MONITORING AND RESEARCH DEPARTMENT

REPORT NO. 20-06

THORNTON COMPOSITE RESERVOIR

GROUNDWATER MONITORING REPORT

FOURTH QUARTER 2019

May 2020

Protecting Our Water Environment

Metropolitan Water Reclamation District of Greater Chicago

CECIL LUE-HING RESEARCH AND DEVELOPMENT COMPLEX
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Edward W. Podczerwinski, P.E.
Director of Monitoring and Research

March 27, 2020

Mr. Richard P. Cobb, P.G.
Deputy Division Manager
Division of Public Water Supplies
Illinois Environmental Protection Agency
1021 North Grand Avenue
East Springfield, IL 62794-9276

Subject: Transmittal of the Report "Thornton Composite Reservoir Groundwater Monitoring Report Fourth Quarter 2019"

Dear Mr. Cobb:

Please find attached the report entitled "Thornton Composite Reservoir Groundwater Monitoring Report Fourth Quarter 2019" transmitted electronically. The report is prepared for transmittal to the Illinois Environmental Protection Agency (IEPA) in accordance with the Thornton Composite Reservoir Groundwater Monitoring Plan. Also attached is the Excel spreadsheet of the Thornton Composite Reservoir raw data as required by the IEPA.

If you have any questions or would like additional information, please contact Mr. Benjamin Morgan at (708) 588-3743 or MorganB@mwrd.org.

Sincerely,

Albert E. Cox, Ph.D.
Manager
Environmental Monitoring and Research Department

AC:BM:cm

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Thornton Composite Reservoir Groundwater Monitoring Report

Fourth Quarter 2019

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May 2020

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LIST OF ACRONYMS

Acronym	Definition
CCD	Chicago City Datum
CFU	Colony Forming Unit
CSF	Combined Sewer Flow
EC	Electrical Conductivity
FC	Fecal Coliform
GMP	Groundwater Monitoring Plan
GPS	Groundwater Protection System
IAC	Illinois Administrative Code
QC	Quality Control
TCR	Thornton Composite Reservoir
TDS	Total Dissolved Solids
TOC	Total Organic Carbon

ACKNOWLEDGMENT

This report for the Thornton Composite Reservoir Groundwater Monitoring was generated by the Monitoring and Research Department. All samples were collected by Tetra Tech, Inc. under the Thornton Composite Reservoir Contract 19-105-11. Analyses were performed by the Analytical Laboratories Division and the Analytical Bacteriology Laboratory of the Metropolitan Water Reclamation District of Greater Chicago (District). Special thanks are due to Ms. Coleen Maurovich for typing and formatting this report.

DISCLAIMER

Mention of proprietary equipment and chemicals in this report does not constitute endorsement by the District.

INTRODUCTION

A Groundwater Protection System (GPS) was constructed for the Thornton Composite Reservoir (TCR) to protect against the exfiltration of combined sewer overflow (CSF) into the surrounding dolomite aquifers. The CSF and minimal amounts of stormwater are stored in the reservoir during and after large storm events. To monitor the performance of the GPS, a network of monitoring wells located outside the perimeter of the GPS is being monitored as discussed in the Revised Groundwater Monitoring Plan (GMP) (Black & Veatch, 2016). As explained in the Revised GMP, one sample of reservoir water, one from the Main Quarry Sump, and one from each of the seven wells are collected annually and analyzed for the Illinois Administrative Code (IAC) Title 35 Part 620 Class I groundwater constituents. In addition, following a reservoir fill event or during a routine quarterly event, groundwater is sampled from the seven wells and the Main Quarry Sump and tested for a targeted list of parameters that are more likely to be detected in CSF water.

The monitoring well system consists of one deep well, TB-124, which monitors the underlying Galena Aquifer, and six vertical Westbay multi-level monitoring wells: TB-118, TB-119, TB-120, TB-121, TB-122, and TB-123, which monitor the Silurian Dolomite aquifers. As discussed in the Revised GMP, following a reservoir fill event, bi-weekly sampling is required while the water in the reservoir remains above an elevation of -280 ft Chicago City Datum (CCD). Groundwater is sampled from each well at the first sample interval port immediately below the reservoir water elevation. Each of the multi-level monitoring wells is capable of monitoring four distinct 20-ft intervals in the Silurian Dolomite aquifer.

The locations of monitoring wells, the quarry sump, the TCR, and the GPS are presented in Figure 1. The Main Quarry Sump is located beyond the south boundary of the GPS and is not a component of the TCR but is an integral part of the Hanson Material Services mining quarry to the south of the TCR. This sump facilitates mining operations by minimizing the water level at the bottom of the quarry. It is possible that the bottom of this sump could extend beyond the lowest depth of the TCR (-297.5 ft CCD). The sump contains mainly groundwater and small quantities of surface runoff, and it is sampled quarterly and during fill events, along with the wells, to evaluate the potential migration of contaminants from the TCR to the sump.

Table 1 lists the characteristics of all wells at the TCR site (well location coordinates, elevations and depths, and the sampling port interval elevations).

Prior to the TCR becoming operational in November 2015, eight (8) sampling events were conducted on a quarterly basis for two years (May 2012 through March 2014) to provide background data on the existing groundwater quality. In order to evaluate the effectiveness of the grout curtain and the GPS, the Revised GMP (2016) presents the analysis of data for all samples collected during the background monitoring period and provides a baseline for comparison with routine monitoring data. Changes over time in groundwater calcium and magnesium concentrations would also be useful in tracking the occurrence of infiltration/exfiltration. Groundwater analytical data routinely generated for the monitoring wells, reservoir, and sump

