

Summary Report

To : Nick Colucci, Director

Date : July 31, 2020

Town of Erin, Infrastructure Services

Re. : Monthly Monitoring Report

From : Andrew Pentney

Groundwater Monitoring Program

CC : Triton Engineering

Project : Station Street Dam Reconstruction

The following is a summary report regarding the monitoring completed to date as part of the *Groundwater Monitoring and Mitigation Plan, Reconstruction of Station Street and Replacement of Station Street Bridge (Structure 2064) and Dam Control Structure, Hillsburgh (May 23, 2019)*.

Monitoring Locations

As per the monitoring plan the following monitors were installed on April 20, 2020:

- Hillsburgh Pond (stilling well)
- 3 drive-point piezometers at locations around the perimeter of the Pond

The monitoring locations are shown on the attached **Figure 1**, as surveyed by Triton Engineering.

The drive-point piezometers were installed by hand into the shallow sediments along the perimeter of the pond, and allow a comparison of the pond levels to the water table elevations immediately adjacent to the pond at those locations.

Monitor DP1 was deepened on April 30, 2020 in order to intercept the water table.

According to data collected as part of this program, the commencement of construction related pond lowering began on May 12, 2020.

Monitoring Completed

Water level monitoring is completed through occasional manual measurements and on an hourly basis by transducer/dataloggers installed at each location. At most locations water level monitoring began on April 20, 2010. At DP1 water level monitoring began on April 30, 2020. The monitor installation details are provided on the attached **Table 1**. Dataloggers are downloaded every 2nd week, and manual pond level measurements are also obtained weekly.

A hydrograph showing measured water level elevations to date is attached as **Figure 2**. Reported precipitation (rainfall) at the Environment Canada Fergus Shand Dam weather station (closest monitoring station) is additionally plotted on **Figure 2** for comparison purposes.

Water quality samples can be obtained from the Pond, DP1 and DP3. Monitor DP2 is installed in fine grain sediments that do not “produce” sufficient water to obtain representative samples.

Water quality sampling occurred on April 24th and May 4th, prior to construction activities in order to provide baseline data. Samples were also obtained on May 27th, June 9th, June 26th, July 10th and July 22nd (every 2nd week) after construction began.

Water quality sampling results to date are summarized on the attached **Table 2**.

Observations

Groundwater-surface water interaction is summarized as follows:

- Water levels collected to date at DP1 show that the water table along the southeast (downgradient) edge of the pond is significantly lower than the pond (approx. 1.5 m difference), indicating recharge conditions and groundwater flow away from the pond in this location.
- Water levels at DP2 are observed to be higher than the pond level under spring conditions. This indicates groundwater flow toward and into the pond in this area (likely extending along the northwest edge) at that time. Recent water levels indicate that summer evapotranspiration in this area may naturally lower the groundwater table to (or slightly below) the pond level.
- Water levels collected at DP3 indicate that the water table is naturally below the pond level, indicating recharge conditions and groundwater flow away from the pond in this area (likely extending from the creek inflow location to the dam).
- The pond was lowered from mid-May to early June to allow initial construction. A coffer dam was installed in early June, which allowed pond levels to be reestablished. Current pond levels are similar to (however slightly below) pre-construction levels.
- Groundwater levels surrounding the pond responded to the pond level increase in early June (after coffer dam construction). Current groundwater levels are relatively stable and appear to correspond to “natural” conditions in the area of the pond.
- To date water table changes associated with pond lowering are relatively minor. No significant changes in water quality are noted.

