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Resiliency Improvements at Watershops Pond Dam

Springfield, Massachusetts

2021 DRAWDOWN PERIOD ECOLOGICAL RESOURCE MONITORING SUMMARY REPORT

DECEMBER 2021

GZA File No. 15.0166625.20

Prepared in Compliance with:

Order of Conditions, DEP File No. 294-0607, issued 09/17/2020

Section 401 Water Quality Certification, BRP WW 08, DEP Transmittal No. X286704, issued 07/23/2021

Section 404 Permit, Fil No. NAE-2020-02301, issued 10/21/2020

Certificate on the SEIR, Secretary of Energy and Environmental Affairs, EOEEA No. 16234, issued 07/31/2020

PREPARED FOR:
City of Springfield
Department of Capital Asset Construction

PREPARED BY:

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February 4, 2022
GZA File No. 15.0166625.20

Springfield Conservation Commission
70 Tapley Street
Springfield, MA 01104

RE: Resiliency Improvements at Watershops Pond Dam
2021 Drawdown Period Ecological Resource Monitoring Summary Report
Springfield, MA

Dear Commissioners:

On behalf of the City of Springfield, Department of Capital Asset Construction (DCAC), GZA GeoEnvironmental, Inc. (GZA) is pleased to submit this 2021 Drawdown Period Ecological Monitoring Summary Report. This report is submitted in accordance with the permits authorizing the work currently being conducted for the Resiliency Improvements at Watershops Pond Dam (the "Project").

Monitoring occurred at Watershops Pond throughout 2021 for dissolved oxygen, turbidity, and temperature within the Pond, as well as depth to groundwater and vegetative communities within representative wetlands, per the Aquatic and Wetland Resource Monitoring and Mitigation Plan reviewed as part of the MEPA Environmental Impact Report, dated August 28, 2020, and approved by the wetlands Order of Conditions – MADEP File No. 294-0607. Monitoring reports have been submitted to the applicable agencies. This report summarizes the 2021 effort. If you have questions, please feel free to contact Jennifer Burke Jennifer Burke@gza.com or 413-374-9614.

Very truly yours,
GZA GeoEnvironmental, Inc.

Jennifer R.M. Burke, P.E.
Senior Project Manager

Daniel M. Nitzsche, CPESC, CESSWI, SE
Consultant / Reviewer

Thomas E. Jenkins, P.E.
Principal-in-Charge

cc:

City of Springfield – Department of Capital Asset Construction

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TABLE OF CONTENTS

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1.0 INTRODUCTION

This ecological resource monitoring summary report is submitted in compliance with the permits authorizing the full drawdown of Watershops Pond conducted for the Resiliency Improvements at Watershops Pond Dam Project (the "Project"). Permits authorizing the Project which incorporated requirements for ecological resource monitoring included the following:

- Certificate on the SEIR, Secretary of Energy and Environmental Affairs, EOEEA No. 16234, issued 07/31/2020
- Order of Conditions issued 09/17/2020 by the Springfield Conservation Commission (DEP File No. 294-0607);
- Section 404 Permit issued 10/21/2020 by U.S. Army Corps of Engineers, New England District (NAE-2020-02301); and
- Section 401 Water Quality Certification, BRP WW 08, issued 07/23/2021 by DEP (DEP Transmittal No. X286704);

Ecological resource monitoring was initially identified to measure the potential environmental impacts associated with the full drawdown of Watershops Pond. The monitoring was discussed conceptually in the Alternatives Analysis included in the Massachusetts Environmental Policy Act (MEPA) Expanded Environmental Notification Form (EENF) filed for the Project (EOEEA No. 16234, EENF dated June 15,2020). On July 31, 2020, the Secretary of the Executive Office of Energy and Environmental Affairs (EEA) issued the Certificate on the EENF requiring the preparation of a Single Environmental Impact Report (SEIR). In response to comments received on the EENF and in response to the Secretary's Certificate on the EENF, a detailed draft "Aquatic and Wetland Resource Monitoring and Mitigation Plan"; the "Plan") was developed in coordination with regulatory agencies and was submitted within the SEIR dated August 28, 2020. The Plan was referenced in the Secretary's Certificate on the SEIR (October 16, 2020) as a mitigation requirement associated with the City of Springfield's (the City) Preferred Alternative of full pond drawdown during the Project. The basic elements of the Plan were developed based upon GZA's knowledge of prior studies of the pond and after numerous consultations with the Springfield Conservation Commission and State and Federal regulatory officials. A copy of the Plan is provided in **Appendix 1**.

