Metropolitan Water Reclamation District of Greater Chicago

MONITORING AND RESEARCH DEPARTMENT

REPORT NO. 14-32

TUNNEL AND RESERVOIR PLAN

CALUMET TUNNEL SYSTEM

ANNUAL GROUNDWATER MONITORING REPORT

FOR 2013

September 2014

Protecting Our Water Environment

Metropolitan Water Reclamation District of Greater Chicago
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September 26, 2014

Ms. Marcia Willhite
Bureau 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, Annual Groundwater Monitoring Report for 2013

Attached are three copies of "Tunnel and Reservoir Plan, Calumet Tunnel System, Annual Groundwater Monitoring Report for 2013."

Very truly yours,

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

TCG:PL:cm
Attachment
cc w/att: Ms. Sally K. Swanson (USEPA Region 5 - WC15J) - (2)
Dr. Zhang
Dr. Cox
Dr. Hundal
Dr. Lindo
cc w/o att: Mr. St. Pierre
Ms. Sharma
Mr. Cohen

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TUNNEL AND RESERVOIR PLAN CALUMET TUNNEL SYSTEM ANNUAL GROUNDWATER MONITORING REPORT FOR 2013

Monitoring and Research Department
Thomas C. Granato, Director

September 2014

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Introduction

All monitoring and observation wells are located along the length of the Calumet Tunnel System. Four monitoring wells (QC-1, -2, -2-1, and -2-2) and 11 observation wells (OC-1 through OC-11) are located along the tunnel between Crawford Avenue and the Calumet Water Reclamation Plant. Seventeen monitoring wells (QC-3 through QC-19) are located between 140th Street and Indiana Avenue. Nine monitoring wells (QC-20 through QC-28) are positioned along Torrence Avenue, with the last nine monitoring wells (QC-29 through QC-37) along the Little Calumet River (Figures 1 and 2). Monitoring well QC-3, located along the tunnel between 140th Street and Indiana Avenue, is no longer sampled due to construction in its vicinity managed by the Village of South Holland. An Illinois Environmental Protection Agency (IEPA) memorandum dated April 22, 2008 (Appendix I) granted permission to the Metropolitan Water Reclamation District of Greater Chicago to abandon this well. Monitoring wells QC-1, -2, and QC-29 through QC-37 are sampled six times per year (IEPA memorandum dated July 9, 2004). Monitoring wells QC-2-1, -2-2, QC-4 through QC-7, and QC-9 through QC-28 are sampled three times per year (IEPA memoranda July 9, 2004 and February 23, 2006). During 2013, all wells were sampled as required. Groundwater elevations in the monitoring wells were measured during each sampling event, while elevations in the observation wells were measured bi-weekly. The groundwater level in monitoring well QC-8-1 is no longer adequate for sampling. However, this well was converted to an observation well several years ago, and groundwater elevations are still measured bi-weekly.

All monitoring wells in the Calumet Tunnel System were sampled at the required frequencies. However, samples could not be retrieved from Wells QC-1 and -32 through -37 because there was no groundwater in them. These wells are considered dry. Their pumps were tested and classified as functional.

Summary of Data

Monitoring Wells. The analytical data for groundwater sampled during 2013 from monitoring wells QC-2 through QC-31 are presented in Table 1. Physical characteristics, such as elevation, groundwater temperature, and estimated time of recharge for each well between initial drawdown and sampling, are also included. Fecal coliform counts for all wells except QC-2 (maximum of 260 MPN/100 mL) were undetectable. Table 2 lists the descriptive statistics for groundwater data of monitoring wells QC-2 through QC-31 for the year 2013.

Observation Wells. Groundwater elevations for observation wells OC-1 through -11 were measured at the required frequencies. Adjusted elevations were calculated relative to the Chicago city datum (579.48 ft. above mean sea level) at the intersection of Madison and State Streets (Table 3). The minimum, mean, and maximum values for each well were calculated and plotted to determine fluctuations in groundwater elevations during the year (Figure 3). Generally, these fluctuations appeared to be minimal throughout the year.

