

Protecting Our Water Environment



Metropolitan Water Reclamation District of Greater Chicago

*MONITORING AND RESEARCH
DEPARTMENT*

REPORT NO. 15-22

TUNNEL AND RESERVOIR PLAN

CALUMET TUNNEL SYSTEM

ANNUAL GROUNDWATER MONITORING REPORT

FOR 2014

July 2015

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July 9, 2015

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 2014

Attached are three copies of "Tunnel and Reservoir Plan, Calumet Tunnel System, Annual Groundwater Monitoring Report for 2014."

Very truly yours,

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

TCG:PL:cm

Attachment

cc/att: Ms. Sally K. Swanson (USEPA Region 5 - WC15J) - (2)

Dr. Zhang

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**TUNNEL AND RESERVOIR PLAN CALUMET TUNNEL SYSTEM
ANNUAL GROUNDWATER MONITORING
REPORT FOR 2014**

Monitoring and Research Department
Thomas C. Granato, Director

July 2015

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ANNUAL DATA FOR MONITORING AND OBSERVATION WELLS

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 is abandoned with the approval from the Illinois Environmental Protection Agency (IEPA) (Appendix 1). 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 2014, all wells were sampled as required, except for QC-2-1, -33, and -36 (only one sample) and QC-1, -32, -34, and -37 (no samples). These wells are considered dry or intermittently dry. Their pumps were tested and classified as functional. 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.

Summary of Data

Monitoring Wells. The analytical data for groundwater sampled during 2014 from monitoring wells QC-2 through QC-36 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 370 CFU/100 mL), were undetectable. Table 2 lists the descriptive statistics for groundwater data of monitoring wells QC-2 through QC-36 for the year 2014.