The Plan addresses potential drawdown impacts to aquatic and wetland habitats that are dependent in whole or in part on the water levels within Watershops Pond. Aquatic characteristics assessed (within Land Under Water Bodies and Waterways (LUWW)) include aquatic vegetation and dissolved oxygen levels, transparency, and temperature within the water column. Vegetated wetlands fringing the pond (Bordering Vegetated Wetlands (BVW)) were also assessed for vegetation growth and health, groundwater levels, and general habitat characteristics.

Pre-drawdown monitoring work was completed during the late growing season of 2020, to provide an adequate baseline of monitoring data representative of the growing season that could be reasonably compared with the results of future monitoring efforts. This report discusses the monitoring conducted during the current 2021 drawdown period, spanning from December 2020 through December 2021 for both the LUWW and BVW resources in accordance with the Plan and permits. A complete series of pre-drawdown and drawdown period reports, dated September 2020 through December 2021, are included as **Appendix 2**.

2.0 DRAWDOWN PERIOD AQUATIC HABITAT MONITORING

2.1 METHODOLOGY

In accordance with the Plan, dissolved oxygen (DO) and temperature profiles and Secchi disk depths (as a measurement of transparency) are being recorded on a periodic basis. During winter drawdown periods, November through February, monitoring for these parameters occurs once every two months. From March through October, during the growing season, monitoring occurs monthly. DO and temperature (°C) are being recorded at 1-foot depth increments for the entire water column. Vertical profiles are conducted at two locations as identified in the Plan based on anticipated residual pool water depths, as well as a third location added in March 2021 to take advantage of a deeper pool location. All three locations are within the main body of the residual pool, as shown in **Figures 1** and **1A**. Additionally, the surface water elevation is recorded during each monitoring event by measuring the depth to the water surface from a notch on the abutment of the privately-owned steel bridge located approximately 200 feet upstream of the dam.

Data are recorded and presented in tabular form after each monitoring event, and the percent of the waterbody volume with DO concentrations above 4 and 5 ppm is calculated, based upon pond bathymetry and volume at each depth for each monitoring event. DO is recorded to bottom depth at one-foot increments using a YSI DO/Temperature probe (Model No. PRO20) with graduated cable. Locations of the vertical profiles are determined by GPS recording latitude and longitude. Maximum depths of the vertical profiles are approximated based upon multiple deployments of a weighted Secchi disk.

2.2 DISSOLVED OXYGEN, TEMPERATURE, AND SECCHI DEPTH RESULTS

In total, 12 surveys occurred during the drawdown period between December 2020 and December 2021. Pool depth, surface water elevation, and pond surface area all varied during these monitoring dates due to variable head height at the dam outlet due to rainfall and stream flow variation. Throughout the year, the Watershops Pond water surface ranged in elevation from El. 140.70 to El. 150.95 feet North American Vertical Datum of 1988 (NAVD88) with a median elevation of El. 141.3 (**Table 1**). Generally, the surface water elevation fluctuated within a narrow range from El. 140.7 to El. 142.7 feet; however, the July 2021 sampling event immediately followed a large rain event, and the surface elevation was observed to be 9.65 feet higher than the observed median.

These elevational changes are accompanied by a change in surface area of the residual pool (**Table 1**). The approximate surface area is calculated using the Watershops Pond Volume Calculations prepared by GZA based on bathymetric survey data obtained by CRE, Inc. in the spring of 2020 (**Appendix 3**). The observed surface area of Watershops Pond during monitoring events ranged from 17.2 to 125.5 acres, with a median area of 22.5 acres.