Summary

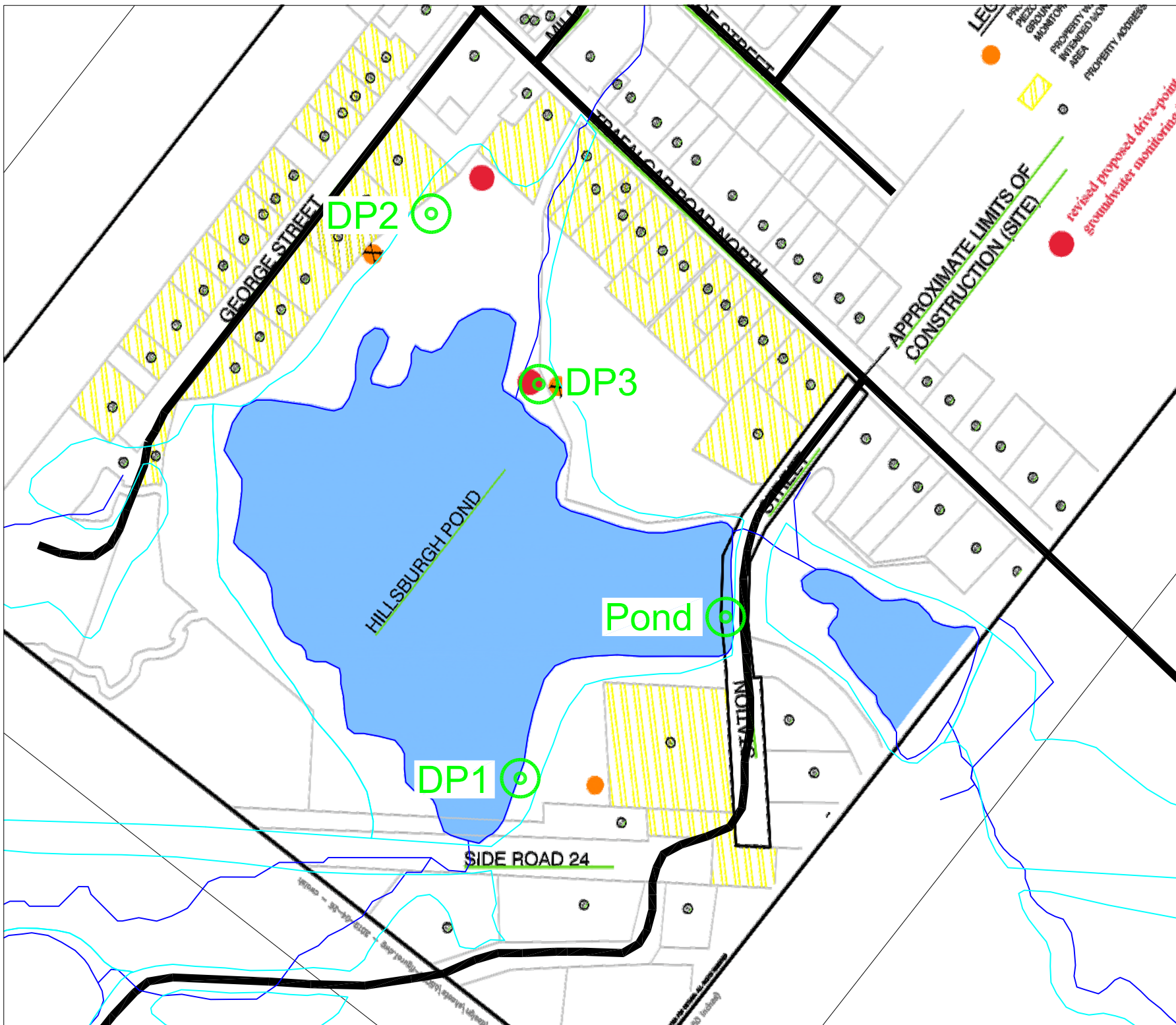
Construction activities have not resulted in any significant changes to groundwater conditions to date. The monitoring schedule includes weekly checks of the pond level and biweekly water level and water quality sampling at the monitoring locations. Monthly reports will also continue to be prepared during construction to update the monitoring results and assess groundwater conditions at, and near, the pond.

Sincerely,



Andrew Pentney, P.Geo.
Senior Hydrogeologist
Groundwater Science Corp.