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

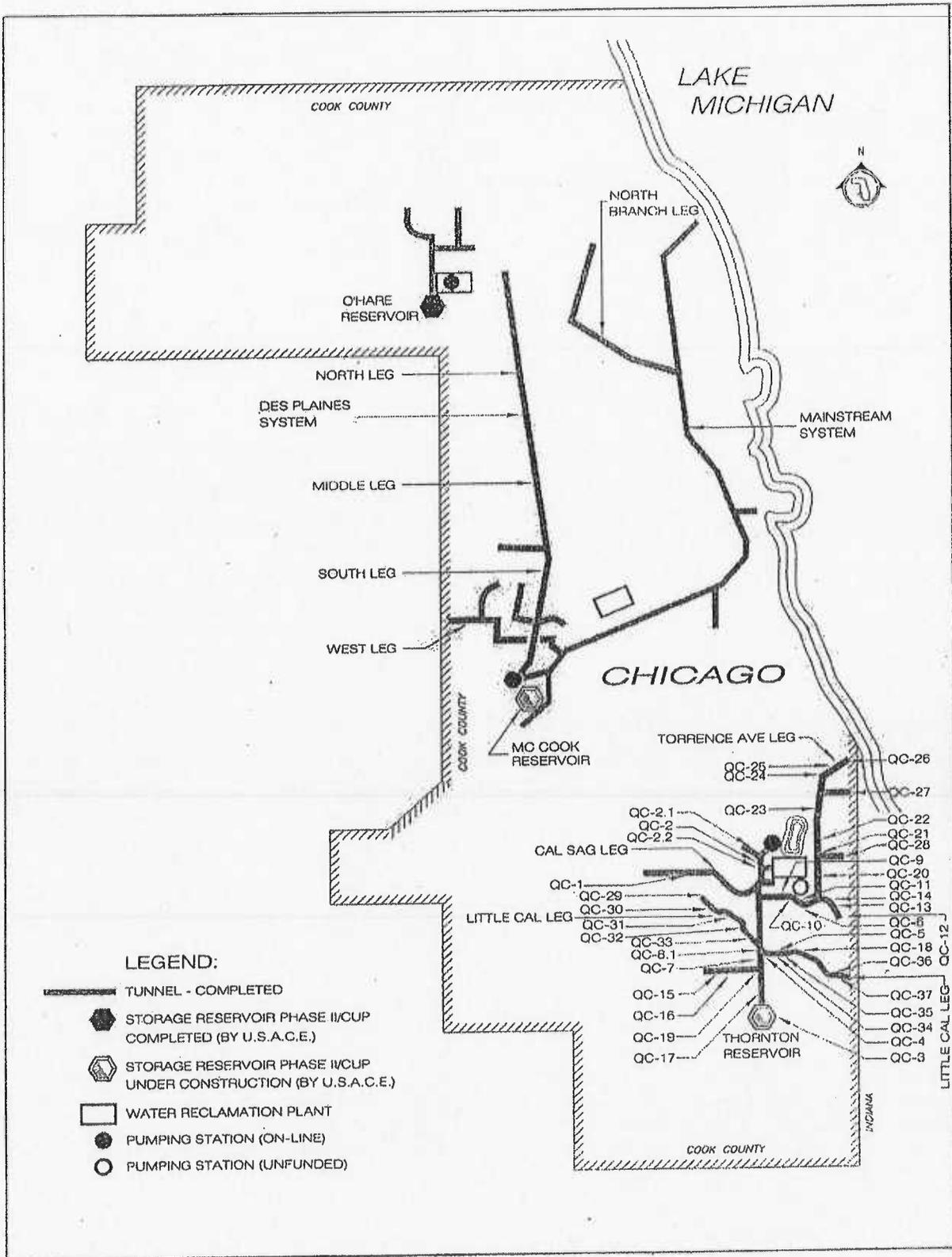


FIGURE 2: MAP OF OBSERVATION WELLS IN THE CALUMET TUNNEL SYSTEM

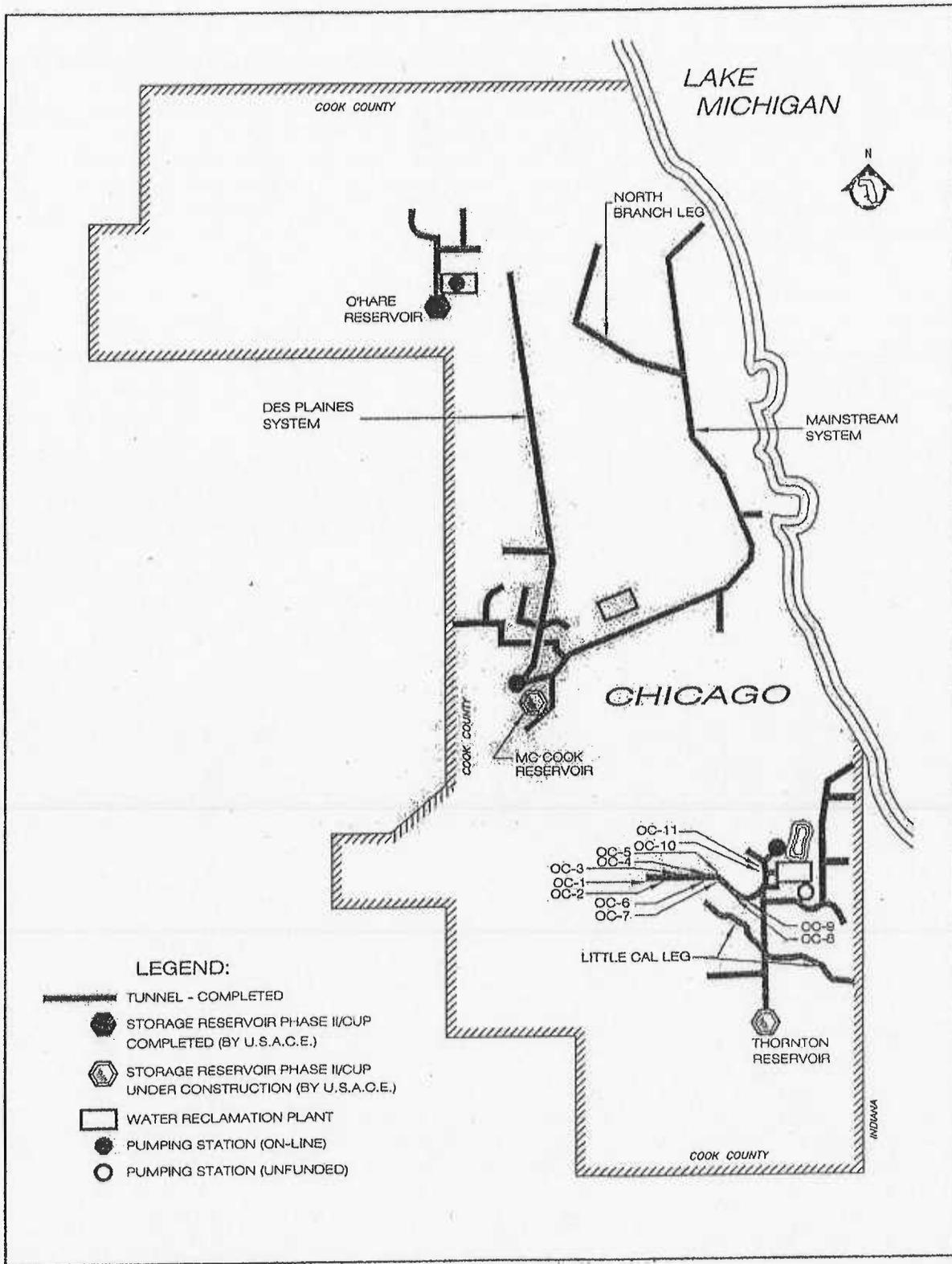


TABLE 1: ANALYSIS OF GROUNDWATER FROM MONITORING WELLS QC-2 THROUGH QC-36 IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN SAMPLED DURING 2014

Well ¹	Date Sampled	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 -----				CFU/100 mL	°C	ft	hr
QC-2	01/30/14	8.2	62	504	1	33	6	0.69	58	<1	11.5	-270	<48
QC-2	03/12/14	7.8	42	366	2	39	24	0.72	86	140	11.0	-271	<48
QC-2	06/05/14	8.3	47	350	2	33	25	0.85	84	370	14.0	-277	<48
QC-2	07/31/14	8.3	50	374	2	37	28	0.70	94	140	15.9	-293	<48
QC-2	09/24/14	8.4	47	356	2	34	21	0.74	92	150	14.6	-287	<48
QC-2	12/11/14	8.1	43	384	2	35	35	0.75	91	<1	12.1	-271	<48
QC-2-1	06/05/14	8.3	31	516	1	31	19	0.40	64	<1	16.0	-288	<48
QC-2-2	03/12/14	8.2	36	340	1	14	26	0.65	43	<1	10.7	-284	<48
QC-2-2	06/05/14	8.4	43	338	1	13	25	0.50	37	<1	14.5	-283	<48
QC-2-2	09/24/14	8.3	43	350	1	14	20	0.54	42	<1	14.4	-284	<48
QC-4	05/21/14	8.6	45	400	<1	<10	14	0.16	9	1	14.6	-228	<48
QC-4	08/07/14	8.8	50	434	<1	<10	14	0.17	10	<1	14.0	-193	<48
QC-4	11/12/14	8.7	50	426	<1	10	19	0.18	11	<1	11.2	-213	<48
QC-5	05/21/14	8.9	66	506	1	38	10	0.15	8	<1	13.6	-203	<48
QC-5	08/07/14	9.0	69	560	1	36	13	0.13	9	<1	13.4	-139	<48
QC-5	11/12/14	8.9	87	532	2	38	18	0.11	8	<1	11.3	-198	<48

