

Protecting Our Water Environment



Metropolitan Water Reclamation District of Greater Chicago

***MONITORING AND RESEARCH
DEPARTMENT***

REPORT NO. 17-33

TUNNEL AND RESERVOIR PLAN

UPPER DES PLAINES TUNNEL SYSTEM

ANNUAL GROUNDWATER MONITORING REPORT

FOR 2016

August 2017

Protecting Our Water Environment

BOARD OF COMMISSIONERS

Mariyana T. Spyropoulos
President
Barbara McGowan
Vice President
Frank Avila
Chairman of Finance
Timothy Bradford
Martin Durkin
Josita Morita
Debra Shore
Kari K. Steele
David J. Walsh

Metropolitan Water Reclamation District of Greater Chicago

CECIL LUE-HING RESEARCH AND DEVELOPMENT COMPLEX
6001 WEST PERSHING ROAD CICERO, ILLINOIS 60804-4112

Edward W. Podczerwinski, P.E.
Acting Director of Monitoring and Research

July 26, 2017

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

Dear Sir or Madam:

Subject: Tunnel and Reservoir Plan, Upper Des Plaines Tunnel System, Annual
Groundwater Monitoring Report for 2016

Attached are three copies of "Tunnel and Reservoir Plan, Upper Des Plaines Tunnel
System, Annual Groundwater Monitoring Report for 2016.

Very truly yours,

Albert E. Cox
Environmental Monitoring and Research Manager
Monitoring and Research Department

AC:PL:cm
Attachment

cc/w att: Ms. Sally K. Swanson (USEPA Region 5 - WC15J) - (2)
Mr. Podczerwinski
Dr. Zhang
Dr. Cox
Dr. Tian
Dr. Lindo
cc w/o att: Mr. St. Pierre
Mr. Murray

Metropolitan Water Reclamation District of Greater Chicago
100 East Erie Street Chicago, Illinois 60611-2803 (312) 751-5600

TUNNEL AND RESERVOIR PLAN
UPPER DES PLAINES TUNNEL SYSTEM
ANNUAL GROUNDWATER MONITORING REPORT
FOR 2016

Monitoring and Research Department
Edward W. Podczewinski, Acting Director

August 2017

TABLE OF CONTENTS

	<u>Page</u>
LIST OF TABLES	ii
LIST OF FIGURES	iii
LIST OF ABBREVIATIONS	iv
ANNUAL DATA FOR MONITORING WELLS	1
Introduction	1
Summary of Data for Monitoring Wells	1

LIST OF TABLES

<u>Table No.</u>		<u>Page</u>
1	Analysis of Groundwater from Monitoring Wells MW-1 Through MW-9 in the Upper Des Plaines Tunnel System of the Tunnel and Reservoir Plan Sampled During 2016	3
2	Descriptive Statistics for Groundwater Data of Monitoring Wells MW-1 Through MW-9 in the Upper Des Plaines Tunnel System of the Tunnel and Reservoir Plan During 2016	6
3	Groundwater Elevations for Monitoring/Observation Wells MW-1 Through MW-9 in the Upper Des Plaines Tunnel System of the Tunnel and Reservoir Plan Measured During 2016	9

LIST OF FIGURES

<u>Figure No.</u>		<u>Page</u>
1	Map of Monitoring Wells in the Upper Des Plaines Tunnel System	2
2	Minimum, Mean, and Maximum of Water Elevations for Monitoring/Observation Wells MW-1 Through MW-9 in the Upper Des Plaines Tunnel System of the Tunnel and Reservoir Plan Measured During 2016	10

LIST OF ABBREVIATIONS

CCD	Chicago City Datum
CFU	colony forming units
FC	fecal coliform
mL	milliliter
TDS	total dissolved solids
TOC	total organic carbon
UDP	Upper Des Plaines

ANNUAL DATA FOR MONITORING WELLS

Introduction

This system consists of two subsystems, Upper Des Plaines (UDP) 20 and UDP 21. The UDP 20 contains six monitoring wells, MW-1 through MW-6, while UDP 21 contains three monitoring wells, MW-7 through MW-9 (Figure 1). These nine monitoring wells are all sampled six times per year (Illinois Environmental Protection Agency memorandum dated July 9, 2004). Groundwater elevations in the monitoring wells were measured during each sampling event. In addition, groundwater elevations were measured biweekly since these wells also function as observation wells.