Table 1. Watershops Pond Elevation and Surface Area
December 2020 through December 2021

Date	Surface Elevation (ft, NAVD 88)	Approximate Surface Area (ac)
12/15/2020	140.70	17.2
2/23/2021	141.05	22.5
3/23/2021	141.30	22.5
4/14/2021	140.80	17.2
5/27/2021	142.70	29.8
6/2/2021	142.20	22.5
6/25/2021	140.70	17.2
7/19/2021	150.95	125.5
8/9/2021	141.95	22.5
9/14/2021	141.30	22.5
10/15/2021	140.95	22.5
12/10/2021	140.90	22.5

Within the residual pool, GZA monitored at three locations. As stated previously, originally only two locations were included within the Plan; however, the third was included starting in March 2021 to incorporate a deeper observed area within the residual pool. Variations in pool depth at these locations are likely a result of the variable pond elevation and slight variations in sampling location, as well as minor natural sediment repositioning within the shallower portions of the drawn down basin, presumably due to high-flow rainfall events. The maximum pool depth of 15 feet was observed in July 2021 (**Table 2**). On average, the three location depths averaged 2.5-6.0 feet deep. Based on Secchi disk depths observed during monitoring events, turbidity varied within the residual pool. The observed Secchi disk depths ranged from 0.6 to 4.0 feet. At the central pond sampling location, east of the railroad bridge, some turbidity measurements include a ">" which indicates that the Secchi disk was visible at the pond bottom.

As anticipated, the observed water temperature varied seasonally, and the observed DO had an inverse relationship with temperature (**Table 2**). The Plan sets DO levels of 5 mg/l as the action threshold. Should average DO values for 75% of the residual pool volume fall between 4 and 5 mg/l, weekly monitoring would be required. If the observed DO is less than 4 mg/l for 75% of the residual pool, aeration would be required, in addition to biweekly monitoring (**Appendix 1**). Dissolved oxygen levels below the threshold value were only observed on May 27, 2021. As these values ranged from 3.3-5.0 mg/l, after notifying the Springfield Conservation Commission, an additional monitoring event was conducted on June 2, 2021, less than one week later. Dissolved oxygen levels observed on June 2, 2021 were above the threshold, so monitoring was continued on a monthly basis. Additionally, the City elected to install aeration in the lower portion of the residual pool to proactively minimize the potential for a similar event occurring again. The aeration system was run almost continually during the period from June 2021 to November 2021.

Table 2. Average Depth, Temperature, Dissolved Oxygen and Secchi Disk Depth Observations December 2020 through December 2021

Date	Location: Main Body, Near Dam, East of Steel Bridge; 42°05.861 N; 072°33.624 W				Location: Main Body, Central Pond, East of RR Bridge; 42°05.940 N; 072°33.345 W				Location: Main Body, Near Dam, 100'± West of Steel Bridge; 42°05.848 N; 072°33.735 W			
	Total Depth (ft)	Avg. Temp (°C)	Avg. DO (mg/l)	Secchi Depth (ft)	Total Depth (ft)	Avg. Temp (°C)	Avg. DO (mg/l)	Secchi Depth (ft)	Total Depth (ft)	Avg. Temp (°C)	Avg. DO (mg/l)	Secchi Depth (ft)
12/15/20	3.8	2.3	12.6	1.0	2.2	2.2	12.4	1.0	NM	NM	NM	NM
2/23/21	4.0	2.7	12.8	2.5	2.0	4.1	12.4	2.0	NM	NM	NM	NM
3/23/21	4.5	7.2	10.7	4.0	1.2	8.5	12.5	1.2	4.2	7.6	10.6	4.0
4/14/21	3.3	12.2	9.0	3.0	1.5	13.9	9.9	1.5	4.3	12.3	9.4	3.3
5/27/21	4.8	20.9	3.6	0.6	2.2	21.9	5.0	0.8	6.3	20.8	3.3	0.8
6/2/21	4.5	19.2	7.9	1.5	2.3	21.3	7.7	1.0	6.0	18.2	8.1	1.5
6/25/21	3.7	19.6	8.3	2.7	0.5	21.5	7.4	>0.5	4.5	19.2	8.9	2.5
7/19/21	13.0	22.4	5.5	1.8	12.5	21.9	5.5	2.1	15.0	22.3	5.6	1.8
8/9/21	5.0	22.0	8.8	1.5	2.0	24.5	8.8	1.5	5.0	22.7	8.7	1.5
9/14/21	4.5	20.9	8.0	2.5	1.0	23.4	8.2	>1.0	4.5	20.8	9.0	2.3
10/15/21	4.5	18.2	8.9	2.5	1.0	21.5	8.4	>1.0	4.5	17.8	9.2	2.5
12/10/21	3.5	4.5	12.3	>3.5	1.3	5.4	12.7	>1.3	4.5	4.5	13.0	>4.5