TABLE 1 (Continued): ANALYSIS OF GROUNDWATER FROM MONITORING WELLS QC-2 THROUGH QC-36 IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN SAMPLED DURING 2014

Well ¹	Date Sampled	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 -----				CFU /100 mL	°C	ft	hr
QC-6	05/21/14	8.6	55	456	2	18	6	0.34	16	<1	13.7	-198	<48
QC-6	08/07/14	8.8	58	480	1	29	7	0.34	16	<1	13.9	-183	<48
QC-6	11/12/14	8.8	73	466	3	17	9	0.35	16	<1	11.6	-198	<48
QC-7	05/21/14	8.6	48	402	2	10	<5	0.29	10	<1	13.5	-167	<48
QC-7	08/07/14	8.6	50	420	1	10	<5	0.29	11	<1	13.2	-148	<48
QC-7	11/12/14	8.7	66	404	1	10	9	0.27	10	<1	11.7	-159	<48
QC-9	03/12/14	7.9	34	314	1	<10	37	0.35	63	<1	11.6	-255	<48
QC-9	06/05/14	8.3	39	390	1	10	36	0.65	61	<1	13.5	-223	<48
QC-9	10/23/14	8.3	34	318	1	12	38	0.30	63	<1	12.7	-247	<48
QC-10	02/19/14	7.8	48	382	<1	30	<5	0.11	11	<1	11.9	-225	<4
QC-10	05/14/14	8.0	42	386	<1	30	<5	0.11	9	<1	12.8	-205	<4
QC-10	08/21/14	8.7	48	642	<1	30	<5	0.10	11	<1	13.4	-177	<4
QC-10	11/19/14	8.8	46	622	1	NRR ⁴	6	0.11	12	<1	11.8	-224	<4
QC-11	02/19/14	7.9	35	336	<1	21	<5	0.14	22	<1	12.5	-193	<4
QC-11	06/17/14	8.7	36	368	2	21	<5	0.18	20	<1	13.7	-223	<4
QC-11	09/30/14	8.6	35	296	<1	21	<5	0.16	21	<1	13.2	-224	<4

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TABLE 1 (Continued): ANALYSIS OF GROUNDWATER FROM MONITORING WELLS QC-2 THROUGH QC-36 IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN SAMPLED DURING 2014

Well ¹	Date Sampled	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				CFU /100 mL	°C	ft	hr
QC-12	02/19/14	7.5	105	884	<1	36	339	0.33	181	<1	12.4	-213	<4
QC-12	06/17/14	8.2	99	888	<1	35	297	0.71	128	<1	13.3	-231	<4
QC-12	09/30/14	8.3	94	802	<1	36	222	0.95	129	<1	13.0	-234	<4
QC-13	04/02/14	8.3	50	414	<1	57	31	0.20	34	<1	12.1	-237	<48
QC-13	06/17/14	8.2	54	504	1	61	30	0.18	36	<1	13.9	-223	<48
QC-13	09/30/14	8.5	56	434	<1	60	25	0.20	36	<1	13.3	-229	<48
QC-14	03/20/14	6.9	82	786	4	168	<5	0.27	155	<1	12.6	-213	<48
QC-14	10/23/14	7.9	92	674	3	131	11	0.32	148	<1	12.5	-199	<48
QC-14	12/18/14	7.9	84	784	3	176	13	0.28	147	<1	12.3	-203	<48
QC-15	03/20/14	8.0	35	298	1	13	<5	0.93	14	<1	12.1	-218	<48
QC-15	10/23/14	8.8	37	300	1	12	6	0.26	15	<1	12.3	-223	<48
QC-15	12/18/14	8.7	35	292	2	12	<5	0.19	62	<1	11.6	-222	<48
QC-16	05/21/14	7.8	46	508	<1	24	77	<0.10	79	<1	14.4	-256	<48
QC-16	08/07/14	8.2	66	516	<1	23	69	<0.10	86	<1	16.1	-249	<48
QC-16	11/12/14	7.9	29	500	<1	24	81	<0.10	89	<1	11.2	-260	<48

TABLE 1 (Continued): ANALYSIS OF GROUNDWATER FROM MONITORING WELLS QC-2 THROUGH QC-36 IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN SAMPLED DURING 2014

Well ¹	Date Sampled	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 -----					CFU /100 mL	°C	ft	hr	
QC-17	03/12/14	7.5	47	522	<1	<10	197	0.30	184	<1	10.1	-169	<48
QC-17	10/23/14	8.1	60	470	<1	<10	188	0.23	137	<1	12.9	-193	<48
QC-17	12/18/14	8.0	53	512	6	<10	173	0.19	165	<1	11.4	-164	<48
QC-18	03/12/14	8.4	40	386	<1	<10	30	0.11	8	<1	10.9	-230	<48
QC-18	10/23/14	9.2	44	346	<1	<10	31	0.13	8	<1	12.3	-206	<48
QC-18	12/18/14	8.5	41	354	1	<10	27	0.10	12	<1	11.2	-220	<48
QC-19	05/14/14	7.9	51	456	<1	<10	176	0.29	111	<1	12.3	-131	<48
QC-19	08/21/14	7.3	52	484	<1	<10	158	0.30	116	<1	13.3	-137	<48
QC-19	11/12/14	8.2	53	430	<1	<10	145	0.29	107	<1	12.0	-127	<48
QC-20	05/14/14	7.2	46	306	<1	19	<5	0.15	19	<1	12.5	-269	<48
QC-20	08/21/14	8.0	33	328	<1	18	<5	0.15	20	<1	13.7	-269	<48
QC-20	11/12/14	8.4	37	292	12	19	38	0.15	40	<1	11.4	-272	<48
QC-21	05/14/14	7.4	32	338	3	18	13	0.20	35	<1	12.1	-261	<48
QC-21	08/21/14	8.1	44	412	3	17	9	0.10	41	<1	14.6	-252	<48
QC-21	11/12/14	8.2	44	536	NRR	NRR	14	<0.10	45	<1	11.3	-241	<48
QC-22	05/14/14	7.8	38	278	1	13	7	0.22	49	<1	11.8	-229	<48
QC-22	08/21/14	8.3	35	420	2	12	<5	0.32	49	<1	13.4	-260	<48
QC-22	11/19/14	8.4	31	256	3	14	9	0.30	39	<1	11.0	-250	<48