During the year, all monitoring wells in the UDP Tunnel system were sampled at the required frequency. Monitoring Wells MW-2, -5, and -7 were all repaired during 2014 through 2015. The pumps in these wells were replaced, and all wells yielded samples as required throughout the year. However, at the end of 2016, Well MW-1 was beginning to exhibit slight problems during sampling. We will continue to observe this well and proceed with repairs when needed. Following repairs in 2015, the wells were decontaminated using the standard procedure to eliminate any fecal coliform (FC) bacteria that might have entered the wells during repairs.

Summary of Data for Monitoring Wells

The analytical data for groundwater sampled during 2016 from monitoring Wells MW-1 through MW-9 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 most wells were non-detectable. There were a few occurrences of fecal coliform detections in several wells, mostly during June and July. During the month of June, an elevated FC count (140 CFU/100 mL) was observed in MW-5. The FC count in the well returned to non-detectable after September.

Table 2 lists the descriptive statistics for the groundwater data of monitoring wells MW-1 through MW-9 for the year 2016. There were no significant changes observed in any analytes that would suggest any potential for groundwater contamination.

Adjusted groundwater elevations in monitoring Wells MW-1 through MW-9 were calculated relative to the Chicago City Datum (CCD) (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 2). Fluctuations were mainly evident in Wells MW-1, -5, -8, and -9 during the year.