NM = Not Measured

2.3 MONITORING RESULTS DISCUSSION

The Plan suggested an action level for DO of 5 mg/l for at least 75% of the water volume within the residual pool, with lesser values potentially triggering mitigation action. This standard was met during the entire drawdown monitoring period to date, except for the May 27, 2021, monitoring date. This monitoring event immediately followed a rain event with local rainfall amounts ranging from 0.53 inches (reported via www.wunderground.com at Bradley International Airport Station) to 0.774 inches (reported via www.localconditions.com for Springfield MA). Compared to the observed April results, the May turbidity results were significantly elevated. GZA hypothesized that the turbidity was increased and the DO was depressed due to a watershed event and not in association with a drawdown-induced seasonal event. Increased turbidity from sediment and/or pollen within the watershed and basin could have resulted in a higher than usual Biochemical Oxygen Demand (BOD), but under such circumstances, DO would be expected to return to normal conditions as the storm-induced turbidity lessened and the sediment settled and pollen dispersed or traveled downstream.

GZA notified the Springfield Conservation Commission on May 28, 2021, of the depressed water quality results, and in consultation with the Commission, GZA performed a second sampling event one week later, on June 2, 2021, to verify if DO had returned to non-threshold levels. On June 2, 2021, the turbidity in Watershops Pond had decreased, and the DO levels had risen to 7.8 mg/l or greater for all contour elevations. This result was more in line with the anticipated gradual fall in DO as the weather and water warms. The return of more normal expected DO levels was observed on this date, even though there were additional rainfall events between May 29 and May 31 preceding the second sampling which ranged from a rainfall total of 0.993 inches (reported via localconditions.com for Springfield MA) to 2.70 inches (reported via wunderground.com at Bradley International Airport Station).

Although an increased water elevation was anticipated during the July 2021 monitoring event due to the significant precipitation in the first half of July, the observed 10-foot water elevation change exceeded expectations. Future sampling

events did not encounter this degree of increased water elevation again. The sustained rainfall over time did not result in as significant an increase in turbidity and decrease in DO, as was observed in May. This may be due to the frequency of rain events. In May, the rainfall was preceded by an extended period of dry weather during a time when seasonal pollen drop was very high, whereas July had rainfall every or every-other day. This consistent rainfall may not have mobilized as much sediment, or it may have flushed the water through the pond more quickly. Additionally, the rain may have resulted in more oxygenated water entering the pond, or the water surface perturbation may have been sustaining DO levels above the action threshold.

Following the May monitoring results, the City elected to install an aeration system in the lower residual pool as a proactive measure. This system was operated almost continually from June 2021 until November 2021. GZA did not observe other remarkable monthly observations, as each monitoring event exceeded the action threshold. It is anticipated that DO levels will continue to exceed action thresholds until the pond is refilled which is anticipated to occur in spring 2022.

3.0 DRAWDOWN PERIOD WETLAND HABITAT MONITORING

3.1 METHODOLOGY

In accordance with the Plan, wetland habitats are being monitored via groundwater measurements performed monthly during the growing season (April to October) and wetland vegetation assessments performed twice per growing season, in May and between August 15 and September 15. Data are collected at the three wetland locations identified in September 2020 (**Figures 2**) which are:

- Springfield College, Main Campus
- Springfield College, East Campus
- Gunnery Sergeant (GYSGT) Thomas J. Sullivan Park.

Based on the wetland size and configuration, GZA established one to three monitoring stations along a hydrologic gradient per location as shown on **Figures 3-5.**

As described in the pre-drawdown report (**Appendix 2**), the soil stratum is sandy, and free water can easily migrate to the open observation hole. Therefore, a new 2-inch diameter observation hole is hand augered for each monitoring event until either free water is observed or to a depth of 24 inches below ground surface, whichever is shallower. Time is allowed for groundwater equilibration, with depth to water measurements taken every few minutes until no change is observed. For holes in which no groundwater is observed, approximately ten minutes is allowed to elapse before concluding that groundwater is not observed at that location for the monitoring event.

Twice per growing season, once during the month of May and once between August 15 and September 15, the wetland vegetation has been inventoried at each test plot using the survey plot sizes and stratum definitions as described by the U.S. Army Corp of Engineers for wetland delineations.