Attached: Figure 1, Figure 2
Table 1, Table 2



Legend
 ● DP1 Dam monitor

Figure 1
 Station Street Dam
 Monitoring Network

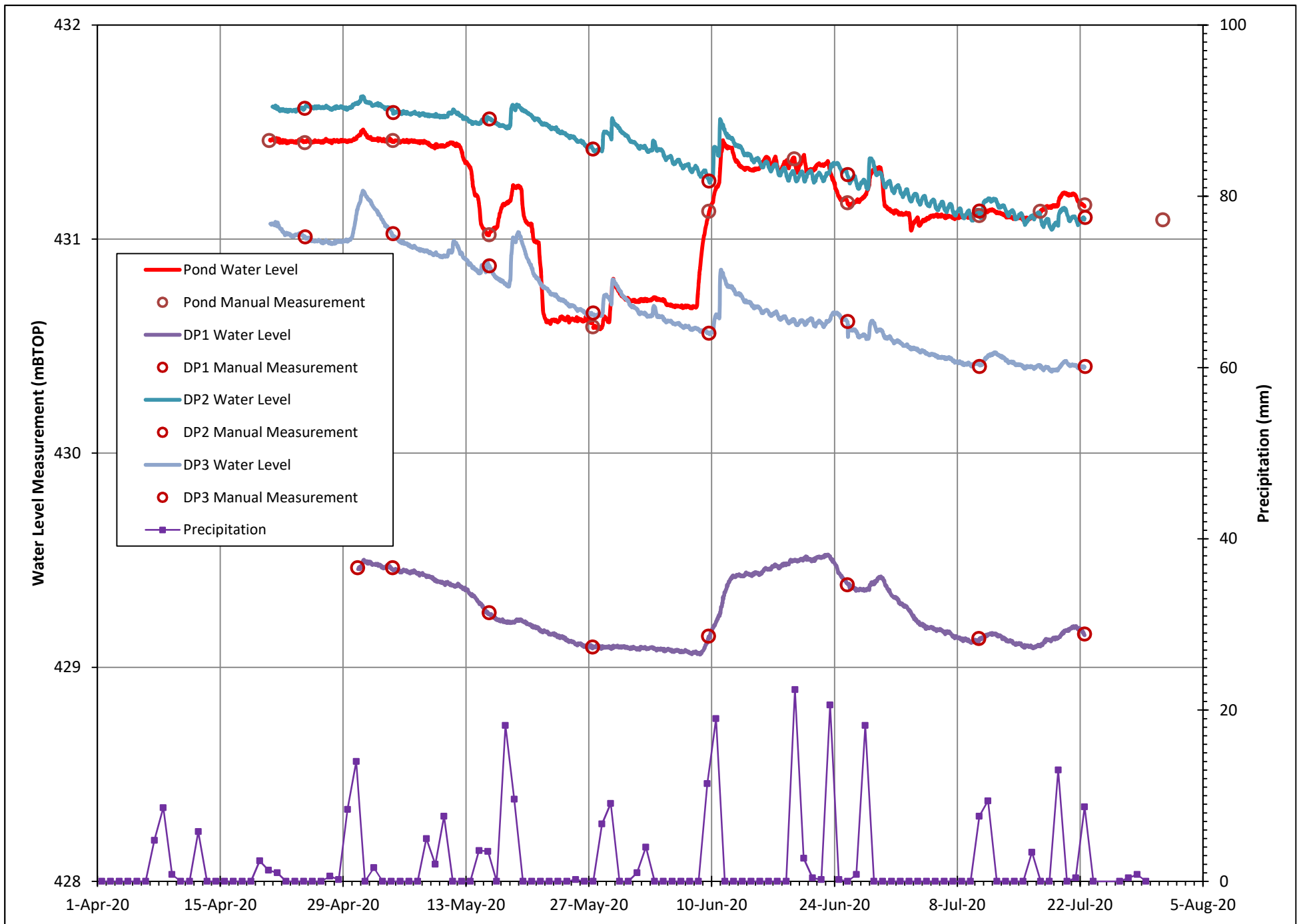


Figure 2: Water Level Hydrograph

Location	Type	As Installed			Elevations	
		Total Depth (mBTOP)	Stick-Up (mAGS)	Screen Lenth (m)	Ground Surface (mASL)	Top of Pipe (mASL)
Pond	stilling well	1.90	1.90	1.00	430.46	432.36
DP1	piezometer	4.09	1.22	0.30	431.57	432.79
DP2	piezometer	2.21	0.42	0.30	431.62	432.13
DP3	piezometer	2.84	1.26	0.30	431.36	432.70
Notes: mBTOP = metres below top of pipe mAGS = metres above ground surface mASL = metres above sea level						