FIGURE 1: MAP OF MONITORING WELLS IN THE UPPER DES PLAINES TUNNEL SYSTEM

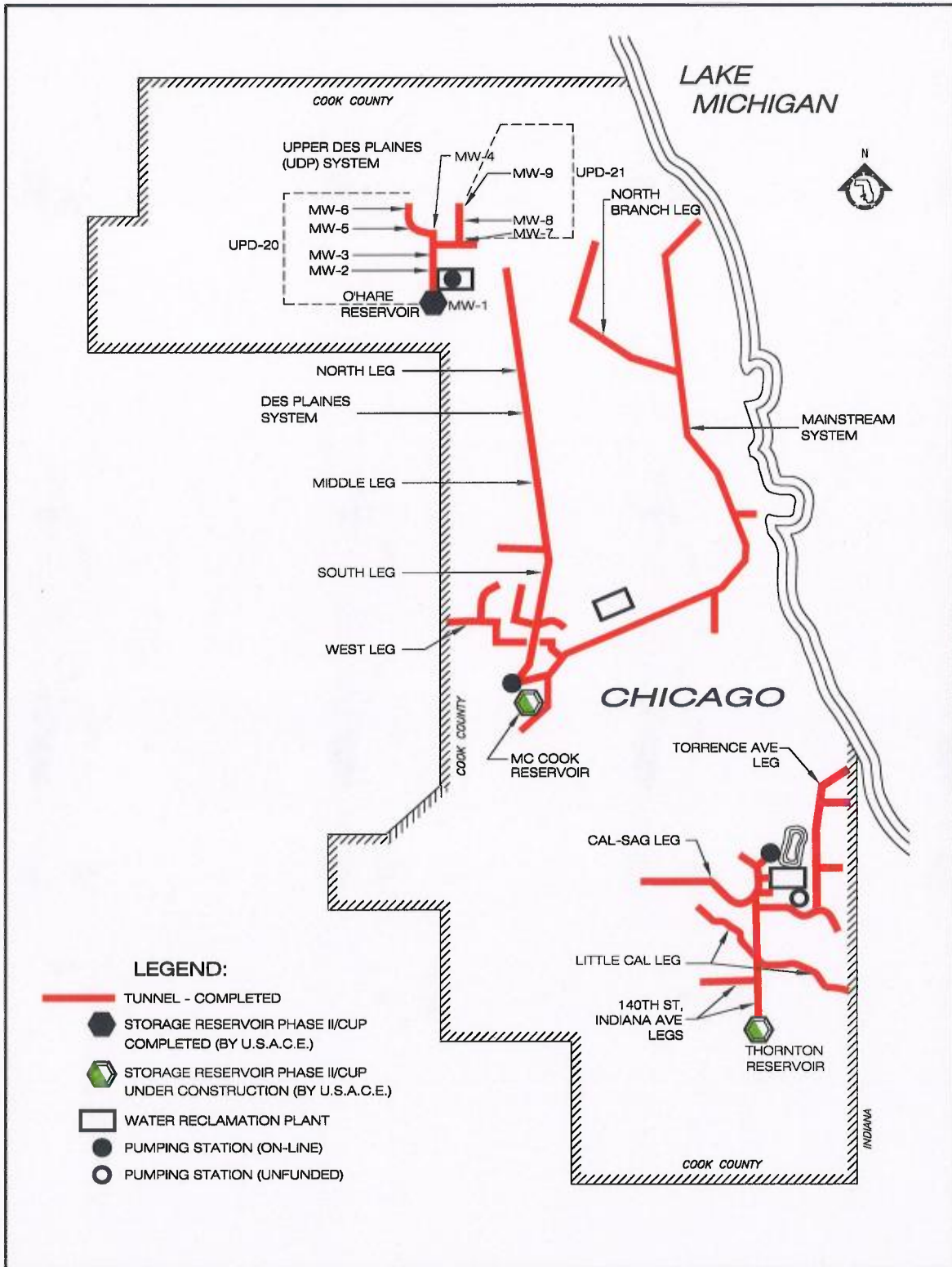


TABLE 1: ANALYSIS OF GROUNDWATER FROM MONITORING WELLS MW-1 THROUGH MW-9 IN THE UPPER DES PLAINES TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN SAMPLED DURING 2016

Well	Date Sampled	pH	EC ¹	TDS ¹	TOC ¹	Cl ⁻	SO ₄ ²⁻	NH ₃ -N	Hardness	Fecal Coliform	Temp	Water Elevation ²	Recharge Time
			mS/m	-----mg/L-----						CFU/100 mL	°C	ft	hr
MW-1	01/06/16	7.7	110	786	<1.0	29	394	0.28	427	<1	13.6	32	<48
MW-1	03/09/16	7.7	109	774	1.2	29	382	0.23	436	<1	15.3	17	<48
MW-1	06/16/16	6.8	136	944	<1.0	38	365	0.34	412	24	16.2	14	<48
MW-1	07/13/16	7.2	108	776	<1.0	31	374	0.26	440	6	15.3	17	<48
MW-1	09/14/16	7.1	106	806	<1.0	30	358	<0.10	440	<1	15.5	17	<48
MW-2	02/17/16	7.3	123	878	1.1	48	408	0.65	478	<1	14.9	46	<48
MW-2	02/29/16	7.7	122	856	<1.0	46	435	0.55	485	<1	13.6	45	<48
MW-2	05/11/16	7.7	112	792	<1.0	47	377	0.74	483	<1	12.9	45	<48
MW-2	07/18/16	7.3	119	896	<1.0	50	407	0.60	485	<1	14.7	45	<48
MW-2	08/11/16	7.5	112	986	<1.0	49	402	0.59	489	<1	15.9	44	<48
MW-2	09/21/16	7.6	120	1,010	<1.0	53	429	0.60	486	<1	14.3	45	<48
MW-2	11/22/16	7.7	121	830	1.1	50	392	0.74	483	<1	13.8	45	<48
MW-3	03/09/16	7.9	54	824	1.0	18	448	0.28	445	<1	14.6	41	<48
MW-3	06/16/16	7.5	108	1,012	<1.0	22	432	0.35	424	<1	15.1	39	<48
MW-3	07/13/16	7.7	110	808	1.6	19	436	0.30	446	4	15.6	40	<48
MW-3	09/14/16	7.6	112	848	1.0	15	453	0.34	459	<1	15.6	39	<48
MW-3	10/06/16	7.5	109	760	<1.0	13	474	0.33	446	<1	15.1	37	<48
MW-3	12/01/16	8.0	108	770	1.7	12	440	0.43	442	<1	14.7	38	<48
MW-4	03/09/16	7.8	130	924	<1.0	64	384	<0.10	536	<1	14.0	0.9	<48
MW-4	06/16/16	7.5	128	1,088	<1.0	71	386	0.13	518	<1	14.0	0.9	<48