3.2 GROUNDWATER AND VEGETATION RESULTS

No groundwater was observed during the monitoring period to date to a depth of 24 inches below ground surface at the monitoring stations located at Springfield College and Springfield College East Campus (**Table 3**). At GYSGT J. Sullivan Park, groundwater was consistently observed in the two lower-gradient monitoring stations, ranging from 14 to 0 inches below

ground surface. At the most upgradient monitoring station (Station 1), ground water was observed between 12 and 24 inches below ground surface except for April 2021, when groundwater was not observed.

Table 3. Depth to Groundwater, April 2021 through October 2021, in inches

Date	Springfield College	Springfield College East Campus		GYSGT J. Sullivan Park			Last Rain Date	Last Rain Amount
	Station 1	Station 1	Station 2	Station 1	Station 2	Station 3		
4/14/21	-27+	-27+	-27+	-27+	-6	-6	4/12/21	0.01"
5/27/21	-24+	-24+	-24+	-16	-8	-2	5/27/21	0.53"
6/25/21	-24+	-24+	-24+	-24	-14	-8	6/23/21	0.12"
7/19/21	-24+	-24+	-24+	-12	-5	-1	7/18/21	1.21"
8/9/21	-24+	-24+	-24+	-17	-11	-3	8/2/21	0.07"
9/8/21	-24+	-24+	-24+	-13	-6	0	9/6/21	0.05"
10/15/21	-24+	-24+	-24+	-18	-13	-1	10/5/21	0.78"

All measurements in inches below ground surface
Depths denoted with a "+" indicate that groundwater was not observed at this depth

The vegetation at the six monitoring stations was inventoried and assessed in May and September 2021 (**Table 4**). No change in percent cover was observed in the tree canopy, shrub/sapling, or vine layers at any of the stations. With the exception of duckweed *(Lemna minor)*, a floating aquatic plant, GZA observed only modest variations of less than 15% for species in the herbaceous layer. Observations identified in **Table 4** with a double asterisk (**) represent instances where a species classification was improved based on the seasonality of the observation.

3.3 INITIAL WETLAND HABITAT MONITORING DISCUSSION

Wetland health cannot be fully assessed until after the pond is refilled and the groundwater level is returned; however, to date the wetlands do not appear to be adversely affected by the temporary drawdown. Overall, GZA has not observed an influx of invasive species nor a replacement of wetland with upland species. Some variation in the observations of percent cover can be attributed to time of year, as some species may grow or die off between monitoring events, or to slight variations in sample location. The center point of each sample plot is marked in the field; however, the exact limits of the sample area are not and can result in minor variation of how species along the edges of sample plots are estimated. After accounting for these sources of variation, the observations indicate the wetland vegetation has remained largely stable across the wetlands monitored.

Despite the groundwater level being greater than 24 inches below ground surface at both Springfield College and Springfield College East Campus monitoring stations, these wetlands appear to be hydraulically supported by rainwater and runoff as evidenced by a stable vegetative community. At GYSGT J. Sullivan Park, the groundwater remained in the root zone (<24 inches below ground surface) for the growing season at Stations 2 and 3 and most of the year at Station 1. Most of the observed variation at GYSGT J. Sullivan Park was between wetland species, with no clear trends towards more upland species. For example, sensitive fern abundance decreased at Station 2 while increasing at Station 1, which is the driest wetland area. Additionally, species first observed in the third monitoring event, September 2021, included wetland species such as smartweed and bindweed, both of which are facultative wet species. Within Station 3, there was a decrease in duckweed from 85% to 0% cover. Duckweed is an aquatic species which floats on the water surface. It persists elsewhere in Watershops Pond and is anticipated to return to the Station 3 area once the open water is restored. Duckweed cannot survive with a water table at or below ground surface.

Ultimately, no significant negative wetland trends have been observed thus far. The wetland vegetation and groundwater depths will continue to be monitored during the growing season in 2022 and final assessments will be completed following refilling of Watershops Pond.