Sample Location:		POND						
Date:		24-Apr-2020	4-May-2020	27-May-2020	9-Jun-2020	25-Jun-2020	10-Jul-2020	22-Jul-2020
Parameter	Units	Water	Water	Water	Water	Water	Water	Water
Anions and Nutrients								
Bromide (Br)	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Chloride (Cl)	mg/L	24.7	25.9	24.4	22.3	23.9	21.8	21.4
Fluoride (F)	mg/L	0.045	0.047	0.050	0.046	0.048	0.052	0.051
Nitrate (as N)	mg/L	3.20	3.03	3.22	3.09	2.76	2.14	1.93
Nitrite (as N)	mg/L	0.014	0.020	0.024	0.026	0.042	0.038	0.029
Sulfate (SO4)	mg/L	18.1	18.7	18.7	20.5	18.3	17.8	17.0
Total Metals								
Aluminum (Al)-Total	mg/L	0.0680	0.2350	0.1120	0.0317	0.0447	0.0233	0.0307
Antimony (Sb)-Total	mg/L	<0.00010	0.00021	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)-Total	mg/L	0.00025	0.00039	0.00038	0.00028	0.00036	0.00043	0.00043
Barium (Ba)-Total	mg/L	0.0342	0.0416	0.0319	0.0404	0.0643	0.0634	0.0507
Beryllium (Be)-Total	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)-Total	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Total	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)-Total	mg/L	0.0000076	0.0000275	0.0000090	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Calcium (Ca)-Total	mg/L	69.2	73.5	60.1	62.0	65.4	61.4	63.1
Cesium (Cs)-Total	mg/L	<0.000010	0.000022	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Chromium (Cr)-Total	mg/L	<0.00050	0.0008	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Cobalt (Co)-Total	mg/L	<0.00010	0.00013	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)-Total	mg/L	0.00060	0.00110	0.00066	<0.00050	<0.00050	<0.00050	<0.00050
Iron (Fe)-Total	mg/L	0.108	0.377	0.179	0.083	0.145	0.119	0.083
Lead (Pb)-Total	mg/L	0.000297	0.001100	0.000572	0.000131	0.000200	0.000139	0.000100
Lithium (Li)-Total	mg/L	0.0021	0.0015	0.0018	0.0015	0.0018	0.0014	0.0015
Magnesium (Mg)-Total	mg/L	21.2	20.3	21.0	21.9	21.4	20.6	22.0
Manganese (Mn)-Total	mg/L	0.0122	0.0394	0.0211	0.0157	0.0288	0.0301	0.0230
Molybdenum (Mo)-Total	mg/L	0.000263	0.000294	0.000271	0.000270	0.000324	0.000369	0.000363
Nickel (Ni)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Phosphorus (P)-Total	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Total	mg/L	1.09	1.04	1.05	1.00	1.05	0.85	0.97
Rubidium (Rb)-Total	mg/L	0.00071	0.00099	0.00083	0.00077	0.00084	0.00073	0.00087
Selenium (Se)-Total	mg/L	0.000141	0.000149	0.000166	0.000113	0.000133	0.000114	0.000132
Silicon (Si)-Total	mg/L	3.82	3.65	4.32	4.34	4.13	4.36	4.51
Silver (Ag)-Total	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Sodium (Na)-Total	mg/L	11.7	11.3	11.0	10.5	10.9	9.1	9.8
Strontium (Sr)-Total	mg/L	0.117	0.124	0.111	0.109	0.118	0.110	0.111
Sulfur (S)-Total	mg/L	7.01	6.42	6.63	7.43	6.53	6.05	6.15
Tellurium (Te)-Total	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Thallium (Tl)-Total	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Thorium (Th)-Total	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Tin (Sn)-Total	mg/L	0.00028	0.00025	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Total	mg/L	0.00318	0.00842	0.00419	0.00112	0.00171	0.00087	<0.00080
Tungsten (W)-Total	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Uranium (U)-Total	mg/L	0.000524	0.000488	0.000517	0.000494	0.000501	0.000540	0.000557
Vanadium (V)-Total	mg/L	<0.00050	0.00086	0.00078	<0.00050	0.00053	0.00064	0.00058
Zinc (Zn)-Total	mg/L	0.0139	0.0865	0.0031	<0.0030	<0.0030	<0.0030	<0.0030
Zirconium (Zr)-Total	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020