FIGURE 1: MONITORING WELL AND MAIN QUARRY SUMP LOCATIONS

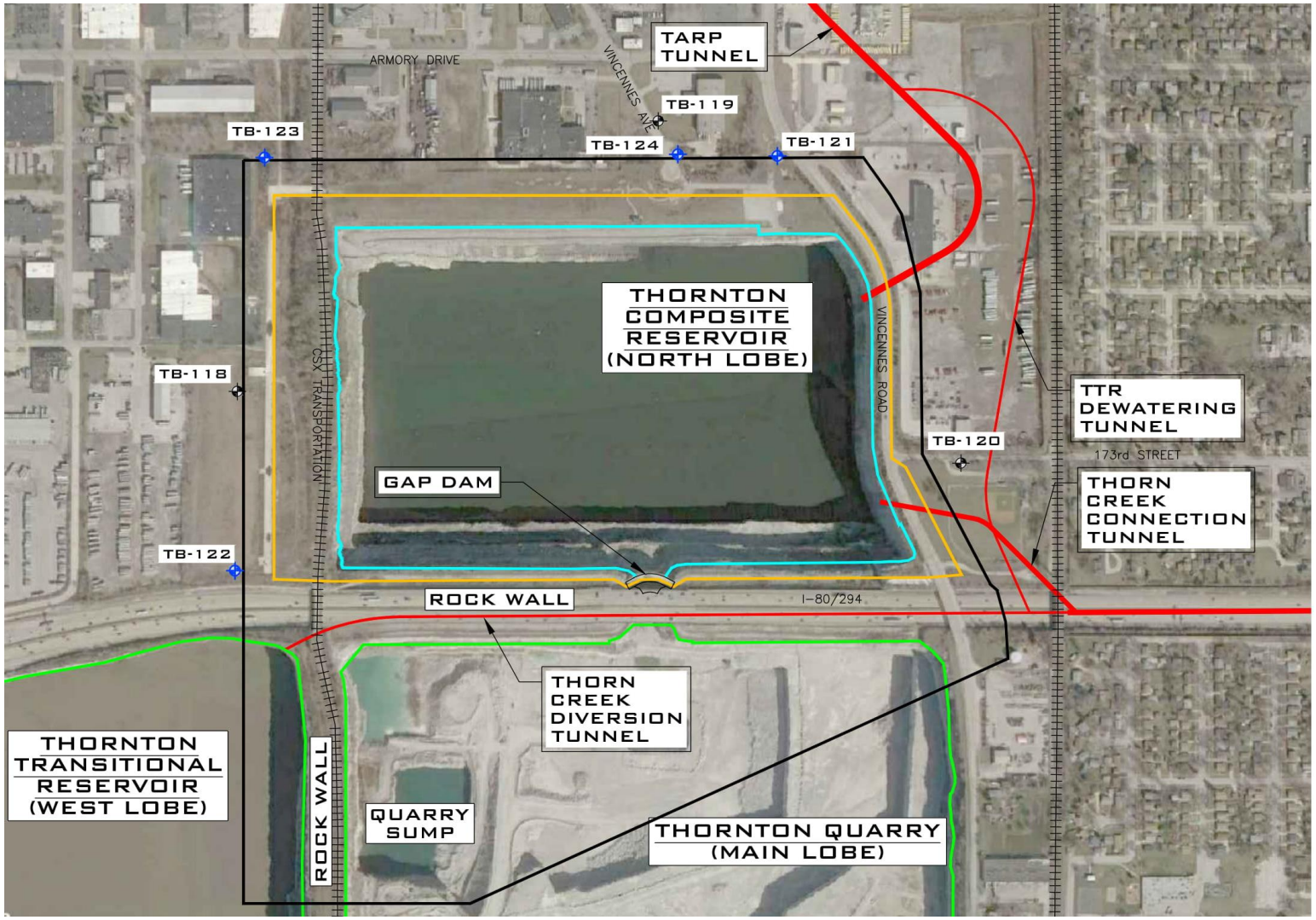

TABLE 1: CHARACTERISTICS OF MONITORING WELLS TB-118 THROUGH TB-124 AT THE THORNTON COMPOSITE RESERVOIR SITE

Well ID	Coordinates[1] Northing (ft)	Coordinates[1] Easting (ft)	Ground Surface El (ft, CCD[2])	Top of Riser El (ft, CCD[2])	Depth of Well (ft)	Sampling Port Interval (ft, CCD) Interval 1	Interval 2	Interval 3	Interval 4
TB-118	1,791,110.38	693,560.44	38.5	41.5	532	-85 to -105	-212 to -232	-283 to -303	-392 to -412
TB-119	1,792,316.63	695,509.39	27.9	29.5	529	-85 to -105	-212 to -232	-283 to -303	-392 to -412
TB-120	1,790,782.31	696,888.93	40.0	42.1	540	-86 to -106	-213 to -233	-284 to -304	-393 to -413
TB-121	1,792,193.10	696,044.98	29.4	30.4	461	-84 to -104	-211 to -231	-282 to -302	-391 to -411
TB-122	1,790,288.61	693,549.38	48.8	51.7	480	-85 to -105	-212 to -232	-283 to -303	-392 to -412
TB-123	1,792,185.60	693,685.69	28.9	31.8	460	-84 to -104	-211 to -231	-282 to -302	-391 to -411
TB-124	1,792,200.77	695,591.56	29.6	29.2	728	-663 to -698			

[1]Illinois State Plane Coordinate System (NAD 1927).
[2]Chicago City Datum (CCD).

will also be compared with the IAC Title 35 Part 620 Class I Groundwater Standards (IPCB, IEPA, 2013) to evaluate any exceedances in groundwater standards.

There were two fill events during the fourth quarter of 2019. The first event (the fourth event of 2019) began on September 27 and lasted until October 21. One complete set of samples was collected on October 1 – 3, 2019, at the Main Quarry Sump and all monitoring wells. The annual monitoring event was conducted in place of biweekly sampling during this fill event, starting on October 14; thus, no additional biweekly sampling for the fill event was needed. The annual monitoring event was suspended on October 23 due to equipment malfunctioning and resumed using rental equipment from December 9 – 19. Annual sampling for inorganic parameters was completed at the Main Quarry Sump, the TCR, and all monitoring wells. Annual sampling for organic and radiological parameters was completed at the Main Quarry Sump, the TCR, and monitoring wells TB-120, TB-121, TB-122, and TB-123 but could not be completed at monitoring wells TB-118, TB-119, or TB-124 due to the equipment malfunction and limited availability of rental equipment. The second fill event during the quarter (the fifth event of 2019) began on October 26 and lasted until November 16. No samples could be collected during this period because of the equipment malfunction. Corrective actions are being implemented to improve access to backup sampling equipment in order to ensure that future equipment malfunctions do not interrupt monitoring activities.