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Table 4. Wetland Vegetation Abundance, September 2020 through September 2021

Common Name	*Scientific Name*	*Wetland Indicator Status*	Springfield College			Springfield College - East Campus						GYSGT J. Sullivan Park								
			Station 1			Station 1			Station 2			Station 1			Station 2			Station 3		
			Sept. 2020	May 2021	Sept. 2021	Sept. 2020	May 2021	Sept. 2021	Sept. 2020	May 2021	Sept. 2021	Sept. 2020	May 2021	Sept. 2021	Sept. 2020	May 2021	Sept. 2021	Sept. 2020	May 2021	Sept. 2021
			Tree Canopy (2,800 SF Survey Area)																	
Red Maple	*Acer rubrum*	*FAC*	30	30	30	60	60	60	90	90	90									
Gray Birch	*Betula populifolia*	*FAC*				40	40	40	5	5	5									
Red Oak	*Quercus rubra*	*FACU*							2	2	2									
Willow	*Salix sp.*						5	5												
			Shrub/Sapling Layer (800 SF Survey Area)																	
Staghorn Sumac	*Rhus typhina*	*NI*	30	30	30															
Black Locust	*Robinia pseudoacacia*	*FACU*	30	30	30															
Multiflora Rose*	*Rosa multiflora*	*FACU*	10	10	10															
Black Elderberry	*Sambucus nigra*	*FACW*	10	10	10							5	5	5	10	10	10			
Black Cherry	*Prunus serotina*	*FACU*	5	5	5															
Highbush Blueberry	*Vaccinium corymbosum*	*FACW*				20	20	20	30	30	30									
Winterberry Holly	*Ilex verticillata*	*FACW*				10	10	10	30	30	30									
Glossy Buckthorn*	*Frangula alnus*	*FAC*				5	5	5												
Speckled Alder	*Alnus incana*	*FACW*										70	70	30**	10	10	10			
Gray Birch	*Betula populifolia*	*FAC*										10	10	40**						
Silver Maple	*Acer saccharinum*	*FACW*										5	5	5						
			Ground Cover (80 SF Survey Area)																	
Wild Mint	*Mentha arvensis*	*FACW*	55	55	55															
Virginia Creeper	*Parthenocissus quinquefolia*	*FACU*	40	40	40															
Fleabane Daisy	*Erigeron annuus*	*FACU*	TR																	
Shallow Sedge	*Carex lurida*	*OBL*				5	5	5												
Tussock sedge	*Carex stricta*	*OBL*				5	5	5	5	5	5									
Glossy Buckthorn*	*Frangula alnus*	*FAC*				2	5	10	5	5	5	10	10	10						
Arrowwood	*Viburnum dentatum*	*FAC*				2	2	TR		3	TR									
Clearweed	*Pilea pumila*	*FACW*				15	10								30	15	60	TR		TR
False nettle	*Boehmeria cylindrica*	*OBL*										10**	5**	5**						
Red Oak	*Quercus rubra*	*FACU*				1	1	1		TR	TR									
Barberpole Sedge	*Scirpus rubrotinctus*	*OBL*				15**														
Iris	*Iris spp.*	*OBL*				2	2	2												
Skunk Cabbage	*Symplocarpus foetidus*	*OBL*				TR	5			5										
Spinulose Wood Fern	*Drypoteris carthusiana*	*FACW*							5		TR	5	5	5						
Pennsylvania Sedge	*Carex Pensylvanica*	*NI*							5	**	TR									
Swamp Azalea	*Rhododendron viscosum*	*FACW*							5	**										
Jewelweed	*Ipatiens capensis*	*FACW*										10	15	15		10	40			
Silky Dogwood	*Cornus amomum*	*FACW*																		
Blackberry	*Rhubus spp.*											2	2	2						
Common Reed	*Phragmites australis*	*FACW*										TR	TR	TR	30	30	30			
Sensitive Fern	*Onoclea sensibilis*	*FACW*										5	20	25	10	10	3			
Purple Loosestrife*	*Lythrum salicaria*	*OBL*	5		5								TR	TR	10	3	TR			
Arrowleaf Tearthumb	*Persicaria sagittata*	*OBL*													5	5	50			
Fringed Sedge	*Carex crinita*	*OBL*					TR					15	15	15	5	5	10			
Broadleaf Cattail	*Typha latifolia*	*OBL*													20	20	5	95	95	95
Arrow Arum	*Peltandra virginica*	*OBL*													3					
Black Nightshade	*Solanum nigrum*	*NI*													3		3			
American Burreed	*Sparganium americanum*	*OBL*													3	3				
Swamp Beggar's Tick	*Bidens discoidea*	*FACW*					2								TR			2		2
Common Duckweed	*Lemna minor*	*OBL*																85		
Greater Water Dock	*Rumex britannica*	*OBL*														2				
Princess Pine	*Lycopodium obscurum*	*FACU*						2		2	2									
Forget-me-not	*Myosotis verna*	*FACU*														2				