TABLE 1 (Continued): ANALYSIS OF GROUNDWATER FROM MONITORING WELLS MW-1 THROUGH MW-9 IN THE UPPER DES PLAINES TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN SAMPLED DURING 2016

Well	Date Sampled	pH	EC ¹	TDS ¹	TOC ¹	Cl ⁻	SO ₄ ²⁻	NH ₃ -N	Hardness	Fecal Coliform	Temp	Water Elevation ²	Recharge Time
			mS/m	-----mg/L-----						CFU/100 mL	°C	ft	hr
MW-4	07/13/16	7.5	128	814	<1.0	55	379	<0.10	562	<1	14.8	-0.1	<48
MW-4	09/14/16	7.6	135	968	<1.0	71	376	<0.10	558	<1	14.4	-0.1	<48
MW-4	10/06/16	7.6	130	878	<1.0	68	406	0.13	544	<1	14.0	-0.1	<48
MW-4	12/01/16	7.7	127	886	<1.0	64	376	0.2	528	<1	13.6	-0.1	<48
MW-5	03/09/16	9.2	142	798	<1.0	265	105	<0.10	95	<1	14.6	-54	<48
MW-5	06/16/16	8.8	163	790	<1.0	322	106	0.23	98	140	13.9	-54	<48
MW-5	07/13/16	8.0	147	890	<1.0	216	244	0.45	246	6	14.3	-54	<48
MW-5	09/14/16	9.3	75	590	<1.0	171	111	0.11	97	1	14.6	-54	<48
MW-5	10/06/16	7.9	133	800	<1.0	130	307	0.61	299	<1	13.8	-56	<48
MW-5	12/01/16	8.7	52	284	1.4	54	51	<0.10	69	<1	13	-56	<48
MW-6	01/07/16	7.7	86	742	<1.0	44	371	0.62	385	<1	13.4	68	<4
MW-6	03/02/16	8.0	105	722	<1.0	36	362	0.54	378	<1	13.2	68	<4
MW-6	07/06/16	7.5	102	982	<1.0	37	383	0.64	376	<1	14.3	67	<4
MW-6	09/01/16	7.3	107	850	<1.0	36	364	0.52	381	<1	14.3	66	<4
MW-6	12/21/16	7.5	105	656	1.1	39	297	0.63	349	<1	13.4	66	<4
MW-7	02/17/16	7.4	120	788	<1.0	36	390	0.60	494	<1	14.7	19	<4
MW-7	03/02/16	7.5	117	818	<1.0	36	408	0.53	483	<1	15.2	21	<4
MW-7	07/18/16	7.5	119	862	<1.0	37	384	0.51	470	<1	15.4	21	<4
MW-7	08/11/16	7.5	117	974	1.7	39	364	0.52	480	<1	15.0	20	<4
MW-7	09/21/16	7.7	115	988	<1.0	38	399	0.54	504	<1	16.1	21	<4