This report presents field activities, observations, and analytical data for surface and groundwater monitoring samples taken at the Main Quarry Sump and at all monitoring wells during fill event sampling conducted from October 1 – 3, 2019, and at the Main Quarry Sump, the TCR, and at all monitoring wells during the annual monitoring event from October 14 – December 19, 2019.

FIELD ACTIVITIES

For this report period, one complete set of fill event samples was collected at the Main Quarry Sump, the deep well, and at sampling port interval 3 of all multi-level wells from October 1 – 3. Sampling for the annual monitoring event was conducted from October 14 – 23 and December 9 – 19, comprising a complete set of samples for inorganic analysis by District laboratories collected at the Main Quarry Sump, the TCR, the deep well, and at sampling port interval 3 of all multi-level wells, and a partial set of samples collected at the Main Quarry Sump, the TCR, and at sampling port interval 3 of multi-level wells TB-120, TB-121, TB-122, and TB-123 for organic and radiological compound analysis by a contract lab. Sample collection dates are shown in Table 2.

Using a WTW Multi 3400i pH/conductivity/temperature meter, the pH, electrical conductivity (EC), and temperature of each sample were measured and recorded immediately after collection.

Prior to sampling the multi-level wells, hydrostatic pressure was measured to calculate the groundwater elevation at Port 3 of each well. Table 3 lists the elevations at Port 3 of each well and the corresponding groundwater elevations during the fill event sampling in October and the annual sampling in October and December, 2019.

All samples were packed in ice and shipped to the District's Analytical Laboratories Division for the analysis of selected inorganic constituents (IAC Title 35 Part 620 Class I Groundwater Standards) in accordance with the revised GMP. Additional aliquots were also prepared in the field and shipped in ice to the District's Analytical Microbiology and Biomonitoring Laboratory for fecal coliform analysis.

TABLE 2: DEVICES AND CORRESPONDING DATES OF SAMPLING DURING FILL EVENT SAMPLING IN OCTOBER AND THE ANNUAL MONITORING EVENT IN OCTOBER AND DECEMBER 2019

Date of Sampling	Event	Device/Structure Sampled
10/01/2019	Fill Event #4	TB-120, TB-121, TB-122
10/02/2019	Fill Event #4	TB-118, TB-118 Duplicate, TB-119
10/03/2019	Fill Event #4	TB-123, TB-124, Main Quarry Sump
10/14/2019	Annual Sampling	TB-120, TB-120 Duplicate
10/15/2019	Annual Sampling	TB-121
10/17/2019	Annual Sampling	TB-124 (inorganic only)
10/23/2019	Annual Sampling	Reservoir, Main Quarry Sump
12/09/2019	Annual Sampling	TB-119, TB-124 (inorganic only)[1]
12/10/2019	Annual Sampling	TB-122 (inorganic only)
12/19/2019	Annual Sampling	TB-118, TB-123 (inorganic only)
12/20/2019	Annual sampling	TB-122, TB-123 (organic only)

[1]Well TB-124 was sampled twice for inorganic parameters and the mean of both results are used in this report.

TABLE 3: SUMMARY OF GROUNDWATER ELEVATIONS AT SAMPLING PORT 3 OF EACH WELL AND CORRESPONDING GROUNDWATER ELEVATIONS DURING FILL EVENT MONITORING IN OCTOBER AND THE ANNUAL MONITORING EVENT IN OCTOBER AND DECEMBER 2019

Fill Event	Sample Date	Well ID	Sampling Port 003 Elevation	Groundwater Elevation
			---------- (ft CCD[1]) ----------	
4	10/02/2019	TB-118	-289	-89
4	10/02/2019	TB-119	-289	-164
4	10/01/2019	TB-120	-290	-164
4	10/01/2019	TB-121	-288	-170
4	10/01/2019	TB-122	-288	-159
4	10/03/2019	TB-123	-288	-49
4	10/03/2019	TB-124[2]	NA[3]	-322
Annual	12/19/2019	TB-118	-289	-87
Annual	12/09/2019	TB-119	-289	-163
Annual	10/14/2019	TB-120	-290	-169
Annual	10/15/2019	TB-121	-288	-170
Annual	12/10/2019	TB-122	-288	-156
Annual	12/20/2019	TB-122	-288	-156
Annual	12/19/2019	TB-123	-288	-48
Annual	12/20/2019	TB-123	-288	-48
Annual	10/17/2019	TB-124	NA	-340
Annual	12/09/2019	TB-124	NA	-389

[1]Chicago City Datum.
[2]TB-124 is a conventional well screened from -663 to -698 ft CCD. Samples were taken at approximately 650 ft below ground surface once during fill event sampling in October 2019 and twice during the annual monitoring event in October and December 2019.
[3]NA = Not Applicable.

ANALYTICAL RESULTS

Table 4 lists the analytical methods used by the laboratory for measured parameters. Analytical results were reviewed to identify any analytes that exceeded the Illinois Class I Groundwater Standards (35 IAC Part 620).

The analytical data for all well samples and the Main Quarry Sump sample collected during fill event monitoring from October 1 – 3 are presented in Table 5. There were a few exceedances of the Part 620 groundwater standards, including total dissolved solids (TDS), chloride, sulfate, boron, and zinc, as indicated in bold font in Table 5. Among these parameters, only zinc showed a value higher than the background maximum.

The analytical data for all well samples, the TCR, and the Main Quarry Sump collected during the annual monitoring event from October 14 – 23 and December 9 – 19 are presented in Table 6. There were a few exceedances of the Part 620 groundwater standards, including TDS, chloride, sulfate, and boron, as indicated in bold font in Table 6. None of these parameters showed a value higher than the background maximum.

