0.15	BLOQ	276
QC-11	2/8/11	22	<1	BLOQ	0.13	BLOQ	302
QC-11	5/11/11	18	<1	BLOQ	BLOQ	BLOQ	308
QC-12	1/5/11	38	<1	347	0.46	BLOQ	934
QC-12	5/11/11	35	<1	264	0.39	BLOQ	898
QC-12	12/7/11	39	<1	274	0.36	BLOQ	848
QC-13	5/11/11	50	<1	35	0.16	BLOQ	464
QC-13	9/8/11	58	<1	40	0.19	BLOQ	440
QC-13	12/7/11	57	<1	35	0.21	BLOQ	470
QC-14	3/3/11	129	<1	BLOQ	0.26	2.6	676
QC-14	6/2/11	110	<1	BLOQ	0.16	2.5	676
QC-14	8/31/11	134	<1	BLOQ	0.26	3.2	764
QC-15	3/3/11	14	<1	BLOQ	0.15	BLOQ	296
QC-15	6/2/11	12	<1	BLOQ	0.17	1.7	318
QC-15	8/31/11	12	<1	BLOQ	0.22	BLOQ	356
QC-16	3/3/11	23	<1	61	BLOQ	BLOQ	506
QC-16	6/2/11	22	<1	70	BLOQ	1.2	522
QC-16	8/31/11	23	<1	66	BLOQ	BLOQ	544

TABLE AIV-1 (Continued): 2011 CHLORIDE, FECAL COLIFORM, SULFATE, AMMONIA NITROGEN, TOTAL ORGANIC CARBON, AND TOTAL DISSOLVED SOLIDS DATA FOR MONITORING WELLS QC-1, QC-2, QC-2.1, QC-2.2, QC-4 THROUGH QC-7, AND QC-9 THROUGH QC-37 IN THE CALUMET 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 mg/L
QC-17	3/3/11	11	<1	185	0.25	1.1	570
QC-17	6/2/11	15	51	174	0.31	1.4	566
QC-17	8/31/11	10	<1	181	0.28	BLOQ	500
QC-18	3/3/11	BLOQ	<1	31	0.11	BLOQ	362
QC-18	6/2/11	BLOQ	<1	28	0.13	BLOQ	388
QC-18	8/31/11	BLOQ	<1	30	0.15	BLOQ	540
QC-19	4/14/11	BLOQ	<1	142	0.19	BLOQ	432
QC-19	8/31/11	BLOQ	<1	150	0.28	BLOQ	464
QC-19	12/8/11	BLOQ	<1	150	0.30	BLOQ	460
QC-20	4/28/11	18	<1	BLOQ	0.12	BLOQ	252
QC-20	6/16/11	33	1	108	0.15	1.1	606
QC-20	8/31/11	18	<1	28	0.17	BLOQ	366
QC-21	4/28/11	17	<1	BLOQ	0.18	2.5	346
QC-21	6/16/11	19	<1	61	0.12	8.9	582
QC-21	8/31/11	20	<1	52	BLOQ	7.3	490
QC-22	3/10/11	16	<1	BLOQ	0.20	1.9	172
QC-22	6/16/11	17	<1	BLOQ	0.19	1.7	414
QC-22	9/15/11	16	<1	BLOQ	0.21	1.9	310
QC-23	3/10/11	23	<1	BLOQ	BLOQ	1.4	310
QC-23	6/16/11	19	<1	BLOQ	BLOQ	BLOQ	470
QC-23	9/15/11	20	<1	BLOQ	0.10	BLOQ	336
QC-24	3/10/11	30	<1	BLOQ	0.12	BLOQ	224
QC-24	6/16/11	29	<1	BLOQ	0.13	BLOQ	490
QC-24	9/15/11	28	<1	BLOQ	0.14	BLOQ	258
QC-25	3/10/11	14	<1	BLOQ	0.15	BLOQ	208
QC-25	6/16/11	15	<1	BLOQ	0.12	BLOQ	352
QC-25	9/15/11	14	<1	30	0.17	BLOQ	280