TABLE 1 (Continued): ANALYSIS OF GROUNDWATER FROM MONITORING WELLS QC-2 THROUGH QC-36 IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN SAMPLED DURING 2014

Well ¹	Date Sampled	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 -----				CFU /100 mL	°C	ft	hr
QC-23	05/22/14	8.7	40	316	<1	21	<5	0.10	6	<1	12.8	-232	<48
QC-23	08/27/14	8.7	42	466	<1	19	<5	0.13	22	<1	13.6	-239	<48
QC-23	11/19/14	9.2	39	350	12	20	<5	0.12	3	<1	11.2	-221	<48
QC-24	05/22/14	8.5	28	224	<1	27	<5	0.14	13	<1	12.0	-236	<48
QC-24	08/27/14	8.8	30	336	<1	30	<5	0.17	21	<1	13.5	-236	<48
QC-24	11/19/14	8.7	28	244	2	27	<5	0.15	13	<1	11.6	-236	<48
QC-25	05/22/14	7.8	25	218	<1	13	7	0.12	25	<1	13.2	-239	<48
QC-25	08/27/14	8.4	28	336	<1	14	10	0.19	19	<1	13.7	-232	<48
QC-25	11/19/14	8.2	27	228	3	13	13	0.15	31	<1	11.9	-231	<48
QC-26	05/22/14	9.0	32	270	<1	12	<5	0.10	6	<1	13.0	-225	<48
QC-26	08/27/14	9.0	38	440	<1	14	<5	0.13	6	<1	13.4	-225	<48
QC-26	11/19/14	8.4	32	268	2	12	<5	0.11	5	<1	11.9	-226	<48
QC-27	05/22/14	8.1	29	240	<1	31	<5	0.16	23	<1	12.9	-208	<48
QC-27	08/27/14	8.7	30	332	<1	30	<5	0.19	23	<1	13.7	-199	<48
QC-27	11/19/14	8.8	29	240	<1	31	<5	0.17	24	<1	11.6	-204	<48

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TABLE 1 (Continued): ANALYSIS OF GROUNDWATER FROM MONITORING WELLS QC-2 THROUGH QC-36 IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN SAMPLED DURING 2014

Well ¹	Date Sampled	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 -----				CFU /100 mL	°C	ft	hr
QC-28	05/22/14	8.6	31	256	2	13	<5	0.10	15	<1	13.7	-245	<48
QC-28	08/27/14	8.6	33	382	1	12	<5	<0.10	16	<1	13.8	-238	<48
QC-28	11/19/14	8.9	37	246	1	12	<5	0.10	16	<1	12.1	-238	<48
QC-29	01/30/14	7.2	113	788	1	164	165	0.75	315	<1	11.6	-55	<48
QC-29	03/20/14	7.2	102	1,022	2	201	226	0.81	449	<1	11.4	-54	<48
QC-29	04/10/14	7.1	114	902	2	179	194	0.75	380	<1	12.1	-59	<48
QC-29	07/31/14	7.4	110	970	2	198	202	0.80	446	<1	13.2	-55	<48
QC-29	10/08/14	7.6	112	880	2	149	163	0.80	397	<1	12.5	-55	<48
QC-29	12/11/14	7.9	111	926	2	177	186	0.76	391	<1	11.1	-54	<48
QC-30	01/30/14	8.1	50	400	1	10	86	0.38	60	<1	12.0	-129	<48
QC-30	03/20/14	7.1	46	388	1	<10	88	0.40	62	<1	11.1	-130	<48
QC-30	04/10/14	8.4	44	412	1	10	92	0.45	69	<1	12.4	-129	<48
QC-30	07/31/14	8.5	46	424	1	11	92	0.44	64	1	13.3	-128	<48
QC-30	10/08/14	8.5	44	340	1	16	64	0.15	49	<1	12.1	-138	<48
QC-30	12/11/14	8.2	48	430	1	13	100	0.48	66	<1	10.8	-128	<48
QC-31	01/30/14	8.0	63	536	1	17	181	0.86	215	<1	11.8	-53	<48
QC-31	03/20/14	7.3	62	564	1	15	183	1.1	244	<1	12.0	-53	<48
QC-31	04/10/14	8.0	62	572	1	15	195	1.5	234	<1	13.0	-58	<48
QC-31	07/31/14	7.8	67	562	1	14	194	1.1	251	<1	13.1	-53	<48

TABLE 1 (Continued): ANALYSIS OF GROUNDWATER FROM MONITORING WELLS QC-2 THROUGH QC-36 IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN SAMPLED DURING 2014

Well ¹	Date Sampled	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				CFU /100 mL	°C	ft	hr
QC-31	10/08/14	7.9	32	528	1	13	166	1.1	209	<1	12.7	-60	<48
QC-31	12/11/14	7.7	74	570	1	16	190	1.0	243	<1	12.1	-59	<48
QC-33	04/03/14	7.9	53	496	1	26	58	0.27	11	<1	12.9	-168	<48
QC-35	02/13/14	8.0	106	908	1	32	42	0.12	16	<1	11.1	-153	<48
QC-35	09/04/14	10.0	108	910	4	30	31	<0.10	12	<1	15.3	-156	<48
QC-36	02/13/14	8.0	92	804	<1	31	8	0.10	10	<1	10.6	-134	<48

¹No samples retrieved from Wells QC-1, -32, -34, and -37; considered intermittently or permanently dry; only one sample from QC-2-1, -33, and -36.