Almost all organic parameters were undetectable in the annual monitoring samples from wells and the Main Quarry Sump (Table 6). No organic parameters were detected above their Class I Groundwater Standard in any well or in the Main Quarry Sump. Mecoprop, 2,4-Dinitrotoluene, 1,4-Dioxane, Benzo[a]anthracene, Benzo[k]fluoranthene, and Bis(2-ethylhexyl)phthalate were all undetectable in all samples, but for each of these parameters the lab reporting limit for at least one analysis was higher than the Class I Groundwater Standard. The lab reporting limit for Bis(2-ethylhexyl)phthalate was also higher than its background maximum (0.0052 mg/L).

There was no detection of fecal coliform bacteria in any well during either fill event sampling or the annual monitoring event (Tables 5 and 6). Fecal coliform populations were detected at the Main Quarry Sump only during October fill event sampling at 4 CFU/100 mL (Table 5).

TABLE 4: ANALYTICAL METHODS USED FOR REQUIRED PARAMETERS

Parameters	Analytical Method
Inorganic	
Chloride, Fluoride, Sulfate	USEPA 300.0
Total Dissolved Solids	SM 2540C
TAL metals	USEPA 200.8
Mercury	SM 3112B
Ammonia (as N)	USEPA 350.1
Hardness (as Calcium and Magnesium)	SM 3120B, SM 2340B
TOC	SM 5310-C
Cyanide	USEPA 335.3
Organic	
Herbicides including 2,4-D; 2,4,5-TP (Silvex); Dalapon; Dicamba; Dinoseb; Mecoprop; Picloram	USEPA 8151A
Endothall	USEPA 548.1
Polychlorinated biphenyls (PCBs)	USEPA 8082A
Pesticides including Alachlor; alpha-BHC; Chlordane; Endrin; gamma-BHC; Heptachlor; Heptachlor Epoxide; Methoxychlor; Toxaphene; and Simazine	USEPA 8081B
All Explosives	USEPA 8330B
1,2-Dibromo-3-Chloropropane; Ethylene Dibromide	USEPA 504.1
Aldicarb; Carbofuran	USEPA 531.1
All other VOCs	USEPA 8260B
Phenolics, total recoverable	USEPA 9066
All other SVOCs and Atrazine	USEPA 8270D
Radiological	
Radium-226 (pCi/L)	USEPA 903.0
Radium-228 (pCi/L)	USEPA 904.0
Others	
Phenols (at District labs for fill event samples)	USEPA 420.4
Fecal Coliform	SM 9222D

TABLE 5: ANALYSIS OF GROUNDWATER SAMPLED FROM MONITORING WELLS TB-118 THROUGH TB-124 AND THE MAIN QUARRY SUMP AT THE THORNTON COMPOSITIE RESERVOIR SITE FOR FILL EVENT MONITORING IN OCTOBER 2019

Parameter	Unit	Part 620 Groundwater Standard	Maximum Background	Lab RL[1]	Well								Sump
					TB-118	TB-118D[2]	TB-119	TB-120	TB-121	TB-122	TB-123	TB-124	
pH		6.5 - 9.0	8.4	NL[3]	8.3	8.3	8.5	8.1	7.9	8.1	7.8	8.4	7.3
EC	mS/m	NL	415	NL	144	144	113	187	142	174	128	251	176
TDS	mg/L	1,200	2,960	25	**1,408**[4]	**1,402**	540	734	1,088	916	598	**1,548**	884
TOC	"	NL	1	1	2.6	2.4	1.7	3.2	1.7	1.9	2.4	<1.0	1.4
Chloride	"	200	1,230	1	**363**	**365**	56	138	**255**	192	57	**264**	114
Sulfate	"	400	890	1	201	203	96	103	182	79	125	**590**	342
Ammonia as N	"	NL	ND[5]	0.30	0.55	0.53	0.50	0.48	0.63	0.54	0.65	1.1	<0.30
Total Phenol	"	0.1	0.06	0.005	<0.005	<0.005	<0.005	0.008	0.005	0.005	<0.005	<0.005	<0.005
Fecal Coliform	CFU/100 mL	NL	<1	1	<1	<1	<1	<1	<1	<1	<1	<1	4
Ag	mg/L	0.05	0.003	0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
B	"	2	3.8	0.005	0.825	0.803	0.934	1.07	1.12	**2.46**	1.82	1.07	0.319
Be	"	0.004	0.002	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Co	"	1	0.035	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.006
Cr	"	0.1	86.4	0.002	0.005	<0.002	<0.002	<0.002	0.004	<0.002	<0.002	<0.002	<0.002
Cu	"	0.65	0.004	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.004	<0.001
Mn	"	0.15	0.183	0.001	0.005	0.005	0.004	0.004	0.003	0.003	0.003	0.013	0.003
Se	"	0.05	0.008	0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.002	0.002
V	"	0.049	<0.010	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zn	"	5	10	0.005	0.11	0.15	0.04	0.10	0.17	0.11	0.18	**17.4**	0.01
Ca	"	NL	276	0.5	168	170	80.0	87.2	135	67.2	79.8	92.5	95.2
Mg	"	NL	153	0.5	83.7	84.7	41.0	44.4	70.6	34.7	41.9	61.1	69.3

[1]Lab reporting limit.
[2]Duplicate sample.
[3]No existing limit.
[4]Concentrations in bold font indicate exceedance of Part 620 Class 1 Groundwater Standards.
[5]Not determined.