TABLE AIV-1 (Continued): 2011 CHLORIDE, FECAL COLIFORM, SULFATE, AMMONIA NITROGEN, TOTAL ORGANIC CARBON, AND TOTAL DISSOLVED SOLIDS DATA FOR MONITORING WELLS QC-1, QC-2, QC-2.1, QC-2.2, QC-4 THROUGH QC-7, AND QC-9 THROUGH QC-37 IN THE CALUMET 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 mg/L	
QC-26	3/10/11	BLOQ	<1	BLOQ	BLOQ	BLOQ	270	
QC-26	6/23/11	BLOQ	<1	BLOQ	BLOQ	BLOQ	474	
QC-26	9/15/11	32	<1	BLOQ	BLOQ	BLOQ	308	
QC-27	3/10/11	33	<1	BLOQ	0.14	BLOQ	236	
QC-27	6/23/11	25	<1	BLOQ	0.15	BLOQ	348	
QC-27	9/15/11	32	<1	BLOQ	0.13	BLOQ	268	
QC-28	3/10/11	13	<1	BLOQ	BLOQ	1.2	236	
QC-28	6/23/11	BLOQ	<1	BLOQ	BLOQ	1.2	408	
QC-28	9/15/11	13	<1	BLOQ	BLOQ	1.3	278	
QC-29	3/10/11	228	<1	190	0.75	1.5	982	
QC-29	4/28/11	195	<1	175	0.77	1.5	928	
QC-29	6/23/11	176	<1	150	0.69	1.2	1,032	
QC-29	8/26/11	216	<1	189	0.76	1.7	1,102	
QC-29	10/27/11	195	<1	164	0.77	1.3	894	
QC-29	12/8/11	177	<1	150	0.71	BLOQ	828	
QC-30	3/10/11	BLOQ	<1	53	BLOQ	1.1	358	
QC-30	4/28/11	27	<1	175	0.77	1.2	548	
QC-30	6/23/11		Monitoring well could not be sampled <sup>3</sup>					
QC-30	8/26/11	BLOQ	<1	72	BLOQ	BLOQ	502	
QC-30	10/27/11	BLOQ	<1	51	0.14	BLOQ	320	
QC-30	12/8/11	BLOQ	<1	74	0.13	BLOQ	358	
QC-31	3/10/11	BLOQ	<1	177	1.00	1.2	576	
QC-31	4/28/11	13	<1	169	1.06	1.9	568	
QC-31	6/23/11	BLOQ	<1	164	0.92	BLOQ	530	
QC-31	8/26/11	15	<1	173	0.59	1.1	560	
QC-31	10/27/11	13	<1	184	1.04	1.0	568	
QC-31	12/8/11	13	<1	198	1.03	BLOQ	572	
QC-32	3/17/11		Monitoring well could not be sampled <sup>3</sup>					
QC-32	4/28/11		Monitoring well could not be sampled <sup>3</sup>					
QC-32	6/23/11		Monitoring well could not be sampled <sup>3</sup>					