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

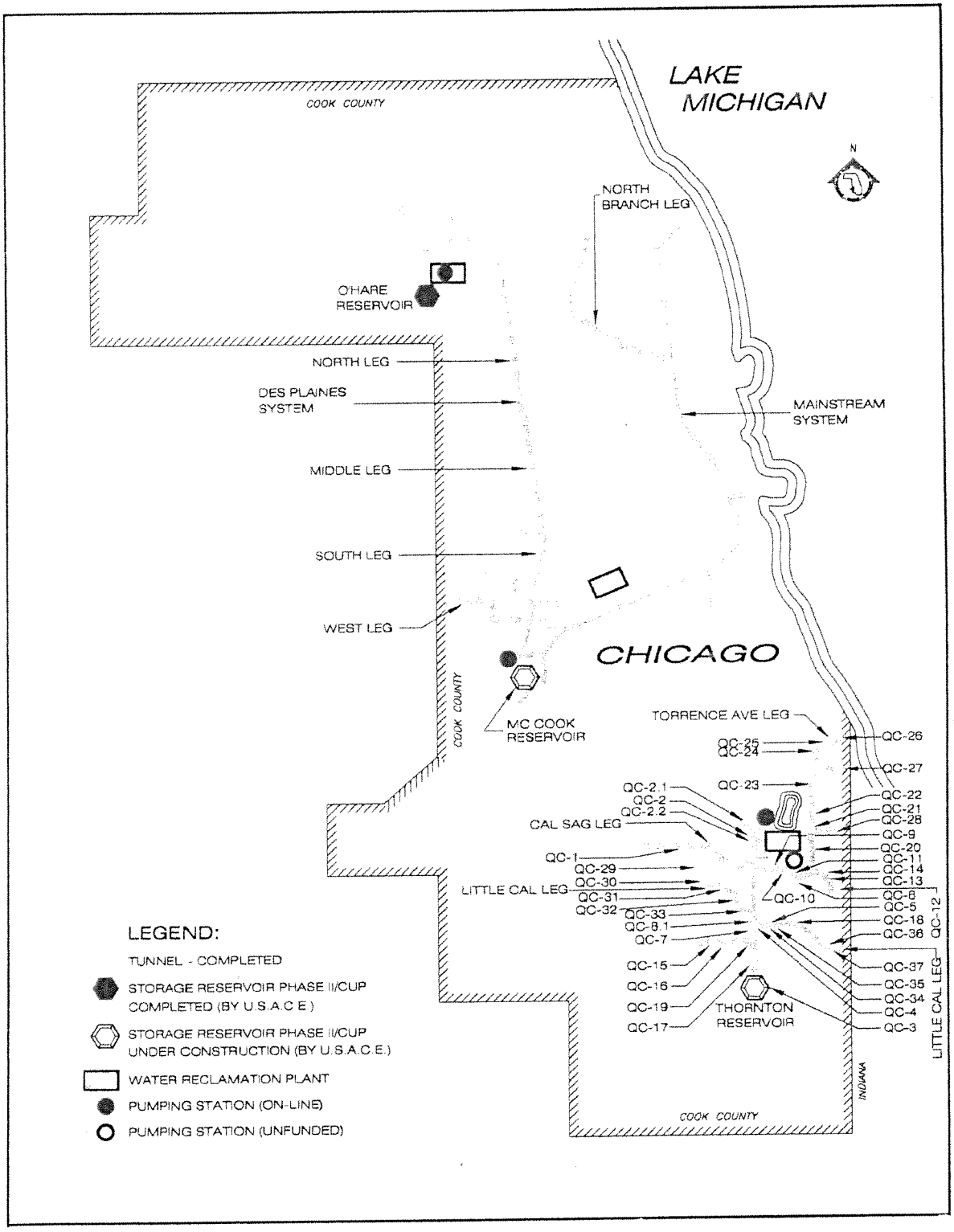

FIGURE 2: MAP OF OBSERVATION WELLS IN THE CALUMET TUNNEL SYSTEM

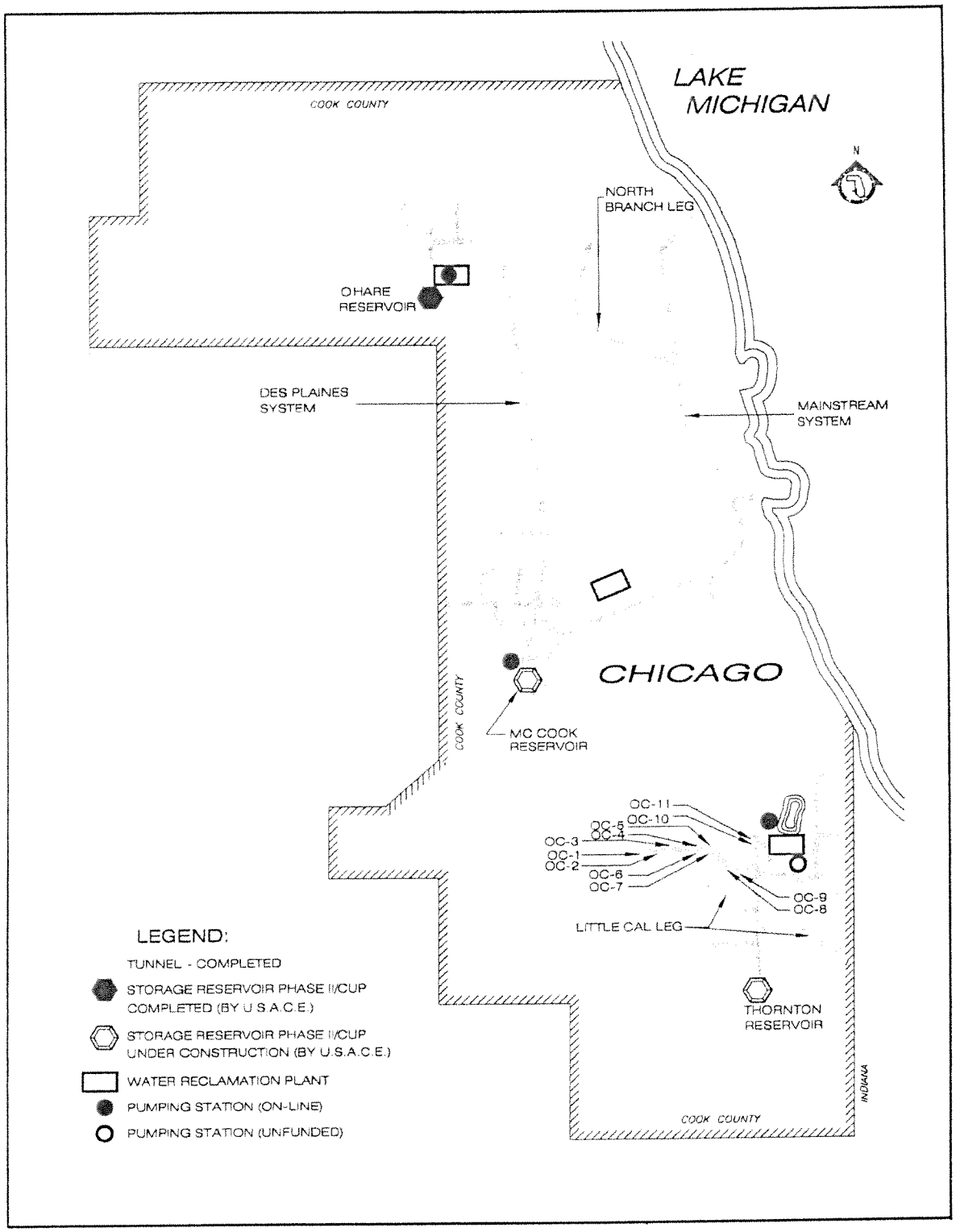

TABLE 1: ANALYSIS OF GROUNDWATER FROM MONITORING WELLS QC-2 THROUGH QC-31 IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN SAMPLED DURING 2013