²EC = electrical conductivity; TDS = total dissolved solids; TOC = total dissolved organic carbon.

³Relative to Chicago city datum (579.48 ft above mean sea level) at intersection of Madison and State Streets.

⁴No reportable result; values very high: 208 (QC-10, 11/19, Cl); 642 and 83 (QC-21, 11/12, TOC and Cl, respectively).

TABLE 2: DESCRIPTIVE STATISTICS FOR GROUNDWATER DATA OF MONITORING WELLS QC-2 THROUGH QC-36 IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2014

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 -----						CFU/100 mL
QC-2	Minimum	7.8	42	350	1	33	6	0.69	58	<1
	Mean	8.2	49	389	2	35	23	0.74	84	32
	Maximum	8.4	62	504	2	39	35	0.85	94	370
	Std. Dev.	0.2	7	58	0.3	2	10	0.06	13	NA ⁴
	Median	8.2	47	370	2	35	24	0.73	89	140
	Coeff. of Var. (%)	2.4	15	15	17	7	42	7.8	16	NA
QC-2-1	Minimum	8.3	31	516	1	31	19	0.40	64	<1
	Mean	8.3	31	516	1	31	19	0.40	64	<1
	Maximum	8.3	31	516	1	31	19	0.40	64	<1
	Std. Dev.	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Median	8.3	31	516	1	31	19	0.40	64	<1
	Coeff. of Var. (%)	NA	NA	NA	NA	NA	NA	NA	NA	NA
QC-2-2	Minimum	8.2	36	338	1	13	20	0.50	37	<1
	Mean	8.3	41	343	1	14	24	0.56	41	<1
	Maximum	8.4	43	350	1	14	26	0.65	43	<1
	Std. Dev.	0.1	4	6	0.1	1	3	0.08	3	NA
	Median	8.3	43	340	1	14	25	0.54	42	<1
	Coeff. of Var. (%)	1.2	9	2	9	4	14	14	8	NA

TABLE 2 (Continued): DESCRIPTIVE STATISTICS FOR GROUNDWATER DATA OF MONITORING WELLS QC-2 THROUGH QC-36 IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2014

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 -----						CFU/100 mL
QC-4	Minimum	8.6	45	400	<1	<10	14	0.16	9	<1
	Mean	8.7	48	420	<1	<10	16	0.17	10	<1
	Maximum	8.8	50	434	<1	10	19	0.18	11	1
	Std. Dev.	0.1	3	18	0	0	3	0.01	1	NA
	Median	8.7	50	426	<1	10	14	0.17	10	<1
	Coeff. of Var. (%)	1.5	6	4	0.0	0	16	5.9	10	NA
QC-5	Minimum	8.9	66	506	1	36	10	0.11	8	<1
	Mean	8.9	74	533	2	37	14	0.13	8	<1
	Maximum	9.0	87	560	2	38	18	0.15	9	<1
	Std. Dev.	0.1	12	27	0.4	1	4	0.02	1	NA
	Median	8.9	69	532	1	38	13	0.13	8	<1
	Coeff. of Var. (%)	0.8	16	5	26	3	32	15	7	NA
QC-6	Minimum	8.6	55	456	1	17	6	0.34	16	<1
	Mean	8.7	62	467	2	21	7	0.34	16	<1
	Maximum	8.8	73	480	3	29	9	0.35	16	<1
	Std. Dev.	0.1	10	12	0.8	7	2	0.01	0	NA
	Median	8.8	58	466	2	18	7	0.34	16	<1
	Coeff. of Var. (%)	1.4	16	3	43	31	25	1.7	0	NA

TABLE 2 (Continued): DESCRIPTIVE STATISTICS FOR GROUNDWATER DATA OF MONITORING WELLS QC-2 THROUGH QC-36 IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2014

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 -----						CFU/100 mL
QC-7	Minimum	8.6	48	402	1	10	<5	0.27	10	<1
	Mean	8.6	54	409	1	10	5	0.28	10	<1
	Maximum	8.7	66	420	2	10	9	0.29	11	<1
	Std. Dev.	0.1	10	10	0.1	0	2	0.01	1	NA
	Median	8.6	50	404	1	10	5	0.29	10	<1
	Coeff. of Var. (%)	0.8	18	2	7	0	40	4.1	6	NA
QC-9	Minimum	7.9	34	314	1	<10	36	0.30	61	<1
	Mean	8.1	36	341	1	11	37	0.43	62	<1
	Maximum	8.3	39	390	1	12	38	0.65	63	<1
	Std. Dev.	0.2	3	43	0.2	1	1	0.19	1	NA
	Median	8.3	34	318	1	11	37	0.35	62	<1
	Coeff. of Var. (%)	2.9	8	13	18	13	3	44	2	NA
QC-10	Minimum	7.8	42	382	<1	30	<5	0.10	9	<1
	Mean	8.3	46	508	1	30	5	0.11	11	<1
	Maximum	8.8	48	642	1	30	6	0.11	12	<1
	Std. Dev.	0.5	3	143	0.0	0	1	0.01	1	NA
	Median	8.3	47	504	1	30	6	0.11	11	<1
	Coeff. of Var. (%)	5.9	6	28	0.0	0	20	4.7	12	NA