TABLE AIV-1 (Continued): 2011 CHLORIDE, FECAL COLIFORM, SULFATE, AMMONIA NITROGEN, TOTAL ORGANIC CARBON, AND TOTAL DISSOLVED SOLIDS DATA FOR MONITORING WELLS QC-1, QC-2, QC-2.1, QC-2.2, QC-4 THROUGH QC-7, AND QC-9 THROUGH QC-37 IN THE CALUMET 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 mg/L
QC-32	8/26/11		Monitoring well could not be sampled <sup>3</sup>				
QC-32	10/27/11		Monitoring well could not be sampled <sup>3</sup>				
QC-32	12/2/11		Monitoring well could not be sampled <sup>3</sup>				
QC-33	3/17/11		Monitoring well could not be sampled <sup>3</sup>				
QC-33	4/28/11		Monitoring well could not be sampled <sup>3</sup>				
QC-33	6/23/11		Monitoring well could not be sampled <sup>3</sup>				
QC-33	8/26/11		Monitoring well could not be sampled <sup>3</sup>				
QC-33	10/27/11		Monitoring well could not be sampled <sup>3</sup>				
QC-33	12/2/11		Monitoring well could not be sampled <sup>3</sup>				
QC-34	3/17/11		Monitoring well could not be sampled <sup>3</sup>				
QC-34	4/28/11		Monitoring well could not be sampled <sup>3</sup>				
QC-34	6/23/11		Monitoring well could not be sampled <sup>3</sup>				
QC-34	8/26/11		Monitoring well could not be sampled <sup>3</sup>				
QC-34	10/27/11		Monitoring well could not be sampled <sup>3</sup>				
QC-34	12/2/11		Monitoring well could not be sampled <sup>3</sup>				
QC-35	3/17/11	37	<1	95	BLOQ	BLOQ	910
QC-35	4/14/11		Monitoring well could not be sampled <sup>3</sup>				
QC-35	6/23/11		Monitoring well could not be sampled <sup>3</sup>				
QC-35	8/26/11		Monitoring well could not be sampled <sup>3</sup>				
QC-35	10/27/11		Monitoring well could not be sampled <sup>3</sup>				
QC-35	12/21/11	32	<1	90	BLOQ	1.2	930
QC-36	3/17/11	36	2	BLOQ	BLOQ	1.2	794
QC-36	4/14/11		Monitoring well could not be sampled <sup>3</sup>				
QC-36	6/23/11		Monitoring well could not be sampled <sup>3</sup>				
QC-36	8/26/11		Monitoring well could not be sampled <sup>3</sup>				
QC-36	10/27/11		Monitoring well could not be sampled <sup>3</sup>				
QC-36	12/2/11		Monitoring well could not be sampled <sup>3</sup>				
QC-37	3/17/11		Monitoring well could not be sampled <sup>3</sup>				
QC-37	4/14/11		Monitoring well could not be sampled <sup>3</sup>				
QC-37	6/23/11		Monitoring well could not be sampled <sup>3</sup>				
QC-37	8/26/11		Monitoring well could not be sampled <sup>3</sup>				

TABLE AIV-1 (Continued): 2011 CHLORIDE, FECAL COLIFORM, SULFATE, AMMONIA NITROGEN, TOTAL ORGANIC CARBON, AND TOTAL DISSOLVED SOLIDS DATA FOR MONITORING WELLS QC-1, QC-2, QC-2.1, QC-2.2, QC-4 THROUGH QC-7, AND QC-9 THROUGH QC-37 IN THE CALUMET 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 mg/L
QC-37	10/27/11						Monitoring well could not be sampled <sup>3</sup>
QC-37	12/2/11						Monitoring well could not be sampled <sup>3</sup>

<sup>1</sup>The limit of quantification (LOQ) is 10.0 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 a 0.45-µm membrane.

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

<sup>4</sup>BLOQ = Below LOQ.

TABLE AIV-2: 2011 HARDNESS, CONDUCTIVITY, pH, TEMPERATURE, ELEVATION, AND RECHARGE DATA FOR MONITORING WELLS QC-1, QC-2, QC-2.1, QC-2.2, QC-4 THROUGH QC-7, AND QC-9 THROUGH QC-37 IN THE CALUMET TUNNEL SYSTEM