Well[1]	Sample Date	pH	EC[2]	TDS[2]	TOC[2]	Cl^-	SO_4^{2-}	NH_3-N	Hardness	Fecal Coliform	Temp	Water Elevation[3]	Recharge Time
			mS/m	mg/L						MPN/100 mL	^0C	ft.	hr.
QC-2	01/10/13	8.0	35	344	2	29	75	0.70	88	<1	12.2	-275	<48
QC-2	04/25/13	7.3	32	370	2	34	23	0.76	95	260	12.4	-272	<48
QC-2	07/18/13	7.6	62	446	1	33	24	0.15	98	21	15.6	-278	<48
QC-2	09/05/13	8.2	47	494	2	33	20	0.80	89	<1	14.0	-280	<48
QC-2	10/03/13	8.2	45	344	2	33	26	0.44	83	<1	14.4	-283	<48
QC-2	11/20/13	7.7	21	348	2	32	27	0.35	83	20	12.5	-275	<48
QC-2-1	01/10/13	7.7	44	502	1	33	<5	0.62	67	<1	10.1	-286	<48
QC-2-1	04/25/13	7.1	41	516	1	33	<5	0.64	66	<1	12.9	-281	<48
QC-2-1	07/18/13	8.2	43	660	1	31	<5	0.66	67	<1	14.6	-282	<48
QC-2-2	01/10/13	8.2	58	330	1	14	26	0.46	46	<1	11.1	-282	<48
QC-2-2	04/25/13	8.5	53	336	2	15	22	0.55	44	<1	11.9	-279	<48
QC-2-2	07/18/13	8.0	47	428	1	13	22	0.59	45	<1	15.9	-285	<48
QC-4	03/14/13	7.9	43	442	<1	<10	10	0.13	10	<1	11.3	-224	<48
QC-4	08/15/13	8.9	52	432	<1	NA[4]	14	0.18	10	<1	13.1	-233	<48
QC-4	10/03/13	8.9	53	418	<1	<10	13	0.13	10	<1	13.4	-227	<48
QC-5	02/27/13	8.4	63	534	1	33	9	0.16	9	<1	11.1	-209	<48
QC-5	08/15/13	8.8	69	538	1	NA	11	0.14	8	<1	15.0	-211	<48
QC-5	10/03/13	8.7	64	532	1	38	12	0.13	8	<1	13.0	-208	<48
QC-6	02/27/13	8.2	51	448	1	14	6	0.33	19	<1	11.4	-202	<48

TABLE 1 (Continued): ANALYSIS OF GROUNDWATER FROM MONITORING WELLS QC-2 THROUGH QC-31 IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN SAMPLED DURING 2013

Well[1]	Sample Date	pH	EC[2]	TDS[2]	TOC[2]	Cl^-	SO_4^{2-}	NH_3-N	Hardness	Fecal Coliform	Temp	Water Elevation[3]	Recharge Time
			mS/m	mg/L						MPN/100 mL	^0C	ft.	hr.
QC-6	08/15/13	8.6	56	520	2	NA	8	0.34	17	<1	13.0	-205	<48
QC-6	10/03/13	8.7	55	454	1	18	6	0.33	16	<1	12.7	-202	<48
QC-7	02/27/13	8.1	43	388	2	10	<5	0.28	13	<1	11.5	-169	<48
QC-7	08/15/13	8.6	50	432	1	NA	<5	0.37	12	<1	13.1	-172	<48
QC-7	10/03/13	8.4	50	392	2	11	<5	0.24	12	<1	12.9	-168	<48
QC-9	03/14/13	7.7	30	336	1	12	33	0.13	64	<1	11.4	-237	<48
QC-9	08/15/13	8.2	40	338	1	NA	33	0.21	66	<1	13.2	-246	<48
QC-9	10/03/13	8.3	40	308	1	10	35	<0.10	65	<1	14.0	-247	<48
QC-10	04/23/13	8.6	42	378	<1	30	<5	0.13	13	<1	12.6	-222	<4
QC-10	07/30/13	8.2	50	410	<1	29	<5	0.12	12	<1	13.0	-220	<4
QC-10	11/26/13	8.9	48	372	<1	31	<5	0.36	10	<1	12.4	-177	<4
QC-11	04/23/13	8.6	40	274	<1	21	7	0.13	19	<1	13.2	-218	<4
QC-11	07/30/13	8.1	37	304	<1	20	<5	0.13	21	<1	13.8	-218	<4
QC-11	11/26/13	8.8	36	270	<1	21	<5	0.15	19	<1	12.6	-201	<4
QC-12	04/23/13	7.8	78	938	<1	38	321	0.35	191	<1	13.0	-235	<4
QC-12	07/30/13	7.9	107	934	<1	34	313	0.34	176	<1	13.3	-233	<4
QC-12	11/26/13	8.0	106	848	<1	35	279	0.56	138	<1	12.6	-222	<4
QC-13	04/23/13	7.9	80	424	<1	59	27	0.19	39	<1	13.3	-231	<48
QC-13	07/30/13	7.9	57	462	<1	57	31	0.18	38	<1	14.1	-228	<48

TABLE 1 (Continued): ANALYSIS OF GROUNDWATER FROM MONITORING WELLS QC-2 THROUGH QC-31 IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN SAMPLED DURING 2013