TABLE 6: ANALYSIS OF GROUNDWATER SAMPLED AT MONITORING WELLS TB-118 THROUGH TB-124, THE MAIN QUARRY SUMP, AND THE THORNTON COMPOSITE RESERVOIR DURING THE ANNUAL MONITORING EVENT IN OCTOBER AND DECEMBER 2019

Parameter	Part 620 Groundwater Standard	Maximum Background	Lab RL[1]	Well TB-118	TB-119	TB-120	TB-120D[2]	TB-121	TB-122	TB-123	TB-124[3]	Sump	Reservoir
pH	6.5-9.0	8.4	NL[4]	7.8	8.3	7.8	7.8	7.8	8.1	8.1	8.4	8.4	NDR[5]
EC (mS/m)	NL	415	NL	133	122	173	173	122	152	123	183	185	NDR[5]
Fecal coliform (CFU/100 mL)	NL	<1	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	9,100
	Concentration (mg/L)												
TDS	1,200	2,960	10	**1404**[6]	496	698	708	920	894	568	**1307**	838	390
TOC	NL	1	1	2.8	2.4	1.9	2	1.5	2.5	1.2	5.5	1.7	6.4
Cyanide, Total	0.2	BRL[7]	0.010	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.006	<0.005	<0.005
Fluoride	4.0	3.2	0.20	0.52	0.60	0.65	0.71	0.47	1.0	0.61	0.76	NDR[8]	0.31
Chloride	200	1,230	20	**437**	64	142	118	**270**	**227**	62	**221**	130	71
Sulfate	400	890	20	225	106	107	92	192	94	131	**433**	359	98
Ammonia	NL	ND[9]	0.30	0.57	0.51	0.47	0.47	0.73	0.55	0.72	1.8	<0.30	6.1
METALS													
Ag	0.05	0.003	0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
As	0.01	0.025	0.001	<0.001	<0.001	0.001	0.001	<0.001	<0.001	<0.001	0.002	0.001	0.002
B	2.0	3.78	0.005	0.732	0.914	0.951	0.988	0.995	**2.50**	1.80	0.746	0.297	0.111
Ba	2.0	0.217	0.001	0.039	0.031	0.046	0.046	0.094	0.017	0.052	0.052	0.018	0.031
Be	0.004	0.002	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cd	0.005	0.002	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Co	1.0	0.035	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.006	<0.001
Cr	0.10	86.4	0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Cu	0.65	0.004	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.006
Fe	5.0	3.23	0.010	0.156	0.128	0.132	0.132	0.033	0.034	0.026	0.115	0.021	1.40
Hg	0.002	0.0007	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	NDR[10]	NDR[10]
Mn	0.15	0.183	0.001	0.005	0.005	0.003	0.003	0.003	0.003	0.002	0.002	0.003	0.074
Ni	0.10	0.093	0.001	0.005	0.002	<0.001	<0.001	0.001	<0.001	<0.001	0.003	0.024	0.005
Pb	0.0075	0.006	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.005

TABLE 6 (Continued): ANALYSIS OF GROUNDWATER SAMPLED AT MONITORING WELLS TB-118 THROUGH TB-124, THE MAIN QUARRY SUMP, AND THE THORNTON COMPOSITE RESERVOIR DURING THE ANNUAL MONITORING EVENT IN OCTOBER AND DECEMBER 2019

Parameter	Part 620 Groundwater Standard	Maximum Background	Lab RL[1]	Well TB-118	TB-119	TB-120	TB-120D[2]	TB-121	TB-122	TB-123	TB-124	Sump	Reservoir
	Concentration (mg/L)												
METALS													
Sb	0.006	0.012	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001
Se	0.05	0.008	0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.003	<0.002	<0.002
Tl	0.002	0.013	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
V	0.049	<0.01	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001
Zn	5.0	9.95	0.005	0.036	0.396	0.026	0.026	0.133	0.032	0.022	0.885	<0.005	0.111
Ca	NL	276	0.50	179	87.3	88.2	87.5	133	71.8	83.3	35.2	106	51.3
Mg	NL	153	0.50	87.7	43.9	44.3	43.9	67.6	37.3	43.9	15.2	82.0	19.7
HERBICIDES													
2,4-D	0.07	BRL	0.00059	NC[11]	NC	<0.00058	<0.00058	<0.00059	<0.00049	<0.00053	NC	<0.0005	0.0012
2,4,5-TP (Silvex)	0.05	BRL	0.00030	NC	NC	<0.00029	<0.00029	<0.00030	<0.00025	<0.00026	NC	<0.00025	<0.00024
Atrazine	0.003	BRL	0.0022	NC	NC	<0.0022	<0.0021	<0.0022	<0.0022	<0.0020	NC	<0.0019	<0.0019
Dalapon	0.20	BRL	0.0059	NC	NC	<0.0058	<0.0058	<0.0059	<0.0049	<0.0053	NC	<0.0050	<0.0049
Dicamba	0.21	BRL	0.00059	NC	NC	<0.00058	<0.00058	<0.00059	<0.00049	<0.00053	NC	<0.00050	<0.00049
Dinoseb	0.007	BRL	0.0012	NC	NC	<0.0012	<0.0012	<0.0012	<0.00099	<0.0011	NC	<0.00099	<0.00098
Endothall	0.100	BRL	0.01	NC	NC	<0.01	<0.01	<0.01	<0.01	<0.01	NC	<0.01	<0.01
Mecoprop	0.007	BRL	0.14	NC	NC	<0.14	<0.14	<0.14	<0.12	<0.13	NC	<0.12	<0.12
Picloram	0.50	BRL	0.00059	NC	NC	<0.00058	<0.00058	<0.00059	<0.00049	<0.00053	NC	<0.00050	<0.00049
Simazine	0.004	BRL	0.0019	NC	NC	<0.0019	<0.0018	<0.0018	<0.0017	<0.0016	NC	<0.0016	<0.0016

TABLE 6 (Continued): ANALYSIS OF GROUNDWATER SAMPLED AT MONITORING WELLS TB-118 THROUGH TB-124, THE MAIN QUARRY SUMP, AND THE THORNTON COMPOSITE RESERVOIR DURING THE ANNUAL MONITORING EVENT IN OCTOBER AND DECEMBER 2019