Monitoring Well Number	Date of Sampling	Hard. mg/L	Cond. <sup>1</sup> μmhos/cm	pH <sup>1</sup> Unit	Temp. °C	Groundwater Elevation <sup>2</sup> Feet	Recharge <sup>3</sup> Hours
QC-1	3/3/11						
QC-1	4/14/11						Monitoring well could not be sampled <sup>4</sup>
QC-1	6/9/11						Monitoring well could not be sampled <sup>4</sup>
QC-1	8/18/11						Monitoring well could not be sampled <sup>4</sup>
QC-1	10/27/11						Monitoring well could not be sampled <sup>4</sup>
QC-1	12/8/11						Monitoring well could not be sampled <sup>4</sup>
QC-2	3/3/11	92	408	7.8	12	-279	<48
QC-2	4/14/11	87	346	7.9	13	-280	<48
QC-2	6/9/11	94	469	8.1	14	-265	<48
QC-2	8/18/11	93	573	7.7	16	-269	<48
QC-2	10/27/11	88	356	8.0	12	-276	<48
QC-2	12/8/11	89	364	7.8	11	-284	<48
QC-2.1	3/3/11	64	659	7.8	12	-280	<48
QC-2.1	6/9/11	58	673	8.1	14	-286	<48
QC-2.1	8/18/11	39	632	7.6	17	-296	<48
QC-2.2	3/3/11	45	412	8.1	12	-282	<48
QC-2.2	6/9/11	40	426	8.7	13	-257	<48
QC-2.2	8/18/11	67	512	7.9	15	-217	<48
QC-4	3/3/11	14	407	8.2	11	-235	<48
QC-4	6/9/11	10	595	8.8	13	*	<48
QC-4	8/18/11	17	563	8.3	18	-254	<48
QC-5	3/3/11	9	637	8.3	12	-200	<48
QC-5	6/9/11	9	721	8.8	13	-212	<48
QC-5	9/9/11	33	640	8.4	12	-202	<48
QC-6	3/3/11	16	509	8.6	12	-180	<48
QC-6	6/9/11	15	553	8.6	13	-181	<48
QC-6	9/9/11	26	525	8.4	13	-193	<48

TABLE AIV-2 (Continued): 2011 HARDNESS, CONDUCTIVITY, pH, TEMPERATURE, ELEVATION, AND RECHARGE DATA FOR MONITORING WELLS QC-1, QC-2, QC-2.1, QC-2.2, QC-4 THROUGH QC-7, AND QC-9 THROUGH QC-37 IN THE CALUMET TUNNEL SYSTEM

Monitoring Well Number	Date of Sampling	Hard. mg/L	Cond. <sup>1</sup> μmhos/cm	pH <sup>1</sup> Unit	Temp. °C	Groundwater Elevation <sup>2</sup> Feet	Recharge <sup>3</sup> Hours
QC-7	4/14/11	11	443	8.4	12	-180	<48
QC-7	9/9/11	17	550	8.3	13	-168	<48
QC-7	12/8/11	11	420	8.2	11	-189	<48
QC-9	3/3/11	64	291	8.2	12	-247	<48
QC-9	6/2/11	64	455	8.2	14	-223	<48
QC-9	9/9/11	62	333	7.8	13	-254	<48
QC-10	1/5/11	12	440	7.9	11	-225	<4
QC-10	2/8/11	14	463	7.8	12	-227	<4
QC-10	5/11/11	13	473	8.7	14	-169	<4
QC-11	1/5/11	21	546	7.9	11	-235	<4
QC-11	2/8/11	20	565	7.6	11	-238	<4
QC-11	5/11/11	20	383	8.7	14	-192	<4
QC-12	1/5/11	191	844	7.4	13	-246	<4
QC-12	5/11/11	159	845	8.0	15	-214	<4
QC-12	12/7/11	149	815	8.0	10	-219	<4
QC-13	5/11/11	36	456	7.9	15	-222	<48
QC-13	9/8/11	40	588	7.9	15	-225	<48
QC-13	12/7/11	43	443	7.8	13	-228	<48
QC-14	3/3/11	128	448	7.9	12	-209	<48
QC-14	6/2/11	122	999	7.8	14	-212	<48
QC-14	8/31/11	141	749	7.5	14	-206	<48
QC-15	3/3/11	15	347	8.4	12	-233	<48
QC-15	6/2/11	15	470	8.2	19	-230	<48
QC-15	8/31/11	15	436	7.8	13	-235	<48
QC-16	3/3/11	84	461	8.1	12	-249	<48
QC-16	6/2/11	86	740	7.9	14	-261	<48
QC-16	8/31/11	87	367	7.5	15	-256	<48