TABLE 2 (Continued): DESCRIPTIVE STATISTICS FOR GROUNDWATER DATA OF MONITORING WELLS QC-2 THROUGH QC-36 IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2014

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 -----						CFU/100 mL
QC-11	Minimum	7.9	35	296	<1	21	<5	0.14	20	<1
	Mean	8.4	35	333	1	21	<5	0.16	21	<1
	Maximum	8.7	36	368	2	21	<5	0.18	22	<1
	Std. Dev.	0.4	1	36	0.6	0	0	0.02	1	NA
	Median	8.6	35	336	2	21	<5	0.16	21	<1
	Coeff. of Var. (%)	5.3	2	11	43	0	0	13	5	NA
QC-12	Minimum	7.5	94	802	<1	35	222	0.33	128	<1
	Mean	8.0	99	858	<1	36	286	0.66	146	<1
	Maximum	8.3	105	888	<1	36	339	0.95	181	<1
	Std. Dev.	0.5	5	49	0.0	1	60	0.31	30	NA
	Median	8.2	99	884	<1	36	297	0.71	129	<1
	Coeff. of Var. (%)	5.7	5	6	0.0	2	21	47	21	NA
QC-13	Minimum	8.2	50	414	<1	57	25	0.18	34	<1
	Mean	8.3	53	451	<1	59	29	0.19	35	<1
	Maximum	8.5	56	504	1	61	31	0.20	36	<1
	Std. Dev.	0.2	3	47	0.0	2	3	0.01	1	NA
	Median	8.3	54	434	1	60	30	0.20	36	<1

TABLE 2 (Continued): DESCRIPTIVE STATISTICS FOR GROUNDWATER DATA OF MONITORING WELLS QC-2 THROUGH QC-36 IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2014

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 -----						CFU/100 mL
	Coeff. of Var. (%)	1.9	5	10	0.0	4	11	6.0	3	NA
QC-14	Minimum	6.9	82	674	3	131	<5	0.27	147	<1
	Mean	7.6	86	748	3	158	12	0.29	151	<1
	Maximum	7.9	92	786	4	176	13	0.32	155	<1
	Std. Dev.	0.6	6	64	0.5	24	1	0.03	6	NA
	Median	7.9	84	784	3	168	12	0.28	151	<1
	Coeff. of Var. (%)	7.5	6	9	14	15	9	9.1	4	NA
QC-15	Minimum	8.0	35	292	1	12	<5	0.19	14	<1
	Mean	8.5	36	297	1	12	5	0.46	38	<1
	Maximum	8.8	37	300	2	13	6	0.93	62	<1
	Std. Dev.	0.4	1	4	0.2	1	1	0.41	34	NA
	Median	8.7	35	298	1	12	6	0.26	38	<1
	Coeff. of Var. (%)	5.3	3	1	15	5	20	89	89	NA
QC-16	Minimum	7.8	29	500	<1	23	69	<0.10	79	<1
	Mean	8.0	47	508	<1	24	76	<0.10	85	<1
	Maximum	8.2	66	516	<1	24	81	<0.10	89	<1
	Std. Dev.	0.2	19	8	0.0	1	6	0.00	5	NA
	Median	7.9	46	508	<1	24	77	<0.10	86	<1

TABLE 2 (Continued): DESCRIPTIVE STATISTICS FOR GROUNDWATER DATA OF MONITORING WELLS QC-2 THROUGH QC-36 IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2014

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 -----					CFU/100 mL	
	Coeff. of Var. (%)	3.0	40	2	0.0	2	8	0.00	6	NA
QC-17	Minimum	7.5	47	470	<1	<10	173	0.19	165	<1
	Mean	7.9	53	501	4	<10	186	0.24	175	<1
	Maximum	8.1	60	522	6	<10	197	0.30	184	<1
	Std. Dev.	0.3	6	28	3	0	12	0.06	13	NA
	Median	8.0	53	512	1	<10	188	0.23	175	<1
	Coeff. of Var. (%)	3.9	12	6	75	0	7	23	8	NA
QC-18	Minimum	8.4	40	346	<1	<10	27	0.10	8	<1
	Mean	8.7	42	362	1	<10	29	0.11	10	<1
	Maximum	9.2	44	386	1	<10	31	0.13	12	<1
	Std. Dev.	0.4	2	21	0.0	0	2	0.02	3	NA
	Median	8.5	41	354	1	<10	30	0.11	10	<1
	Coeff. of Var. (%)	4.9	4	6	0.0	0	8	13	28	NA
QC-19	Minimum	7.3	51	430	<1	<10	145	0.29	107	<1
	Mean	7.8	52	457	<1	<10	160	0.29	111	<1
	Maximum	8.2	53	484	<1	<10	176	0.30	116	<1
	Std. Dev.	0.4	1	27	0.0	0	16	0.01	5	NA
	Median	7.9	52	456	<1	<10	158	0.29	111	<1

TABLE 2 (Continued): DESCRIPTIVE STATISTICS FOR GROUNDWATER DATA OF MONITORING WELLS QC-2 THROUGH QC-36 IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2014