Parameter	Part 620 Groundwater Standard	Maximum Background	Lab RL[1]	Well								Sump	Reservoir
				TB-118	TB-119	TB-120	TB-120D[2]	TB-121	TB-122	TB-123	TB-124		
	Concentration (mg/L)												
PCBs													
PCB-1016 (Aroclor 1016)	0.0005	BRL	0.00045	NC	NC	<0.00045	<0.00042	<0.00044	<0.00044	<0.00040	NC	<0.00040	<0.00040
PCB-1221 (Aroclor 1221)	0.0005	BRL	0.00045	NC	NC	<0.00045	<0.00042	<0.00044	<0.00044	<0.00040	NC	<0.00040	<0.00040
PCB-1232 (Aroclor 1232)	0.0005	BRL	0.00045	NC	NC	<0.00045	<0.00042	<0.00044	<0.00044	<0.00040	NC	<0.00040	<0.00040
PCB-1242 (Aroclor 1242)	0.0005	BRL	0.00045	NC	NC	<0.00045	<0.00042	<0.00044	<0.00044	<0.00040	NC	<0.00040	<0.00040
PCB-1248 (Aroclor 1248)	0.0005	BRL	0.00045	NC	NC	<0.00045	<0.00042	<0.00044	<0.00044	<0.00040	NC	<0.00040	<0.00040
PCB-1254 (Aroclor 1254)	0.0005	BRL	0.00045	NC	NC	<0.00045	<0.00042	<0.00044	<0.00044	<0.00040	NC	<0.00040	<0.00040
PCB-1260 (Aroclor 1260)	0.0005	BRL	0.00045	NC	NC	<0.00045	<0.00042	<0.00044	<0.00044	<0.00040	NC	<0.00040	<0.00040
PCBs, Total	0.0005	ND	0.00045	NC	NC	<0.00045	<0.00042	<0.00044	<0.00044	<0.00040	NC	<0.00040	<0.00040
PESTICIDES													
Alachlor	0.002	BRL	0.00049	NC	NC	<0.00049	<0.00044	<0.00044	<0.00044	<0.00040	NC	<0.00040	<0.00040
Aldicarb	0.003	0.0048	0.0025	NC	NC	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	NC	<0.0025	<0.0025
alpha-BHC (benzene hexachloride)	0.00011	BRL	0.000049	NC	NC	<0.000049	<0.000044	<0.000044	<0.000044	<0.000040	NC	<0.000040	<0.000040
Carbofuran	0.04	BRL	0.0025	NC	NC	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	NC	<0.0025	<0.0025
Chlordane	0.002	BRL	0.000097	NC	NC	<0.000097	<0.000089	<0.000089	<0.000087	<0.000080	NC	<0.000080	<0.000081
Endrin	0.002	BRL	0.000049	NC	NC	<0.000049	<0.000044	<0.000044	<0.000044	<0.000040	NC	<0.000040	<0.000040

TABLE 6 (Continued): ANALYSIS OF GROUNDWATER SAMPLED AT MONITORING WELLS TB-118 THROUGH TB-124, THE MAIN QUARRY SUMP, AND THE THORNTON COMPOSITE RESERVOIR DURING THE ANNUAL MONITORING EVENT IN OCTOBER AND DECEMBER 2019

Parameter	Part 620 Groundwater Standard	Maximum Background	Lab RL[1]	Well								Sump	Reservoir
				TB-118	TB-119	TB-120	TB-120D[2]	TB-121	TB-122	TB-123	TB-124		
	Concentration (mg/L)												
gamma-BHC (Lindane)	0.0002	BRL	0.000049	NC	NC	<0.000049	<0.000044	<0.000044	<0.000044	<0.000040	NC	<0.000040	<0.000040
Heptachlor	0.0004	BRL	0.000049	NC	NC	<0.000049	<0.000044	<0.000044	<0.000044	<0.000040	NC	<0.000040	<0.000040
Heptachlor epoxide	0.0002	BRL	0.000049	NC	NC	<0.000049	<0.000044	<0.000044	<0.000044	<0.000040	NC	<0.000040	<0.000040
Methoxychlor	0.040	BRL	0.000097	NC	NC	<0.000097	<0.000089	<0.000089	<0.000087	<0.000080	NC	<0.000080	<0.000081
Toxaphene	0.003	BRL	0.00049	NC	NC	<0.00049	<0.00044	<0.00044	<0.00044	<0.00040	NC	<0.00040	<0.00040
EXPLOSIVES													
1,3-Dinitrobenzene	0.0007	BRL	0.00047	NC	NC	<0.00044	<0.00046	<0.00047	<0.00040	<0.00040	NC	<0.00042	<0.00038
2,4-Dinitrotoluene	0.0001	0.0684	0.00047	NC	NC	<0.00044	<0.00046	<0.00047	<0.00040	<0.00040	NC	<0.00042	<0.00038
2,6-Dinitrotoluene	0.0003	0.0197	0.00024	NC	NC	<0.00022	<0.00023	<0.00024	<0.00020	<0.00020	NC	<0.00021	<0.00019
1,3,5-Trinitrobenzene (TNB)	0.84	BRL	0.0012	NC	NC	<0.0011	<0.0011	<0.0012	<0.0010	<0.00099	NC	<0.0010	<0.00095
2,4,6-Trinitrotoluene (TNT)	0.014	BRL	0.00047	NC	NC	<0.00044	<0.00046	<0.00047	<0.00040	<0.00040	NC	<0.00042	<0.00038
Nitrobenzene	0.014	BRL	0.00047	NC	NC	<0.00044	<0.00046	<0.00047	<0.00040	<0.00040	NC	<0.00042	<0.00038
HMX	1.4	0.04400	0.00047	NC	NC	<0.00044	<0.00046	<0.00047	<0.00040	<0.00040	NC	<0.00042	<0.00038
RDX (Cyclonite)	0.084	0.00021	0.00036	NC	NC	<0.00033	<0.00034	<0.00036	<0.00030	<0.00030	NC	<0.00031	<0.00029
VOCs													
1,1,1-Trichloroethane	0.200	BRL	0.001	NC	NC	<0.001	<0.001	<0.001	<0.001	<0.001	NC	<0.001	<0.001
1,1,2-Trichloroethane	0.005	BRL	0.001	NC	NC	<0.001	<0.001	<0.001	<0.001	<0.001	NC	<0.001	<0.001
1,1-Dichloroethane	1.4	BRL	0.001	NC	NC	<0.001	<0.001	<0.001	<0.001	<0.001	NC	<0.001	<0.001
1,1-Dichloroethene	0.007	BRL	0.001	NC	NC	<0.001	<0.001	<0.001	<0.001	<0.001	NC	<0.001	<0.001
1,2-Dichloroethane	0.005	BRL	0.001	NC	NC	<0.001	<0.001	<0.001	<0.001	<0.001	NC	<0.001	<0.001
1,2-Dichloropropane	0.005	BRL	0.001	NC	NC	<0.001	<0.001	<0.001	<0.001	<0.001	NC	<0.001	<0.001