TABLE AIV-2 (Continued): 2011 HARDNESS, CONDUCTIVITY, pH, TEMPERATURE, ELEVATION, AND RECHARGE DATA FOR MONITORING WELLS QC-1, QC-2, QC-2.1, QC-2.2, QC-4 THROUGH QC-7, AND QC-9 THROUGH QC-37 IN THE CALUMET TUNNEL SYSTEM

Monitoring Well Number	Date of Sampling	Hard. mg/L	Cond. <sup>1</sup> µmhos/cm	pH <sup>1</sup> Unit	Temp. °C	Groundwater Elevation <sup>2</sup> Feet	Recharge <sup>3</sup> Hours
QC-17	3/3/11	172	441	7.7	12	-172	<48
QC-17	6/2/11	198	623	7.3	14	-164	<48
QC-17	8/31/11	152	493	7.4	13	-181	<48
QC-18	3/3/11	14	373	9.0	12	-195	<48
QC-18	6/2/11	7	557	8.3	17	-223	<48
QC-18	8/31/11	56	333	9.3	13	-195	<48
QC-19	4/14/11	103	423	8.9	12	-143	<48
QC-19	8/31/11	103	453	7.7	12	-162	<48
QC-19	12/8/11	111	423	8.4	11	-150	<48
QC-20	4/28/11	20	401	8.1	13	-276	<48
QC-20	6/16/11	158	730	7.2	15	-270	<48
QC-20	8/31/11	63	361	8.3	14	-263	<48
QC-21	4/28/11	49	679	7.6	12	-276	<48
QC-21	6/16/11	75	324	7.7	15	-244	<48
QC-21	8/31/11	84	510	7.9	15	-258	<48
QC-22	3/10/11	34	270	7.2	12	-265	<48
QC-22	6/16/11	41	406	8.0	15	-243	<48
QC-22	9/15/11	46	361	7.8	13	-260	<48
QC-23	3/10/11	7	356	8.6	12	-242	<48
QC-23	6/16/11	17	499	9.0	13	-223	<48
QC-23	9/15/11	6	428	9.1	13	-245	<48
QC-24	3/10/11	13	296	8.1	11	-236	<48
QC-24	6/16/11	40	381	8.5	14	-223	<48
QC-24	9/15/11	13	311	8.9	13	-235	<48
QC-25	3/10/11	20	259	7.9	12	-235	<48
QC-25	6/16/11	27	194	8.0	14	-235	<48
QC-25	9/15/11	48	332	8.3	13	-242	<48

TABLE AIV-2 (Continued): 2011 HARDNESS, CONDUCTIVITY, pH, TEMPERATURE, ELEVATION, AND RECHARGE DATA FOR MONITORING WELLS QC-1, QC-2, QC-2.1, QC-2.2, QC-4 THROUGH QC-7, AND QC-9 THROUGH QC-37 IN THE CALUMET TUNNEL SYSTEM