Well[1]	Sample Date	pH	EC[2]	TDS[2]	TOC[2]	Cl^-	SO_4^{2-}	NH_3-N	Hardness	Fecal Coliform	Temp	Water Elevation[3]	Recharge Time
			mS/m	mg/L						MPN/100 mL	^0C	ft.	hr.
QC-13	11/26/13	8.2	53	412	1.1	58	29	0.19	35	<1	12.3	-237	<48
QC-14	03/14/13	6.8	45	690	3	119	<5	0.29	120	<1	12.8	-199	<48
QC-14	09/26/13	7.7	100	750	4	312	<5	0.32	146	<1	13.4	-209	<48
QC-14	10/31/13	7.6	104	786	4	166	<5	0.24	164	<1	13.5	-199	<48
QC-15	03/14/13	8.0	36	464	<1	54	<5	0.24	12	<1	12.8	-217	<48
QC-15	09/26/13	8.8	44	302	1	13	<5	0.28	14	<1	13.3	-218	<48
QC-15	10/31/13	8.0	38	308	1	12	<5	0.24	14	<1	13.9	-215	<48
QC-16	03/21/13	7.7	46	500	1	21	67	<0.10	110	<1	11.2	-249	<48
QC-16	09/26/13	8.1	62	490	<1	21	63	<0.10	78	<1	13.5	-256	<48
QC-17	03/21/13	7.6	44	528	<1	<10	189	0.30	17	<1	10.7	-173	<48
QC-17	09/26/13	8.4	47	508	<1	<10	174	0.28	165	<1	13.1	-198	<48
QC-17	10/31/13	8.3	57	512	<1	<10	180	0.28	166	<1	12.6	-193	<48
QC-18	03/21/13	8.9	38	370	<1	<10	35	0.11	23	<1	6.0	-190	<48
QC-18	09/26/13	9.1	45	360	<1	<10	27	0.10	7	<1	12.9	-202	<48
QC-18	10/31/13	9.1	44	364	<1	<10	25	<0.10	8	<1	12.3	-201	<48
QC-19	03/21/13	8.4	43	466	<1	<10	154	0.56	6	<1	7.5	-150	<48
QC-19	09/26/13	9.1	47	446	<1	<10	141	0.28	110	<1	12.7	-129	<48
QC-19	10/31/13	8.9	50	452	<1	<10	149	0.29	118	<1	12.6	-98	<48

TABLE 1 (Continued): ANALYSIS OF GROUNDWATER FROM MONITORING WELLS QC-2 THROUGH QC-31 IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN SAMPLED DURING 2013

Well[1]	Sample Date	pH	EC[2]	TDS[2]	TOC[2]	Cl^-	SO_4^{2-}	NH_3-N	Hardness	Fecal Coliform	Temp	Water Elevation[3]	Recharge Time
			mS/m	mg/L						MPN/100 mL	^0C	ft.	hr.
QC-20	05/09/13	7.5	42	412	<1	17	85	0.15	99	<1	15.9	-263	<48
QC-20	08/08/13	8.4	35	308	1	18	17	0.17	33	<1	13.5	-265	<48
QC-20	11/06/13	8.5	33	274	<1	19	<5	0.15	21	<1	12.4	-263	<48
QC-21	05/09/13	7.9	30	390	2	17	12	<0.10	60	1	20.2	-235	<48
QC-21	08/08/13	7.9	50	398	4	20	22	<0.10	88	<1	13.5	-280	<48
QC-21	11/06/13	8.1	45	370	4	19	9	<0.10	48	<1	12.8	-237	<48
QC-22	05/09/13	7.7	30	285	2	16	<5	0.19	36	<1	14.1	-221	<48
QC-22	08/08/13	7.9	39	310	2	15	<5	0.19	57	<1	14.4	-264	<48
QC-22	11/06/13	8.0	34	266	2	14	<5	0.26	49	<1	12.5	-233	<48
QC-23	05/09/13	8.2	49	320	<1	19	<5	<0.10	6	<1	16.3	-223	<48
QC-23	08/08/13	9.2	45	318	<1	18	<5	0.12	6	<1	13.7	-240	<48
QC-23	11/06/13	9.3	41	334	<1	20	<5	0.13	6	<1	12.2	-232	<48
QC-24	03/21/13	8.4	30	216	<1	27	<5	0.14	26	<1	11.6	-223	<48
QC-24	08/08/13	8.0	33	260	1	24	<5	0.18	15	<1	14.1	-236	<48
QC-24	12/19/13	8.7	29	256	<1	25	<5	0.16	13	<1	12.4	-223	<48
QC-25	03/21/13	7.8	27	220	<1	13	<5	0.17	16	<1	11.3	-240	<48
QC-25	08/08/13	7.8	29	242	<1	13	10	0.18	35	<1	14.9	-236	<48
QC-25	12/19/13	8.7	26	236	<1	13	6	0.19	23	<1	12.7	-243	<48
QC-26	03/21/13	8.5	30	244	<1	11	17	0.11	68	<1	11.1	-222	<48

TABLE 1 (Continued): ANALYSIS OF GROUNDWATER FROM MONITORING WELLS QC-2 THROUGH QC-31 IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN SAMPLED DURING 2013

Well[1]	Sample Date	pH	EC[2]	TDS[2]	TOC[2]	Cl^-	SO_4^{2-}	NH_3-N	Hardness	Fecal Coliform	Temp	Water Elevation[3]	Recharge Time
			mS/m	mg/L						MPN/100 mL	^{0}C	ft.	hr.
QC-26	08/08/13	8.9	35	284	<1	11	<5	<0.10	9	<1	13.4	-229	<48
QC-26	12/19/13	9.3	32	278	<1	11	<5	0.11	6	<1	12.9	-228	<48
QC-27	03/21/13	8.3	31	246	<1	29	<5	0.17	10	<1	10.9	-210	<48
QC-27	08/08/13	7.9	34	250	<1	29	<5	0.19	28	<1	14.3	-206	<48
QC-27	12/19/13	8.2	30	232	<1	30	<5	0.18	24	<1	12.5	-205	<48
QC-28	03/21/13	8.2	33	258	1	12	<5	<0.10	10	<1	12.0	-240	<48
QC-28	08/08/13	8.3	35	314	1	16	<5	0.12	20	<1	16.2	-246	<48
QC-28	12/19/13	8.8	32	268	1	12	<5	<0.10	17	<1	12.9	-245	<48
QC-29	03/14/13	7.7	81	904	1	174	180	0.80	351	<1	11.1	-58	<48
QC-29	07/18/13	8.2	39	466	1	<10	76	0.43	63	<1	14.8	-53	<48
QC-29	08/15/13	7.2	110	976	2	NA[4]	190	0.80	457	<1	14.2	-57	<48
QC-29	09/05/13	7.2	106	1,090	1	181	169	0.75	409	<1	13.1	-57	<48
QC-29	10/03/13	7.1	125	870	1	174	179	0.72	372	<1	12.4	-59	<48
QC-29	11/20/13	7.3	114	978	1	198	197	0.78	424	<1	11.7	-55	<48
QC-30	03/14/13	7.9	45	582	2	<10	77	0.41	57	<1	11.1	-138	<48
QC-30	07/18/13	8.3	40	892	1	161	154	0.66	352	<1	14.7	-138	<48
QC-30	08/15/13	8.1	50	446	<1	NA	77	0.45	65	<1	12.1	-132	<48
QC-30	09/05/13	8.3	49	544	<1	<10	81	0.43	66	<1	12.8	-133	<48
QC-30	10/03/13	8.1	49	398	1	10	87	0.42	64	<1	12.5	-138	<48
QC-30	11/20/13	8.1	22	418	<1	<10	85	0.40	69	<1	11.3	-132	<48