Table 2: Water Quality Results Summary

Sample Location:		DP1					
Date:		4-May-2020	27-May-2020	9-Jun-2020	25-Jun-2020	10-Jul-2020	22-Jul-2020
Parameter	Units	Water	Water	Water	Water	Water	Water
Anions and Nutrients							
Bromide (Br)	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Chloride (Cl)	mg/L	26.6	30.1	36	26.9	27.2	28.4
Fluoride (F)	mg/L	0.050	0.041	0.037	0.048	0.058	0.052
Nitrate (as N)	mg/L	3.070	2.72	1.17	2.5	1.29	1.58
Nitrite (as N)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Sulfate (SO4)	mg/L	18.4	16.8	11.3	22.3	20.4	19.3
Dissolved Metals							
Aluminum (Al)-Dissolved	mg/L	<0.0050	<0.0050	0.0068	<0.0050	<0.0050	<0.0050
Antimony (Sb)-Dissolved	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)-Dissolved	mg/L	0.00018	0.00017	0.00018	0.00013	0.00019	0.00017
Barium (Ba)-Dissolved	mg/L	0.0352	0.0375	0.0475	0.0513	0.0396	0.0428
Beryllium (Be)-Dissolved	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)-Dissolved	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Dissolved	mg/L	<0.010	<0.010	<0.010	0.012	0.014	0.014
Cadmium (Cd)-Dissolved	mg/L	0.0000255	0.0000412	0.0000253	0.0000807	0.0000318	0.0000325
Calcium (Ca)-Dissolved	mg/L	68.5	73.2	97.7	70.6	72.1	72.8
Cesium (Cs)-Dissolved	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Chromium (Cr)-Dissolved	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Cobalt (Co)-Dissolved	mg/L	<0.00010	0.00011	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)-Dissolved	mg/L	0.00053	0.0004	0.00048	0.00076	0.00053	0.00063
Iron (Fe)-Dissolved	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Lead (Pb)-Dissolved	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)-Dissolved	mg/L	<0.0010	<0.0010	0.0011	<0.0010	0.0015	0.0018
Magnesium (Mg)-Dissolved	mg/L	19.1	22.4	28.1	19.8	18.9	19.7
Manganese (Mn)-Dissolved	mg/L	0.009	0.0096	0.0205	0.00094	0.00603	0.0119
Molybdenum (Mo)-Dissolved	mg/L	0.00029	0.000224	0.000144	0.000907	0.000213	0.000223
Nickel (Ni)-Dissolved	mg/L	0.00099	0.00534	0.0006	0.00075	0.00228	0.00146
Phosphorus (P)-Dissolved	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Dissolved	mg/L	1.090	1.04	1.18	1.34	1.21	1.38
Rubidium (Rb)-Dissolved	mg/L	0.00053	0.00051	0.00087	0.00092	0.00073	0.00097
Selenium (Se)-Dissolved	mg/L	0.00018	0.000242	0.000151	0.000171	0.000093	0.000183
Silicon (Si)-Dissolved	mg/L	3.74	3.9	4.88	5.11	5.11	5.32
Silver (Ag)-Dissolved	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Sodium (Na)-Dissolved	mg/L	13.7	14.4	18.4	13.9	12.7	13.6
Strontium (Sr)-Dissolved	mg/L	0.122	0.13	0.157	0.129	0.124	0.13
Sulfur (S)-Dissolved	mg/L	6.7	6.1	4.18	7.81	7.01	7.31
Tellurium (Te)-Dissolved	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Thallium (Tl)-Dissolved	mg/L	<0.000010	<0.000010	<0.000010	0.000015	<0.000010	<0.000010
Thorium (Th)-Dissolved	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Tin (Sn)-Dissolved	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Dissolved	mg/L	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Tungsten (W)-Dissolved	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Uranium (U)-Dissolved	mg/L	0.000588	0.000622	0.000596	0.000424	0.000355	0.000301
Vanadium (V)-Dissolved	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)-Dissolved	mg/L	0.43	0.669	0.166	1.93	0.95	1.53
Zirconium (Zr)-Dissolved	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020