Monitoring Well Number	Date of Sampling	Hard. mg/L	Cond. <sup>1</sup> µmhos/cm	pH <sup>1</sup> Unit	Temp. °C	Groundwater Elevation <sup>2</sup> Feet	Recharge <sup>3</sup> Hours	
QC-26	3/10/11	6	306	9.0	11	-233	<48	
QC-26	6/23/11	58	468	7.5	13	-222	<48	
QC-26	9/15/11	8	313	8.7	13	-230	<48	
QC-27	3/10/11	25	289	8.2	12	-206	<48	
QC-27	6/23/11	24	369	7.6	13	-205	<48	
QC-27	9/15/11	24	279	8.3	13	-208	<48	
QC-28	3/10/11	21	292	8.8	12	-246	<48	
QC-28	6/23/11	22	390	7.6	13	-240	<48	
QC-28	9/15/11	17	282	8.5	13	-245	<48	
QC-29	3/10/11	422	999	7.0	12	-66	<48	
QC-29	4/28/11	306	1,233	7.0	13	-71	<48	
QC-29	6/23/11	361	1,098	7.9	12	-63	<48	
QC-29	8/26/11	518	860	7.3	13	-68	<48	
QC-29	10/27/11	380	885	7.4	12	-66	<48	
QC-29	12/8/11	343	845	7.4	11	-63	<48	
QC-30	3/10/11	58	365	8.4	9	-138	<48	
QC-30	4/28/11	234	397	7.9	12	-142	<48	
QC-30	6/23/11		Monitoring well could not be sampled <sup>4</sup>					
QC-30	8/26/11	105	413	6.9	14	-139	<48	
QC-30	10/27/11	42	342	8.2	12	-136	<48	
QC-30	12/8/11	52	445	7.8	11	-144	<48	
QC-31	3/10/11	239	540	7.4	12	-72	<48	
QC-31	4/28/11	239	748	7.3	12	-77	<48	
QC-31	6/23/11	208	693	7.8	13	-58	<48	
QC-31	8/26/11	214	545	7.8	16	-88	<48	
QC-31	10/27/11	237	530	7.8	12	-105	<48	
QC-31	12/8/11	240	495	8.0	11	-83	<48	
QC-32	3/17/11		Monitoring well could not be sampled <sup>4</sup>					
QC-32	4/28/11		Monitoring well could not be sampled <sup>4</sup>					
QC-32	6/23/11		Monitoring well could not be sampled <sup>4</sup>					

TABLE AIV-2 (Continued): 2011 HARDNESS, CONDUCTIVITY, pH, TEMPERATURE, ELEVATION, AND RECHARGE DATA FOR MONITORING WELLS QC-1, QC-2, QC-2.1, QC-2.2, QC-4 THROUGH QC-7, AND QC-9 THROUGH QC-37 IN THE CALUMET TUNNEL SYSTEM

Monitoring Well Number	Date of Sampling	Hard. mg/L	Cond. <sup>1</sup> µmhos/cm	pH <sup>1</sup> Unit	Temp. °C	Groundwater Elevation <sup>2</sup> Feet	Recharge <sup>3</sup> Hours
QC-32	8/26/11						
QC-32	10/27/11						
QC-32	12/2/11						
QC-33	3/17/11						
QC-33	4/28/11						
QC-33	6/23/11						
QC-33	8/26/11						
QC-33	10/27/11						
QC-33	12/2/11						
QC-34	3/17/11						
QC-34	4/28/11						
QC-34	6/23/11						
QC-34	8/26/11						
QC-34	10/27/11						
QC-34	12/2/11						
QC-35	3/17/11	22	950	8.4	13	-151	<48
QC-35	4/14/11						
QC-35	6/23/11						
QC-35	8/26/11						
QC-35	10/27/11						
QC-35	12/21/11	20	1,075	8.6	12	-152	<48
QC-36	3/17/11	12	920	8.6	14	-130	<48
QC-36	4/14/11						
QC-36	6/23/11						
QC-36	8/26/11						
QC-36	10/27/11						
QC-36	12/2/11						
QC-37	3/17/11						
QC-37	4/14/11						
QC-37	6/23/11						
QC-37	8/26/11						

TABLE AIV-2 (Continued): 2011 HARDNESS, CONDUCTIVITY, pH, TEMPERATURE, ELEVATION, AND RECHARGE DATA FOR MONITORING WELLS QC-1, QC-2, QC-2.1, QC-2.2, QC-4 THROUGH QC-7, AND QC-9 THROUGH QC-37 IN THE CALUMET TUNNEL SYSTEM

Monitoring Well Number	Date of Sampling	Hard. mg/L	Cond. <sup>1</sup> μmhos/cm	pH <sup>1</sup> Unit	Temp. °C	Groundwater Elevation <sup>2</sup> Feet	Recharge <sup>3</sup> Hours
QC-37	10/27/11						Monitoring well could not be sampled <sup>4</sup>
QC-37	12/2/11						Monitoring well could not be sampled <sup>4</sup>

<sup>1</sup>Unfiltered samples, all others were filtered through a 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 well recovered sufficiently for sampling.

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

\*Groundwater elevation not taken. Reason not given in field log sheet.