TABLE 1 (Continued): ANALYSIS OF GROUNDWATER FROM MONITORING WELLS QC-2 THROUGH QC-31 IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN SAMPLED DURING 2013

Well[1]	Sample Date	pH	EC[2]	TDS[2]	TOC[2]	Cl^-	SO_4^{2-}	NH_3-N	Hardness	Fecal Coliform	Temp	Water Elevation[3]	Recharge Time
			mS/m	mg/L						MPN/100 mL	^{0}C	ft.	hr.
QC-31	03/14/13	7.6	56	490	<1	15	170	0.85	182	<1	12.1	-64	<48
QC-31	07/18/13	8.0	28	626	1	13	189	1.1	264	<1	14.9	-67	<48
QC-31	08/15/13	7.6	70	582	1	NA	177	1.1	254	<1	12.8	-59	<48
QC-31	09/05/13	7.8	67	604	1	15	183	1.0	240	<1	13.4	-65	<48
QC-31	10/03/13	7.7	68	552	1	16	190	1.0	241	<1	12.9	-68	<48
QC-31	11/20/13	8.1	63	548	1	16	182	1.0	220	<1	12.3	-62	<48

[1]No samples obtained from Wells QC-1 and -32 through -37; considered intermittently or permanently dry; only two samples retrieved from QC-16.
[2]EC = electrical conductivity; TDS = total dissolved solids; TOC = total dissolved organic carbon.
[3]Relative to Chicago city datum (579.48 ft above mean sea level) at intersection of Madison and State Streets.
[4]No analysis; sample insufficient for re-run.

TABLE 2: DESCRIPTIVE STATISTICS FOR GROUNDWATER DATA OF MONITORING WELLS QC-2 THROUGH QC-31 IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2013

Well[1]	Statistic	pH	EC[2]	TDS[2]	TOC[2]	Cl^-	SO_4^{2-}	NH_3-N	Hardness	Fecal Coliform[3]
			mS/m	mg/L						MPN/100 mL
QC-2	Minimum	7.3	21	344	1	29	20	0.15	83	1
	Mean	7.8	40	391	2	32	33	0.53	89	7
	Maximum	8.2	62	494	2	34	75	0.80	98	260
	Std. Dev.	0.4	14	64	0.2	2	21	0.26	6	NA[4]
	Median	7.9	40	359	2	33	25	0.57	89	11
	Coeff. of Var. (%)	4.8	35	16	13	5	65	49	7	NA
QC-2-1	Minimum	7.1	41	502	1	31	<5	0.62	66	<1
	Mean	7.7	42	559	1	32	<5	0.64	67	<1
	Maximum	8.2	44	660	1	33	<5	0.66	67	<1
	Std. Dev.	0.6	2	87	0.1	1	0	0.02	1	NA
	Median	7.7	43	516	1	33	<5	0.64	67	<1
	Coeff. of Var. (%)	7.5	4	16	9	4	0	3.1	1	NA
QC-2-2	Minimum	8.0	47	330	1	13	22	0.46	44	<1
	Mean	8.2	53	365	1	14	23	0.53	45	<1
	Maximum	8.5	58	428	2	15	26	0.59	46	<1
	Std. Dev.	0.3	6	55	0.1	1	2	0.07	1	NA
	Median	8.2	53	336	1	14	22	0.55	45	<1
	Coeff. of Var. (%)	3.4	11	15	4	7	11	12	2	NA
QC-4	Minimum	7.9	43	418	<1	<10	10	0.13	10	<1
	Mean	8.6	49	431	<1	<10	12	0.15	10	<1
	Maximum	8.9	53	442	<1	<10	14	0.18	10	<1
	Std. Dev.	0.5	5	12	0	0	2	0.03	0	NA

TABLE 2 (Continued): DESCRIPTIVE STATISTICS FOR GROUNDWATER DATA OF MONITORING WELLS QC-2 THROUGH QC-31 IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2013

Well[1]	Statistic	pH	EC[2]	TDS[2]	TOC[2]	Cl^-	SO_4^{2-}	NH_3-N	Hardness	Fecal Coliform[3]
			mS/m	mg/L						MPN/100 mL
	Median	8.9	52	432	<1	<10	13	0.13	10	<1
	Coeff. of Var. (%)	6.3	11	3	0.0	0	18	20	0	NA
QC-5	Minimum	8.4	63	532	1	33	9	0.13	8	<1
	Mean	8.6	65	535	1	36	11	0.14	8	<1
	Maximum	8.8	69	538	1	38	12	0.16	9	<1
	Std. Dev.	0.2	3	3	0.1	4	2	0.02	1	NA
	Median	8.7	64	534	1	36	11	0.14	8	<1
	Coeff. of Var. (%)	2.1	5	1	8	10	18	11	7	NA
QC-6	Minimum	8.2	51	448	1	14	6	0.33	16	<1
	Mean	8.5	54	474	1	16	94	0.33	17	<1
	Maximum	8.7	56	520	2	18	8	0.34	19	<1
	Std. Dev.	0.3	3	40	0.1	3	98	0.01	2	NA
	Median	8.6	55	454	1	16	35	0.33	17	<1
	Coeff. of Var. (%)	3.0	5	8	4	18	105	1.7	9	NA
QC-7	Minimum	8.1	43	388	1	10	<5	0.24	12	<1
	Mean	8.4	47	404	1	11	<5	0.30	12	<1
	Maximum	8.6	]	432	2	11	<5	0.37	13	<1
	Std. Dev.	0.2	4	24	0.1	1	0	0.07	1	NA
	Median	8.4	50	392	2	11	<5	0.28	12	<1
	Coeff. of Var. (%)	2.8	9	6	4	7	0	22	5	NA