Table 2: Water Quality Results Summary

Sample Location:		DP3						
	Date:	24-Apr-2020	4-May-2020	27-May-2020	9-Jun-2020	25-Jun-2020	10-Jul-2020	22-Jul-2020
Parameter	Units	Water	Water	Water	Water	Water	Water	Water
Anions and Nutrients								
Bromide (Br)	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Chloride (Cl)	mg/L	20.9	21.4	21.7	21.1	22.6	22.8	21.1
Fluoride (F)	mg/L	0.055	0.055	0.055	0.057	0.053	0.062	0.057
Nitrate (as N)	mg/L	0.060	<0.020	<0.020	0.020	<0.020	<0.020	<0.020
Nitrite (as N)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Sulfate (SO4)	mg/L	32.7	32.7	28.3	20.1	16.8	11.9	8.3
Dissolved Metals								
Aluminum (Al)-Dissolved	mg/L	0.0058	<0.0050	<0.0050	0.2920	0.0056	<0.0050	<0.0050
Antimony (Sb)-Dissolved	mg/L	<0.00010	0.00011	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)-Dissolved	mg/L	0.00088	0.00507	0.00522	0.00564	0.00460	0.00489	0.00425
Barium (Ba)-Dissolved	mg/L	0.0750	0.0664	0.0801	0.1030	0.0696	0.0752	0.0714
Beryllium (Be)-Dissolved	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)-Dissolved	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Dissolved	mg/L	<0.010	<0.010	<0.010	<0.010	0.011	0.011	0.01
Cadmium (Cd)-Dissolved	mg/L	<0.0000050	<0.0000050	0.0000129	0.0000467	<0.0000050	<0.0000050	<0.0000050
Calcium (Ca)-Dissolved	mg/L	85.5	88.3	96.7	109.0	113.0	109.0	105.0
Cesium (Cs)-Dissolved	mg/L	<0.000010	<0.000010	<0.000010	0.000014	<0.000010	<0.000010	<0.000010
Chromium (Cr)-Dissolved	mg/L	<0.00050	<0.00050	<0.00050	0.00056	<0.00050	<0.00050	<0.00050
Cobalt (Co)-Dissolved	mg/L	0.00150	0.00043	0.00046	0.00097	0.00035	0.00015	0.00014
Copper (Cu)-Dissolved	mg/L	<0.00020	<0.00020	<0.00020	0.00152	0.00039	<0.00020	<0.00020
Iron (Fe)-Dissolved	mg/L	<0.010	7.94	8.51	6.8	9.52	8.19	6.89
Lead (Pb)-Dissolved	mg/L	0.000135	<0.000050	<0.000050	0.004380	<0.000050	<0.000050	<0.000050
Lithium (Li)-Dissolved	mg/L	<0.0010	<0.0010	0.0011	<0.0010	<0.0010	0.0011	0.0012
Magnesium (Mg)-Dissolved	mg/L	19.0	18.0	21.1	23.4	22.6	21.9	22.5
Manganese (Mn)-Dissolved	mg/L	0.849	0.878	1.170	1.280	1.160	1.030	0.977
Molybdenum (Mo)-Dissolved	mg/L	0.00106	0.00075	0.00080	0.00076	0.00111	0.00079	0.00089
Nickel (Ni)-Dissolved	mg/L	0.00450	0.01330	0.00908	0.00318	0.01190	0.00109	0.00058
Phosphorus (P)-Dissolved	mg/L	<0.050	0.057	0.056	0.073	0.052	<0.050	<0.050
Potassium (K)-Dissolved	mg/L	0.768	0.441	0.537	0.703	0.529	0.566	0.576
Rubidium (Rb)-Dissolved	mg/L	0.00097	0.00051	0.00063	0.00104	0.00063	0.00066	0.00065
Selenium (Se)-Dissolved	mg/L	<0.000050	0.000056	0.000065	0.000511	<0.000050	0.000066	0.000066
Silicon (Si)-Dissolved	mg/L	5.51	6.43	7.14	8.50	8.42	8.16	8.13
Silver (Ag)-Dissolved	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Sodium (Na)-Dissolved	mg/L	11.6	10.0	10.5	11.5	10.4	10.7	11.1
Strontium (Sr)-Dissolved	mg/L	0.124	0.129	0.149	0.159	0.155	0.153	0.159
Sulfur (S)-Dissolved	mg/L	12.2	11.0	8.9	7.6	5.4	4.3	3.6
Tellurium (Te)-Dissolved	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Thallium (Tl)-Dissolved	mg/L	<0.000010	<0.000010	<0.000010	0.000012	<0.000010	<0.000010	<0.000010
Thorium (Th)-Dissolved	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Tin (Sn)-Dissolved	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Dissolved	mg/L	0.00030	0.00034	0.00032	0.00814	0.00035	<0.00030	<0.00030
Tungsten (W)-Dissolved	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Uranium (U)-Dissolved	mg/L	0.000185	0.000081	0.000156	0.000198	0.000115	0.000091	0.000104
Vanadium (V)-Dissolved	mg/L	<0.00050	0.0016	0.00163	0.00257	0.00146	0.00119	0.00113
Zinc (Zn)-Dissolved	mg/L	3.43	0.59	1.88	2.35	1.82	1.43	1.51
Zirconium (Zr)-Dissolved	mg/L	<0.00020	0.00032	0.00035	0.00055	0.00045	0.00043	0.00042

Table 2: Water Quality Results Summary