TABLE 1 (Continued): ANALYSIS OF GROUNDWATER FROM MONITORING WELLS MW-1 THROUGH MW-9 IN THE UPPER DES PLAINES TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN SAMPLED DURING 2016

Well	Date Sampled	pH	EC ¹	TDS ¹	TOC ¹	Cl ⁻	SO ₄ ²⁻	NH ₃ -N	Hardness	Fecal Coliform	Temp	Water Elevation ²	Recharge Time
			mS/m			mg/L				CFU/100 mL	°C	ft	hr
MW-7	11/22/16	7.9	112	818	1.1	37	383	0.60	487	<1	15.5	20	<4
MW-8	03/09/16	8.7	92	790	1.0	64	349	<0.10	405	<1	14.2	-58	<48
MW-8	06/16/16	8.0	100	806	<1.0	101	219	0.20	256	4	14.9	-46	<48
MW-8	07/13/16	7.9	113	792	<1.0	52	346	<0.10	427	1	15.3	-58	<48
MW-8	09/14/16	7.9	116	864	<1.0	46	353	<0.10	470	<1	14.9	-54	<48
MW-8	10/06/16	8.1	101	636	1.2	54	303	0.13	346	<1	14.8	-48	<48
MW-8	12/01/16	8.0	111	762	<1.0	46	357	0.15	434	<1	14.5	-48	<48
5 MW-9	01/06/16	7.6	104	730	1.1	27	375	0.50	373	<1	14.2	-17	<48
MW-9	03/09/16	8.1	51	718	<1.0	37	353	0.35	368	<1	14.8	9	<48
MW-9	06/16/16	8.2	104	884	<1.0	31	321	0.39	349	<1	14.8	9	<48
MW-9	07/13/16	7.7	103	740	<1.0	30	348	0.41	373	<1	14.9	7	<48
MW-9	09/14/16	7.8	103	742	<1.0	29	354	0.43	386	<1	14.6	4	<48
MW-9	12/01/16	8.0	100	684	<1.0	27	331	0.54	362	<1	14.4	7	<48

¹EC = electrical conductivity; TDS = total dissolved solids; TOC = total organic carbon.

²Relative to Chicago City Datum (579.5 ft above mean sea level) at intersection of Madison and State Streets.

TABLE 2: DESCRIPTIVE STATISTICS FOR GROUNDWATER DATA OF MONITORING WELLS MW-1 THROUGH MW-9 IN THE UPPER DES PLAINES TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2016

Well	Statistic	pH	EC ¹	TDS ¹	TOC ¹	Cl ⁻	SO ₄ ²⁻	NH ₃ -N	Hardness	Fecal Coliform ²
			mS/m	mg/L						CFU/100 mL
MW-1	Minimum	6.7	106	774	<1.0	29	358	0.10	412	<1
	Median	7.2	109	786	<1.0	30	374	0.26	436	<1
	Mean	7.2	114	817	1.0	31	374	0.24	431	2
	Maximum	7.7	136	944	1.2	38	394	0.34	440	24
	Std. Dev	0.4	13	72	NA	3	14	0.09	11	3
	Coeff. of Var. (%)	5.0	11	9	NA	12	4	37.0	3	103
MW-2	Minimum	7.3	112	792	<1.0	46	376	0.55	478	<1
	Median	7.5	120	878	<1.0	49	406	0.60	485	<1
	Mean	7.5	118	892	1.0	49	407	0.64	484	<1
	Maximum	7.7	123	1,010	1.1	53	434	0.74	489	<1
	Std. Dev	0.18	5	79	NA	2	20	0.08	3	NA ³
	Coeff. of Var. (%)	2.0	4	9	NA	5	5	12.0	1	NA
MW-3	Minimum	7.4	54	760	<1.0	12	432	0.28	424	<1
	Median	7.6	108	816	<1.0	16	443	0.34	445	<1
	Mean	7.6	100	837	1.2	16	447	0.34	443	1
	Maximum	7.9	112	1,012	1.7	22	473	0.43	459	4
	Std. Dev	0.2	23	91	0.34	3	14	0.05	11	1
	Coeff. of Var. (%)	3.0	23	11	27.9	23	3	15.0	3	97
MW-4	Minimum	7.4	127	814	<1.0	55	375	<0.10	518	<1
	Median	7.5	129	905	<1.0	66	381	0.12	540	<1
	Mean	7.5	130	926	<1.0	65	384	0.13	541	<1