TABLE 2 (Continued): DESCRIPTIVE STATISTICS FOR GROUNDWATER DATA OF MONITORING WELLS QC-2 THROUGH QC-31 IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2013

Well[1]	Statistic	pH	EC[2]	TDS[2]	TOC[2]	Cl^-	SO_4^{2-}	NH_3-N	Hardness	Fecal Coliform[3]
			mS/m			mg/L				MPN/100 mL
QC-9	Minimum	7.7	30	308	1	10	33	0.13	64	<1
	Mean	8.1	36	327	1	11	34	0.17	65	<1
	Maximum	8.3	40	338	1	12	35	0.21	66	<1
	Std. Dev.	0.3	6	17	0	1	1	0.06	1	NA
	Median	8.2	40	336	1	11	33	0.17	65	<1
	Coeff. of Var. (%)	3.9	16	5	0	13	4	33	2	NA
QC-10	Minimum	8.2	42	372	<1	29	<5	0.12	10	<1
	Mean	8.6	47	387	<1	30	<5	0.20	12	<1
	Maximum	8.9	50	410	<1	31	<5	0.36	13	<1
	Std. Dev.	0.3	4	20	0	1	0	0.14	2	NA
	Median	8.6	48	378	<1	30	<5	0.13	12	<1
	Coeff. of Var. (%)	4.0	9	5	0	3	0	67	13	NA
QC-11	Minimum	8.1	36	270	<1	20	<5	0.13	19	<1
	Mean	8.5	38	283	<1	21	5	0.14	20	<1
	Std. Dev.	0.4	2	19	0	1	2	0.01	1	NA
	Median	8.6	37	274	<1	21	4	0.13	19	<1
	Coeff. of Var. (%)	4.2	6	7	0	3	40	8.4	6	NA
QC-12	Minimum	7.8	78	848	<1	34	279	0.34	138	<1
	Mean	7.9	97	907	<1	36	304	0.42	168	<1
	Maximum	8.0	107	938	<1	38	321	0.56	191	<1
	Std. Dev.	0.1	16	51	0	2	23	0.12	27	NA
	Median	7.9	106	934	<1	35	313	0.35	176	<1
	Coeff. of Var. (%)	1.7	17	6	0	6	7	30	16	NA

TABLE 2 (Continued): DESCRIPTIVE STATISTICS FOR GROUNDWATER DATA OF MONITORING WELLS QC-2 THROUGH QC-31 IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2013

Well[1]	Statistic	pH	EC[2]	TDS[2]	TOC[2]	Cl^-	SO_4^{2-}	NH_3-N	Hardness	Fecal Coliform[3]
			mS/m	mg/L						MPN/100 mL
QC-13	Minimum	7.9	53	412	<1	57	27	0.18	35	<1
	Mean	8.0	63	433	<1	58	29	0.19	37	<1
	Maximum	8.2	80	462	<1	59	31	0.19	39	<1
	Std. Dev.	0.2	15	26	0	1	2	0.01	2	NA
	Median	7.9	57	424	<1	58	29	0.19	38	<1
	Coeff. of Var. (%)	2.4	24	6	0	2	7	3.1	6	NA
QC-14	Minimum	6.8	45	690	3	119	<5	0.24	120	<1
	Mean	7.4	83	742	3	199	<5	0.28	143	<1
	Maximum	7.7	104	786	4	312	<5	0.32	164	<1
	Std. Dev.	0.5	33	48	1	101	0	0.04	22	NA
	Median	7.6	100	750	4	166	<5	0.29	146	<1
	Coeff. of Var. (%)	6.1	40	7	17	51	0	14	15	NA
QC-15	Minimum	8.0	36	302	1	12	<5	0.24	12	<1
	Mean	8.3	39	358	1	26	<5	0.25	13	<1
	Maximum	8.8	44	464	1	54	<5	0.28	14	<1
	Std. Dev.	0.4	4	92	0	24	0	0.02	1	NA
	Median	8.0	38	308	1	13	<5	0.24	14	<1
	Coeff. of Var. (%)	5.3	10	26	0	91	0	9.1	9	NA
QC-16	Minimum	7.7	46	490	<1	21	63	<0.10	78	<1
	Mean	7.9	54	495	1	21	65	<0.10	94	<1
	Maximum	8.1	62	500	1	21	67	<0.10	110	<1

TABLE 2 (Continued): DESCRIPTIVE STATISTICS FOR GROUNDWATER DATA OF MONITORING WELLS QC-2 THROUGH QC-31 IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2013

Well[1]	Statistic	pH	EC[2]	TDS[2]	TOC[2]	Cl^-	SO_4^{2-}	NH_3-N	Hardness	Fecal Coliform[3]
			mS/m	mg/L						MPN/100 mL
	Std. Dev.	0.3	12	7	0.2	0	3	0.00	23	NA
	Median	7.9	54	495	1	21	65	<0.10	94	<1
	Coeff. of Var. (%)	3.5	22	1	20	0	5	0.00	24	NA
QC-17	Minimum	7.6	44	508	<1	<10	174	0.28	17	<1
	Mean	8.1	49	516	<1	<10	181	0.29	116	<1
	Maximum	8.4	57	528	<1	<10	189	0.30	166	<1
	Std. Dev.	0.4	7	11	0	0	8	0.01	86	NA
	Median	8.3	47	512	<1	<10	180	0.28	165	<1
	Coeff. of Var. (%)	5.1	14	2	0	0	4	4.0	74	NA
QC-18	Minimum	8.9	38	360	<1	<10	25	<0.10	7	<1
	Mean	9.0	42	365	<1	<10	29	0.10	13	<1
	Maximum	9.1	45	370	<1	<10	35	0.11	23	<1
	Std. Dev.	0.1	4	5	0	0	5	0.01	9	NA
	Median	9.1	44	364	<1	<10	27	0.10	8	<1
	Coeff. of Var. (%)	1.3	9	1	0	0	17	5.6	71	NA
QC-19	Minimum	8.4	43	446	<1	<10	141	0.28	6	<1
	Mean	8.8	47	455	<1	<10	148	0.38	78	<1
	Maximum	9.1	50	466	<1	<10	154	0.56	118	<1
	Std. Dev.	0.3	4	10	0	0	7	0.16	62	NA
	Median	8.9	47	452	<1	<10	149	0.29	110	<1
	Coeff. of Var. (%)	3.9	8	2	0	0	5	42	80	NA