TABLE 6 (Continued): ANALYSIS OF GROUNDWATER SAMPLED AT MONITORING WELLS TB-118 THROUGH TB-124, THE MAIN QUARRY SUMP, AND THE THORNTON COMPOSITE RESERVOIR DURING THE ANNUAL MONITORING EVENT IN OCTOBER AND DECEMBER 2019

Parameter	Part 620 Groundwater Standard	Maximum Background	Lab RL[1]	Well								Sump	Reservoir
				TB-118	TB-119	TB-120	TB-120D[2]	TB-121	TB-122	TB-123	TB-124		
	Concentration (mg/L)												
1,2-Dibromo-3-Chloropropane	0.0002	BRL	0.000018	NC	NC	<0.000017	<0.000018	<0.000017	<0.000018	<0.000018	NC	<0.000018	<0.000018
1,2-Dibromoethane (Ethylene Dibromide)	0.00005	BRL	0.000018	NC	NC	<0.000017	<0.000018	<0.000017	<0.000018	<0.000018	NC	<0.000018	<0.000018
1,4-Dioxane	0.0077	BRL	0.018	NC	NC	<0.018	<0.017	<0.017	<0.018	<0.016	NC	<0.015	<0.016
2-Butanone (Methyl Ethyl Ketone)	4.2	BRL	0.005	NC	NC	<0.005	<0.005	<0.005	<0.005	<0.005	NC	<0.005	<0.005
Acetone	6.3	BRL	0.01	NC	NC	<0.01	<0.01	<0.01	<0.01	<0.01	NC	<0.01	<0.01
Benzene	0.005	BRL	0.0005	NC	NC	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	NC	<0.0005	<0.0005
Carbon disulfide	0.700	0.008	0.002	NC	NC	<0.002	<0.002	<0.002	<0.002	<0.002	NC	<0.002	<0.002
Carbon tetrachloride	0.005	BRL	0.001	NC	NC	<0.001	<0.001	<0.001	<0.001	<0.001	NC	<0.001	<0.001
Chlorobenzene (benzene Cl)	0.100	BRL	0.001	NC	NC	<0.001	<0.001	<0.001	<0.001	<0.001	NC	<0.001	<0.001
Chloroform	0.070	BRL	0.002	NC	NC	<0.002	<0.002	<0.002	<0.002	<0.002	NC	<0.002	<0.002
cis-1,2-Dichloroethene	0.070	BRL	0.001	NC	NC	<0.001	<0.001	<0.001	<0.001	<0.001	NC	<0.001	<0.001
Dichlorodifluoromethane	1.4	BRL	0.003	NC	NC	<0.003	<0.003	<0.003	<0.003	<0.003	NC	<0.003	<0.003
Ethylbenzene	0.700	BRL	0.0005	NC	NC	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	NC	<0.0005	<0.0005
Isopropylbenzene (Cumene)	0.70	BRL	0.001	NC	NC	<0.001	<0.001	<0.001	<0.001	<0.001	NC	<0.001	<0.001
Methylene Chloride (dichloromethane)	0.005	BRL	0.005	NC	NC	<0.005	<0.005	<0.005	<0.005	<0.005	NC	<0.005	<0.005
Methyl tert-butyl ether	0.070	BRL	0.001	NC	NC	<0.001	<0.001	<0.001	<0.001	<0.001	NC	<0.001	<0.001
Styrene	0.1	BRL	0.001	NC	NC	<0.001	<0.001	<0.001	<0.001	<0.001	NC	<0.001	<0.001
Tetrachloroethene	0.005	BRL	0.001	NC	NC	<0.001	<0.001	<0.001	<0.001	<0.001	NC	<0.001	<0.001
Toluene	1.0	0.008	0.0005	NC	NC	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	NC	<0.0005	0.014

TABLE 6 (Continued): ANALYSIS OF GROUNDWATER SAMPLED AT MONITORING WELLS TB-118 THROUGH TB-124, THE MAIN QUARRY SUMP, AND THE THORNTON COMPOSITE RESERVOIR DURING THE ANNUAL MONITORING EVENT IN OCTOBER AND DECEMBER 2019