TABLE 2 (Continued): DESCRIPTIVE STATISTICS FOR GROUNDWATER DATA OF MONITORING WELLS MW-1 THROUGH MW-9 IN THE UPPER DES PLAINES TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2016

Well	Statistic	pH	EC ¹	TDS ¹	TOC ¹	Cl ⁻	SO ₄ ²⁻	NH ₃ -N	Hardness	Fecal Coliform ²
			mS/m	mg/L						CFU/100 mL
	Maximum	7.7	135	1,088	<1.0	71	406	0.20	562	<1
	Std. Dev	0.12	3	94	NA	6	11	0.04	17	NA
	Coeff. of Var. (%)	2.0	2	10	NA	9	3	30.6	3	NA
MW-5	Minimum	7.9	52	284	<1.0	54	51	<0.10	69	<1
	Median	8.7	137	794	<1.0	193	108	0.17	97	<1
	Mean	8.6	119	692	1.0	193	153	0.27	150	3
	Maximum	9.3	163	890	1.4	322	306	0.61	299	140
	Std. Dev	0.58	45	222	0.16	96	98	0.48	96	5
	Coeff. of Var. (%)	7.0	38	32	15.3	50	64	180	64	156
MW-6	Minimum	7.3	86	656	<1.0	36	297	0.52	349	<1
	Median	7.4	105	742	<1.0	37	364	0.62	378	<1
	Mean	7.5	101	790	1.0	38	355	0.59	373	<1
	Maximum	7.9	107	982	1.1	44	382	0.64	385	<1
	Std. Dev	0.26	9	127	0.04	3	33	0.06	14	NA
	Coeff. of Var. (%)	3.0	9	16	4.5	9	9	9.0	4	NA
MW-7	Minimum	7.4	112	788	<1.0	36	364	0.51	470	<1
	Median	7.5	117	840	<1.0	37	386	0.54	485	<1
	Mean	7.5	116	874	1.1	37	388	0.55	486	<1
	Maximum	7.8	120	988	1.7	39	408	0.60	504	<1
	Std. Dev	0.18	3	85	1.0	1	15	0.04	11	NA
	Coeff. of Var. (%)	2.0	2	10	93.0	3	4	7.0	2	NA

TABLE 2 (Continued): DESCRIPTIVE STATISTICS FOR GROUNDWATER DATA OF MONITORING WELLS MW-1 THROUGH MW-9 IN THE UPPER DES PLAINES TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN DURING 2016

Well	Statistic	pH	EC ¹	TDS ¹	TOC ¹	Cl ⁻	SO ₄ ²⁻	NH ₃ -N	Hardness	Fecal Coliform ²
			mS/m	mg/L						CFU/100 mL
MW-8	Minimum	7.8	92	636	<1.0	46	218	<0.10	256	<1
	Median	8.0	106	791	<1.0	53	347	0.12	416	<1
	Mean	8.1	106	775	1.0	60	320	0.13	389	1
	Maximum	8.6	116	864	1.2	101	357	0.20	470	4
	Std. Dev	0.3	9	76	0.08	20	53	0.04	77	1
	Coeff. of Var. (%)	4.0	9	10	7.9	35	17	30.8	20	97
MW-9	Minimum	7.6	51	684	<1.0	27	321	0.35	349	<1
	Median	7.9	103	735	<1.0	29	350	0.42	370	<1
	Mean	7.9	94	749	1.0	30	346	0.44	368	<1
	Maximum	8.1	104	884	1.1	37	374	0.54	386	<1
	Std. Dev	0.22	21	69	0.04	3	18	0.07	12	NA
	Coeff. of Var. (%)	3.0	23	9	4.5	12	5	16.0	3	NA

¹EC = electrical conductivity; TDS = total dissolved solids; TOC = total organic carbon.