TABLE 2 (Continued): DESCRIPTIVE STATISTICS FOR GROUNDWATER DATA OF MONITORING WELLS QC-2 THROUGH QC-31 IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2013

Well[1]	Statistic	pH	EC[2]	TDS[2]	TOC[2]	Cl^-	SO_4^{2-}	NH_3-N	Hardness	Fecal Coliform[3]
			mS/m	mg/L						MPN/100 mL
QC-20	Minimum	7.5	33	274	<1	17	<5	0.15	21	<1
	Mean	8.1	37	331	1	18	36	0.16	51	<1
	Maximum	8.5	42	412	1	19	85	0.17	99	<1
	Std. Dev.	0.6	5	72	0.1	1	43	0.01	42	NA
	Median	8.4	35	308	1	18	17	0.15	33	<1
	Coeff. of Var. (%)	6.9	13	22	6	6	121	7.4	82	NA
QC-21	Minimum	7.9	30	370	2	17	9	<0.10	48	1
	Mean	7.9	42	386	3	19	14	<0.10	65	<1
	Maximum	8.1	50	398	4	20	22	<0.10	88	<1
	Std. Dev.	0.1	10	14	1	2	7	0.00	21	NA
	Median	7.9	45	390	4	19	12	<0.10	60	<1
	Coeff. of Var. (%)	1.4	24	4	31	8	48	0.00	31	NA
QC-22	Minimum	7.7	30	266	2	14	<5	0.19	36	<1
	Mean	7.9	34	287	2	15	<5	0.21	47	<1
	Maximum	8.0	39	310	2	16	<5	0.26	57	<1
	Std. Dev.	0.2	4	22	0.2	1	0	0.04	11	NA
	Median	7.9	34	285	2	15	<5	0.19	49	<1
	Coeff. of Var. (%)	2.2	13	8	9	7	0	19	22	NA
QC-23	Minimum	8.2	41	318	<1	18	<5	0.10	6	<1
	Mean	8.9	45	324	<1	19	<5	0.12	6	<1
	Maximum	9.3	49	334	<1	20	<5	0.13	6	<1
	Std. Dev.	0.6	4	9	0	1	0	0.02	0	NA
	Median	9.2	45	320	<1	19	<5	0.12	6	<1
	Coeff. of Var. (%)	6.7	9	3	0	5	0	13	0	NA

TABLE 2 (Continued): DESCRIPTIVE STATISTICS FOR GROUNDWATER DATA OF MONITORING WELLS QC-2 THROUGH QC-31 IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2013

Well[1]	Statistic	pH	EC[2]	TDS[2]	TOC[2]	Cl^-	SO_4^{2-}	NH_3-N	Hardness	Fecal Coliform3
			mS/m	mg/L						MPN/100 mL
QC-24	Minimum	8.0	29	216	1	24	<5	0.14	13	<1
	Mean	8.4	31	244	1	25	<5	0.16	18	<1
	Maximum	8.7	33	260	1	27	<5	0.18	26	<1
	Std. Dev.	0.3	2	24	0	2	0	0.02	7	NA
	Median	8.4	30	256	1	25	<5	0.16	15	<1
	Coeff. of Var. (%)	4.1	6	10	0	6	0	13	39	NA
QC-25	Minimum	7.8	26	220	<1	13	5	0.17	16	<1
	Mean	8.1	27	233	<1	13	7	0.18	25	<1
	Maximum	8.7	29	242	<1	13	10	0.19	35	<1
	Std. Dev.	0.5	1	11	0	0	2	0.01	10	NA
	Median	7.8	27	236	<1	13	6	0.18	23	<1
	Coeff. of Var. (%)	6.7	5	5	0	0	36	5.6	39	NA
QC-26	Minimum	8.5	30	244	<1	11	5	0.10	6	<1
	Mean	8.9	32	269	<1	11	9	0.11	28	<1
	Maximum	9.3	35	284	<1	11	17	0.11	68	<1
	Std. Dev.	0.4	2	22	0	0	7	0.01	35	NA
	Median	8.9	32	278	<1	11	5	0.11	9	<1
	Coeff. of Var. (%)	4.6	6	8	0	0	78	5.4	126	NA
QC-27	Minimum	7.9	30	232	<1	29	<5	0.17	10	<1
	Mean	8.1	32	243	<1	29	<5	0.18	21	<1

TABLE 2 (Continued): DESCRIPTIVE STATISTICS FOR GROUNDWATER DATA OF MONITORING WELLS QC-2 THROUGH QC-31 IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2013

Well[1]	Statistic	pH	EC[2]	TDS[2]	TOC[2]	Cl^-	SO_4^{2-}	NH_3-N	Hardness	Fecal Coliform[3]
			mS/m			mg/L				MPN/100 mL
	Maximum	8.3	34	250	<1	30	<5	0.19	28	<1
	Std. Dev.	0.2	2	9	0	1	0	0.01	9	NA
	Median	8.2	31	246	<1	29	<5	0.18	24	<1
	Coeff. of Var. (%)	2.4	6	4	0	2	0	5.6	46	NA
QC-28	Minimum	8.2	32	258	1	12	<5	0.10	10	<1
	Mean	8.4	33	280	1	13	<5	0.11	16	<1
	Maximum	8.8	35	314	1	16	<5	0.12	20	<1
	Std. Dev.	0.3	2	30	0.1	2	0	0.01	5	NA
	Median	8.3	33	268	1	12	<5	0.10	17	<1
	Coeff. of Var. (%)	3.9	5	11	8	17	0	11	33	NA
QC-29	Minimum	7.1	39	466	1	10	76	0.43	63	<1
	Mean	7.4	96	881	1	147	165	0.71	346	<1
	Maximum	8.2	125	1,090	2	198	197	0.80	457	<1
	Std. Dev.	0.4	31	217	0.1	77	45	0.14	144	NA
	Median	7.3	108	940	1	174	180	0.77	391	<1
	Coeff. of Var. (%)	5.7	33	25	10	53	27	20	42	NA
QC-30	Minimum	7.9	22	398	1	10	77	0.40	57	<1
	Mean	8.1	43	547	1	40	94	0.46	112	<1
	Maximum	8.3	50	892	2	161	154	0.66	352	<1
	Std. Dev.	0.2	11	184	0.3	68	30	0.10	118	NA
	Median	8.1	47	495	1	10	83	0.43	66	<1
	Coeff. of Var. (%)	2.0	25	34	23	168	32	21	105	NA