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 -----						CFU/100 mL
	Coeff. of Var. (%)	5.6	2	6	0.0	0	10	2.0	4	NA
QC-20	Minimum	7.2	33	292	<1	18	<5	0.15	19	<1
	Mean	7.9	39	309	5	19	5	0.15	26	<1
	Maximum	8.4	46	328	12	19	38	0.15	40	<1
	Std. Dev.	0.6	7	18	6	1	6	0.00	12	NA
	Median	8.0	37	306	1	19	38	0.15	20	<1
	Coeff. of Var. (%)	7.7	18	6	127	3	120	0.00	45	NA
QC-21	Minimum	7.4	32	338	3	17	9	0.10	35	<1
	Mean	7.9	40	429	3	18	12	0.15	40	<1
	Maximum	8.2	44	536	3	18	14	0.20	45	<1
	Std. Dev.	0.4	7	100	0.2	1	3	0.07	5	NA
	Median	8.1	44	412	3	18	13	0.15	41	<1
	Coeff. of Var. (%)	5.5	18	23	7	4	22	47	12	NA
QC-22	Minimum	7.8	31	256	1	12	<5	0.22	39	<1
	Mean	8.2	35	318	2	13	7	0.28	46	<1
	Maximum	8.4	38	420	3	14	9	0.32	49	<1
	Std. Dev.	0.3	3	89	1	1	2	0.05	6	NA

TABLE 2 (Continued): DESCRIPTIVE STATISTICS FOR GROUNDWATER DATA OF MONITORING WELLS QC-2 THROUGH QC-36 IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2014

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 -----						CFU/100 mL
	Median	8.3	35	278	2	13	7	0.30	49	<1
	Coeff. of Var. (%)	4.0	9	28	35	8	29	19	13	NA
QC-23	Minimum	8.7	39	316	<1	19	<5	0.10	3	<1
	Mean	8.9	40	377	5	20	<5	0.12	10	<1
	Maximum	9.2	42	466	12	21	<5	0.13	22	<1
	Std. Dev.	0.2	1	79	6	1	0	0.02	10	NA
	Median	8.7	40	350	1	20	<5	0.12	6	<1
	Coeff. of Var. (%)	2.8	3	21	127	5	0	13	99	NA
QC-24	Minimum	8.5	28	224	<1	27	<5	0.14	13	<1
	Mean	8.6	29	268	1	28	<5	0.15	16	<1
	Maximum	8.8	30	336	2	30	<5	0.17	21	<1
	Std. Dev.	0.2	1	60	0.6	2	0	0.02	5	NA
	Median	8.7	28	244	1	27	<5	0.15	13	<1
	Coeff. of Var. (%)	1.8	4	22	43	6	0	10	29	NA
QC-25	Minimum	7.8	25	218	<1	13	7	0.12	19	<1
	Mean	8.1	27	261	2	13	10	0.15	25	<1
	Maximum	8.4	28	336	3	14	13	0.19	31	<1
	Std. Dev.	0.3	1	65	1	1	3	0.04	6	NA

TABLE 2 (Continued): DESCRIPTIVE STATISTICS FOR GROUNDWATER DATA OF MONITORING WELLS QC-2 THROUGH QC-36 IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2014

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 -----						CFU/100 mL
QC-26	Median	8.2	27	228	1	13	10	0.15	25	<1
	Coeff. of Var. (%)	3.6	4	25	69	4	28	23	24	NA
	Minimum	8.4	32	268	<1	12	<5	0.10	5	<1
	Mean	8.8	34	326	2	13	<5	0.11	6	<1
	Maximum	9.0	38	440	2	14	<5	0.13	6	<1
	Std. Dev.	0.4	1	65	0.7	1	0	0.02	0	NA
QC-27	Median	9.0	32	270	1	12	<5	0.11	6	<1
	Coeff. of Var. (%)	4.4	3	20	43	6	0	19	0	NA
	Minimum	8.1	29	240	<1	30	<5	0.16	23	<1
	Mean	8.5	29	271	<1	31	<5	0.17	23	<1
	Maximum	8.8	30	332	<1	31	<5	0.19	24	<1
	Std. Dev.	0.4	1	53	0.0	1	0	0.02	1	NA
QC-28	Median	8.7	29	240	<1	31	<5	0.17	23	<1
	Coeff. of Var. (%)	4.3	2	20	0.0	2	0	8.8	2	NA
	Minimum	8.6	31	246	1	12	<5	<0.10	15	<1
	Mean	8.7	34	295	1	12	<5	0.10	16	<1
	Maximum	8.9	37	382	2	13	<5	0.10	16	<1

TABLE 2 (Continued): DESCRIPTIVE STATISTICS FOR GROUNDWATER DATA OF MONITORING WELLS QC-2 THROUGH QC-36 IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2014

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 -----						CFU/100 mL
	Std. Dev.	0.2	3	76	0.3	1	0	0.00	1	NA
	Median	8.6	33	256	1	12	<5	0.10	16	<1
	Coeff. of Var. (%)	1.7	10	26	23	5	0	0.00	4	NA
20 QC-29	Minimum	7.1	102	788	1	149	163	0.75	315	<1
	Mean	7.4	110	915	2	178	189	0.78	396	<1
	Maximum	7.9	114	1,022	2	201	226	0.81	449	<1
	Std. Dev.	0.3	4	80	0.2	20	24	0.03	55	NA
	Median	7.3	111	914	2	178	190	0.78	391	<1
	Coeff. of Var. (%)	4.1	4	9	12	11	13	3.6	14	NA
QC-30	Minimum	7.1	44	340	1	<10	64	0.15	60	<1
	Mean	8.1	46	399	1	12	87	0.38	64	<1
	Maximum	8.5	50	430	1	16	100	0.48	69	<1
	Std. Dev.	0.5	2	33	0.2	3	13	0.12	3	NA
	Median	8.3	46	406	1	11	90	0.42	64	<1
	Coeff. of Var. (%)	6.4	5	8	14	21	14	31	5	NA
QC-31	Minimum	7.3	32	528	1	13	166	0.86	215	<1
	Mean	7.8	60	555	1	15	185	1.1	237	<1