Parameter	Part 620 Groundwater Standard	Maximum Background	Lab RL[1]	Well								Sump	Reservoir
				TB-118	TB-119	TB-120	TB-120D[2]	TB-121	TB-122	TB-123	TB-124		
	Concentration (mg/L)												
trans-1,2-Dichloroethene	0.100	BRL	0.001	NC	NC	<0.001	<0.001	<0.001	<0.001	<0.001	NC	<0.001	<0.001
Trichloroethene	0.005	BRL	0.0005	NC	NC	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	NC	<0.0005	<0.0005
Trichlorofluoro methane	2.1	BRL	0.001	NC	NC	<0.001	<0.001	<0.001	<0.001	<0.001	NC	<0.001	<0.001
Vinyl chloride	0.002	BRL	0.001	NC	NC	<0.001	<0.001	<0.001	<0.001	<0.001	NC	<0.001	<0.001
Xylenes, Total	10	BRL	0.001	NC	NC	<0.001	<0.001	<0.001	<0.001	<0.001	NC	<0.001	0.0013
SVOCs													
1,2,4-Trichlorobenzene	0.070	0.050	0.001	NC	NC	<0.001	<0.001	<0.001	<0.001	<0.001	NC	<0.001	<0.001
1,2-Dichlorobenzene (ortho-)	0.600	0.049	0.001	NC	NC	<0.001	<0.001	<0.001	<0.001	<0.001	NC	<0.001	<0.001
1,4-Dichlorobenzene (para-)	0.075	0.048	0.001	NC	NC	<0.001	<0.001	<0.001	<0.001	<0.001	NC	<0.001	<0.001
2-Methylnaphthalene	0.028	0.034	0.0018	NC	NC	<0.0018	<0.0017	<0.0017	<0.0018	<0.0016	NC	<0.0015	<0.0016
2-Methylphenol	0.350	BRL	0.0018	NC	NC	<0.0018	<0.0017	<0.0017	<0.0018	<0.0016	NC	<0.0015	<0.0016
Acenaphthene	0.42	0.077	0.00089	NC	NC	<0.00089	<0.00085	<0.00087	<0.00088	<0.00079	NC	<0.00076	<0.00078
Anthracene	2.10	BRL	0.00089	NC	NC	<0.00089	<0.00085	<0.00087	<0.00088	<0.00079	NC	<0.00076	<0.00078
Benzo[a]anthracene	0.00013	BRL	0.00014	NC	NC	<0.00014	<0.00014	<0.00014	<0.00014	<0.00013	NC	<0.00012	<0.00013
Benzo[a]pyrene	0.0002	BRL	0.00018	NC	NC	<0.00018	<0.00017	<0.00017	<0.00018	<0.00016	NC	<0.00015	0.00018
Benzo[b]fluoranthene	0.00018	BRL	0.00018	NC	NC	<0.00018	<0.00017	<0.00017	<0.00018	<0.00016	NC	<0.00015	0.00026
Benzo[k]fluoranthene	0.00017	BRL	0.00018	NC	NC	<0.00018	<0.00017	<0.00017	<0.00018	<0.00016	NC	<0.00015	<0.00016
Benzoic acid	28	BRL	0.018	NC	NC	<0.018	<0.017	<0.017	<0.018	<0.016	NC	<0.015	<0.016
Bis(2-ethylhexyl) phthalate	0.0060	0.0052	0.0089	NC	NC	<0.0089	<0.0085	<0.0087	<0.0088	<0.0079	NC	<0.0076	<0.0078
Chrysene	0.012	BRL	0.00018	NC	NC	<0.00018	<0.00017	<0.00017	<0.00018	<0.00016	NC	<0.00015	0.00024
Dibenz(a,h)anthracene	0.0003	BRL	0.00027	NC	NC	<0.00027	<0.00026	<0.00026	<0.00026	<0.00024	NC	<0.00023	<0.00023

TABLE 6 (Continued): ANALYSIS OF GROUNDWATER SAMPLED AT MONITORING WELLS TB-118 THROUGH TB-124, THE MAIN QUARRY SUMP, AND THE THORNTON COMPOSITE RESERVOIR DURING THE ANNUAL MONITORING EVENT IN OCTOBER AND DECEMBER 2019

Parameter	Part 620 Groundwater Standard	Maximum Background	Lab RL[1]	Well									
				TB-118	TB-119	TB-120	TB-120D[2]	TB-121	TB-122	TB-123	TB-124	Sump	Reservoir
	Concentration (mg/L)												
Diethyl phthalate	5.60	BRL	0.0044	NC	NC	<0.0044	<0.0043	<0.0044	<0.0044	<0.0040	NC	<0.0038	<0.0039
Di-n-butyl phthalate	0.700	BRL	0.0044	NC	NC	<0.0044	<0.0043	<0.0044	<0.0044	<0.0040	NC	<0.0038	<0.0039
Fluoranthene	0.280	0.113	0.00089	NC	NC	<0.00089	<0.00085	<0.00087	<0.00088	<0.00079	NC	<0.00076	<0.00078
Fluorene	0.280	BRL	0.00089	NC	NC	<0.00089	<0.00085	<0.00087	<0.00088	<0.00079	NC	<0.00076	<0.00078
Hexachloro-cyclopentadiene	0.050	BRL	0.018	NC	NC	<0.018	<0.017	<0.017	<0.018	<0.016	NC	<0.015	<0.016
Indeno[1,2,3-cd]pyrene	0.00043	BRL	0.00018	NC	NC	<0.00018	<0.00017	<0.00017	<0.00018	<0.00016	NC	<0.00015	<0.00016
Naphthalene	0.140	BRL	0.00089	NC	NC	<0.00089	<0.00085	<0.00087	<0.00088	<0.00079	NC	<0.00076	<0.00078
Pentachlorophenol	0.001	0.1690	0.00030	NC	NC	<0.00029	<0.00029	<0.00030	<0.00025	<0.00026	NC	<0.00025	<0.00024
Phenolics, Total Recoverable	0.100	0.062	0.005	NC	NC	<0.005	<0.005	<0.005	<0.005	<0.005	NC	0.0074	<0.005
Pyrene	0.210	0.126	0.00089	NC	NC	<0.00089	<0.00085	<0.00087	<0.00088	<0.00079	NC	<0.00076	<0.00078
RADIOACTIVITY													
Radium-226 (pCi/L)	20	4.31	0.214	NC	NC	0.594	1.11	1.96	1.07	1.51	NC	0.214	0.329
Radium-228 (pCi/L)	20	2.58	0.720	NC	NC	<0.421	0.628	1.17	0.739	0.756	NC	<0.399	<0.720

[1]Lab reporting limit. Where analyses for the same parameter had different RL, the maximum RL is shown. Values for Radium are minimum detection concentrations.
[2]Duplicate sample.
[3]Measurements of inorganic constituents except pH and EC are the mean of two samples collected October 17 and December 9, 2019. For calculating means, values below the reporting limit were treated as equal to the reporting limit. Measurements of pH and EC were collected only on October 17, 2019.
[4]No existing limit.
[5]No data reportable. Field measurements were inadvertently not reported.
[6]For well and sump samples only, concentrations in bold font indicate their exceedance of Part 620 Class 1 Groundwater Standards.
[7]Below reporting limit in background monitoring samples.
[8]No data reportable. Analysis canceled by laboratory because the result was below the limit of quantitation due to dilution.
[9]Not determined.
[10]No data reportable. Analysis canceled by laboratory because the digestion temperature was out of the acceptable range.
[11]Sample could not be collected because of equipment malfunctioning.

REFERENCES

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