TABLE 2 (Continued): DESCRIPTIVE STATISTICS FOR GROUNDWATER DATA OF MONITORING WELLS QC-2 THROUGH QC-31 IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2013

Well[1]	Statistic	pH	EC[2]	TDS[2]	TOC[2]	Cl^-	SO_4^{2-}	NH_3-N	Hardness	Fecal Coliform[3]
			mS/m	mg/L						MPN/100 mL
QC-31	Minimum	7.6	28	490	1	13	170	0.85	182	<1
	Mean	7.8	59	567	1	15	182	1.0	234	<1
	Maximum	8.1	70	626	1	16	190	1.1	264	<1
	Std. Dev.	0.2	16	48	0.1	1	7	0.08	29	NA
	Median	7.7	65	567	1	15	182	1.0	241	<1
	Coeff. of Var. (%)	2.8	27	8	9	8	4	8.1	13	NA

[1]No samples obtained from Wells QC-1 and -32 through -37; considered intermittently or permanently dry; only two samples retrieved from QC-16.
[2]EC = electrical conductivity; TDS = total dissolved solids; TOC = total dissolved organic carbon.
[3]Geometric mean calculated.
[4]Not applicable.

TABLE 3: GROUNDWATER ELEVATIONS FOR OBSERVATION WELLS OC-1 THROUGH OC-11 IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN MEASURED DURING 2013

Date[1]	Observation Well No.											
	OC-1	OC-2	OC-3	OC-4	OC-5	OC-6	OC-7	OC-8	OC-8.1	OC-9	OC-10	OC-11
	Elevation (ft)[2]											
01/04/13	-27.8	-21.6	-151	-169	-143	-81.7	-212	-186	-261	-214	-220	-224
01/18/13	-27.8	-21.6	-147	-158	-142	-78.7	-210	-188	-243	-215	-216	-230
02/01/13	-25.8	-23.6	-149	-165	-141	-79.7	-214	-191	-249	-210	-215	-220
02/08/13	-26.8	-23.6	-151	-168	-41.3	-81.7	-211	-184	-261	-215	-222	-224
02/22/13	-28.8	-20.6	-148	-168	-141	-78.7	-210	-185	-260	-210	-222	-221
03/15/13	-26.8	-22.6	-146	-161	-140	-81.7	-211	-193	-245	-207	-213	-217
03/22/13	-27.8	-21.6	-147	-166	-140	-80.7	-212	-187	-252	-213	-217	-222
04/05/13	-26.8	-21.6	-149	-159	-144	-80.7	-213	-190	-245	-214	-227	-226
04/19/13	-26.8	-20.6	-147	-153	-141	-78.7	-209	-186	-238	-209	-223	-221
05/03/13	-25.8	-21.6	-144	-159	-138	-77.7	-208	-191	-237	-203	-210	-212
05/31/13	-25.8	-23.6	-148	-168	-140	-77.7	-213	-188	-254	-211	-216	-223
06/07/13	-31.8	-21.6	-150	-162	-140	-63.7	-200	-194	-229	-200	-209	-221
06/21/13	-26.8	-22.6	-148	-159	-144	-81.7	-212	-183	-244	--[3]	-227	-219
07/12/13	-26.8	-22.6	-147	-158	-141	-83.7	-211	-188	-243	-215	-228	-225
07/26/13	-29.8	-23.6	-148	-160	-141	-73.7	-199	-196	-225	-202	-207	-218
08/02/13	-27.8	-22.6	-147	-159	-140	-77.7	-196	-198	-217	-207	-205	-216
08/16/13	-28.8	-22.6	-146	-157	-143	-78.7	-197	-197	-215	-205	-209	-220
09/06/13	-28.8	-22.6	-146	-146	-141	-78.7	-195	-200	-214	-205	-210	-221
09/20/13	-27.8	-22.6	-144	-147	-140	-79.7	-196	-199	-212	-207	-207	-218
10/04/13	-28.8	-22.6	-152	-157	-144	-81.7	-211	-189	-242	-214	-226	-228
10/11/13	-29.8	-22.6	-150	-154	-147	-80.7	-209	-191	-239	-213	-227	-226
11/08/13	-25.8	-21.6	-148	-158	-145	-80.7	-214	-188	-244	-212	-226	-225

TABLE 3: GROUNDWATER ELEVATIONS FOR OBSERVATION WELLS OC-1 THROUGH OC-11 IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN MEASURED DURING 2013

Date[1]	Observation Well No.											
	OC-1	OC-2	OC-3	OC-4	OC-5	OC-6	OC-7	OC-8	OC-8.1	OC-9	OC-10	OC-11
	Elevation (ft)[2]											
11/22/13	-25.8	-21.6	-149	-158	-145	-81.7	-213	-189	-246	-215	-226	-227
12/6/13	-34.8	-23.6	-147	-158	-153	-80.7	-215	-188	-246	-214	-227	-225
12/13/13	-27.8	-21.6	-150	-159	-145	-80.7	-213	-191	-246	-214	-226	-227

[1]Date measurements were taken.
[2]Relative to Chicago city datum (mean of 579.48' above sea level) at intersection of State and Madison Streets.
[3]Well inaccessible on 6/21/2013 due to flooding in the area.

FIGURE 3: MINIMUM, MEAN, AND MAXIMUM WATER ELEVATIONS FOR OBSERVATION WELLS OC-1 THROUGH OC-11 IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN MEASURED DURING 2013