²Geometric mean is evaluated since data are assumed to be Log-Normally Distributed.

³Not applicable.

TABLE 3: GROUNDWATER ELEVATIONS FOR OBERVATION WELLS MW-1 THROUGH MW-9 IN THE UPPER DES PLAINES TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN MEASURED DURING 2016

Date	Observation Well Number								
	MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	MW-7	MW-8	MW-9
	----- Elevation (ft) -----								
01/08/16	37.8	44.8	40.6	-1.1	-47.6	64.6	18.7	NA ¹	3.8
01/22/16	36.8	43.8	39.6	-2.1	NA	63.6	21.7	-33.2	1.8
02/19/16	37.8	44.8	40.6	3.9	-46.6	68.6	19.7	8.8	8.8
02/26/16	34.8	43.8	37.6	-2.1	-50.6	59.6	20.7	26.8	-12.2
03/18/16	40.8	44.8	41.6	4.9	-52.6	66.6	19.7	56.8	66.8
03/25/16	39.8	45.8	42.6	2.9	-43.6	64.6	17.7	-32.2	-1.2
04/01/16	40.8	45.8	43.6	3.9	-40.6	63.6	20.7	-20.2	6.8
04/29/16	38.8	45.8	42.6	4.9	-35.6	65.6	21.7	-18.2	7.8
05/06/16	39.8	45.8	42.6	2.9	-34.6	64.6	22.7	-16.2	9.8
05/27/16	38.8	44.8	41.6	3.9	-36.6	64.6	23.7	-20.2	7.8
06/03/16	37.8	45.8	40.6	3.9	-46.6	67.6	11.7	25.8	5.8
06/29/16	38.8	47.8	37.6	-2.1	-53.6	57.6	18.7	16.8	1.8
07/15/16	18.8	44.8	40.6	-1.1	-53.6	64.6	20.7	-46.2	9.8
07/22/16	36.8	46.8	39.6	1.9	-45.6	65.6	12.7	-12.2	3.8
08/05/16	37.8	44.8	40.6	0.9	-44.6	66.6	19.7	-16.2	4.8
08/30/16	37.8	44.8	41.6	1.9	-43.6	67.6	19.7	-14.2	5.8
09/02/16	37.8	43.8	40.6	1.9	-44.6	64.6	19.7	-44.2	11.8
09/23/16	37.8	44.8	41.6	0.9	-43.6	65.6	19.7	-41.2	12.8
10/07/16	37.8	45.8	33.6	-5.1	-56.6	65.6	21.7	-58.2	13.8
10/21/16	36.8	44.8	32.6	-4.1	-49.6	64.6	21.7	8.8	11.8
11/04/16	37.8	43.8	NA	0.9	-45.6	66.6	19.7	-18.2	6.8
11/29/16	38.8	44.8	39.6	1.9	-47.6	65.6	19.7	4.8	5.8
12/02/16	30.8	45.8	35.6	-8.1	-56.6	64.6	20.7	-53.2	2.8
12/09/16	38.8	44.8	39.6	0.1	-42.6	65.6	20.7	-12.2	5.8

¹No data available due to snowy, muddy, or obstructed field conditions.

FIGURE 2: MINIMUM, MEAN, AND MAXIMUM OF WATER ELEVATIONS FOR MONITORING/OBSERVATION WELLS MW-1 THROUGH MW-9 IN THE UPPER DES PLAINES TUNNEL SYSTEM OF THE TUNNEL AND RESERVOIR PLAN MEASURED DURING 2016