TABLE 2 (Continued): DESCRIPTIVE STATISTICS FOR GROUNDWATER DATA OF MONITORING WELLS QC-2 THROUGH QC-36 IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2014

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 -----					CFU/100 mL	
	Maximum	8.0	74	572	1	17	195	1.5	251	<1
	Std. Dev.	0.3	15	19	0.2	1	11	0.20	14	NA
	Median	7.9	63	563	1	15	187	1.1	243	<1
	Coeff. of Var. (%)	3.4	24	3	12	9	6	18	6	NA
QC-33	Minimum	7.9	53	496	1	26	58	0.27	11	<1
	Mean	7.9	53	496	1	26	58	0.27	11	<1
	Maximum	7.9	53	496	1	26	58	0.27	11	<1
	Std. Dev.	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Median	7.9	53	496	1	26	58	0.27	11	<1
	Coeff. of Var. (%)	NA	NA	NA	NA	NA	NA	NA	NA	NA
QC-35	Minimum	8.0	106	908	1	30	31	<0.10	12	<1
	Mean	9.0	107	909	2	31	36	0.11	14	<1
	Maximum	10.0	108	910	4	32	42	0.12	16	<1
	Std. Dev.	1.4	1	1	2	1	8	0.01	3	NA
	Median	9.0	107	909	2	31	36	0.12	14	<1
	Coeff. of Var. (%)	16	1	0.2	81	5	22	13	20	NA
QC-36	Minimum	8.0	92	804	<1	31	8	0.10	10	<1
	Mean	8.0	92	804	<1	31	8	0.10	10	<1

TABLE 2 (Continued): DESCRIPTIVE STATISTICS FOR GROUNDWATER DATA OF MONITORING WELLS QC-2 THROUGH QC-36 IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2014

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 -----						CFU/100 mL
	Maximum	8.0	92	804	<1	31	8	0.10	10	<1
	Std. Dev.	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Median	8.0	92	804	<1	31	8	0.10	10	<1
	Coeff. of Var. (%)	NA	NA	NA	NA	NA	NA	NA	NA	NA

¹No samples for Wells QC-1, -32, -34, and -37; considered intermittently dry; only one sample for QC-2-1, -33, and -36.

²EC = electrical conductivity; TDS = total dissolved solids; TOC = total dissolved organic carbon.

³Geometric mean calculated.

⁴Not applicable for Fecal Coliform data, and in instances of single samples.

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 2014

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 -----											
01/10/14	-24.8	-21.6	-147	-158	-146	-80.7	-213	-187	-246	-214	-226	-225
01/17/14	NR ³	-23.6	-148	-161	-144	-79.7	-210	-185	-235	-210	-228	-223
02/21/14	"	-19.6	-146	NR	NR	-76.7	NR	NR	-239	-209	-225	-223
02/28/14	"	NR	-152	"	-151	-81.7	"	"	-243	-213	-219	-222
03/21/14	"	"	-151	"	NR	-80.7	-209	"	-242	-211	-220	-224
03/31/14	-33.8	-25.6	-154	"	-152	-76.7	-210	"	-236	-211	-215	-222
04/17/14	-33.8	-24.6	-156	"	-151	-75.7	-208	-184	-234	-210	-216	-221
04/25/14	-34.8	-25.6	-156	"	NR	-73.7	-209	NR	-228	NR	-220	-221
05/02/14	-34.8	-24.6	-157	"	"	-74.7	-207	"	-230	"	-218	-239
05/16/14	NR	NR	-137	-161	"	-70.7	-205	"	-219	"	-189	-221
06/06/14	-28.8	-24.6	-152	-161	-143	-70.7	-212	-188	-226	-212	-225	-226
06/27/14	-34.8	-25.6	-153	NR	NR	-67.7	-209	-185	-241	-	-233	-230
07/18/14	-22.8	-19.6	-149	-161	"	-76.7	-209	-194	-225	-215	-218	NR
07/28/14	-23.8	-20.6	-150	-160	"	-76.7	-210	-193	-224	-208	-219	"
08/22/14	-30.8	NR	-154	-154	"	-75.7	NR	NR	-226	NR	-214	"
08/29/14	-32.8	-25.6	-156	-156	"	-76.7	-203	"	-225	"	-213	"
09/12/14	-31.8	NR	-152	NR	"	-75.7	-200	"	-225	"	-211	"
09/19/14	-27.8	-22.6	-152	-159	"	-70.7	-196	"	-238	"	-227	"
10/03/14	-37.8	-25.6	-150	NR	"	-74.7	-194	"	-223	"	-223	"
10/17/14	-36.8	-25.6	-155	-160	"	-76.7	-200	"	-222	"	-207	"

TABLE 3 (Continued): GROUNDWATER ELEVATIONS FOR OBSERVATION WELLS OC-1 THROUGH OC-11 IN THE CALUMET TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN MEASURED DURING 2014

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											
11/07/14	-27.8	-24.6	-152	-158	NR	-78.7	-202	-182	-224	-208	-209	-217
11/17/14	-25.8	-21.6	-150	-155	"	-81.7	-201	-183	-219	-206	-206	-218
12/12/14	-25.8	-20.6	-149	-154	-151	-80.7	-203	-181	-220	-204	-209	-215
12/17/14	-37.8	-25.6	-160	-162	-147	-71.7	-206	NR	-237	-214	-215	-226

¹Date measurements were taken.

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

³No readings; wells inaccessible at various times due to heavy snow, locked gate, muddy road conditions, fallen trees, high weeds, and flooding.

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 2014