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Common Name	Scientific Name	Wetland Indicator Status	Springfield College			Springfield College - East Campus						GYSGT J. Sullivan Park								
			Station 1			Station 1			Station 2			Station 1			Station 2			Station 3		
			Sept. 2020	May 2021	Sept. 2021	Sept. 2020	May 2021	Sept. 2021	Sept. 2020	May 2021	Sept. 2021	Sept. 2020	May 2021	Sept. 2021	Sept. 2020	May 2021	Sept. 2021	Sept. 2020	May 2021	Sept. 2021
Canada Thistle*	*Cirsium arvense*	*FACU*		2	5															
Multiflora Rose*	*Rosa multiflora*	*FACU*																		
Water Hore-hound	*Lycopus ameri-canus*	*OBL*						3												
Highbush Blue-berry	*Vaccinium co-rymbosum*	*FACW*									3									
Elderberry	*Sambucus cana-densis*	*FACW*									5									
Bindweed	*Convolvulus spp.*	*FAC*															5			
Smartweed	*Polygonum spp.*	*FACW*															10			
American Poke-weed	*Phytolacca americana*	*FACU*																		
Awl-fruit sedge	*Carex stipata*	*OBL*					3													
			Vines (2,800 SF Survey Area)																	
Grape	*Vitis spp.*		20	20	20															

TR Trace observation (<2%)
** Invasive in the State of Massachusetts*
**May have previously been misidentified

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4.0 SUMMARY

GZA has monitored Watershops Pond in compliance with the Plan from the initiation of the drawdown in October 2020 through December 2021. GZA will continue to monitor the pond for the duration of the drawdown period and the post-drawdown period, which extends to the end of the growing season in 2022.

Though variation has been observed in both the aquatic and wetland habitat, conditions have remained substantively stable. The City took action to proactively mitigate following the single aquatic monitoring event, where DO levels fell below mitigation triggers. No other sample events observed similarly low DO levels. The wetland data indicates that while local groundwater levels may have dropped, the wetlands appear to be receiving sufficient hydraulic inputs from rainfall and runoff to sustain wetland vegetation. Given the data during the monitoring period to date, the wetlands are anticipated to rebound from the temporary impacts associated with the drawdown. Any mitigation or adaptive management alternatives will be discussed with the Conservation Commission following pond refilling, should action be warranted.

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0 185 370 740
SCALE IN FEET

RESILIENCY IMPROVEMENTS AT WATERSHOPS POND DAM
1 ALLEN STREET
SPRINGFIELD, MASSACHUSETTS

DISSOLVED OXYGEN PROFILE MONITORING LOCATIONS

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GZA GeoEnvironmental, Inc.
Engineers and Scientists
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PREPARED FOR:
CITY OF SPRINGFIELD
NATIONAL DISASTER RESILIENCY PROGRAM
CDBG-NDR GRANT#B-13-MS-25-0002

PROJ MGR:	JRB	REVIEWED BY:	TEJ	CHECKED BY:	SLL
DESIGNED BY:	ARD	DRAWN BY:	ARD	SCALE:	1 in = 350 ft
DATE:	12/21/2020	PROJECT NO:	15.0166625.20	REVISION NO:	

FIG. 1

0 185 370 740
SCALE IN FEET

RESILIENCY IMPROVEMENTS AT WATERSHOPS POND DAM
1 ALLEN STREET
SPRINGFIELD, MASSACHUSETTS

DISSOLVED OXYGEN PROFILE MONITORING LOCATIONS

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CDBG-NDR GRANT#B-13-MS-25-0002

PROJ MGR:	JRB	REVIEWED BY:	TEJ	CHECKED BY:	SLL
DESIGNED BY:	ARD	DRAWN BY:	ARD	SCALE:	1 in = 350 ft
DATE:	03/25/2021	PROJECT NO:	15.0166625.20	REVISION NO:	

FIG. 1A

0 1,000 2,000 4,000

SCALE IN FEET

RESILIENCY IMPROVEMENTS AT WATERSHOPS POND DAM
1 ALLEN STREET
SPRINGFIELD, MASSACHUSETTS

LOCUS MAP

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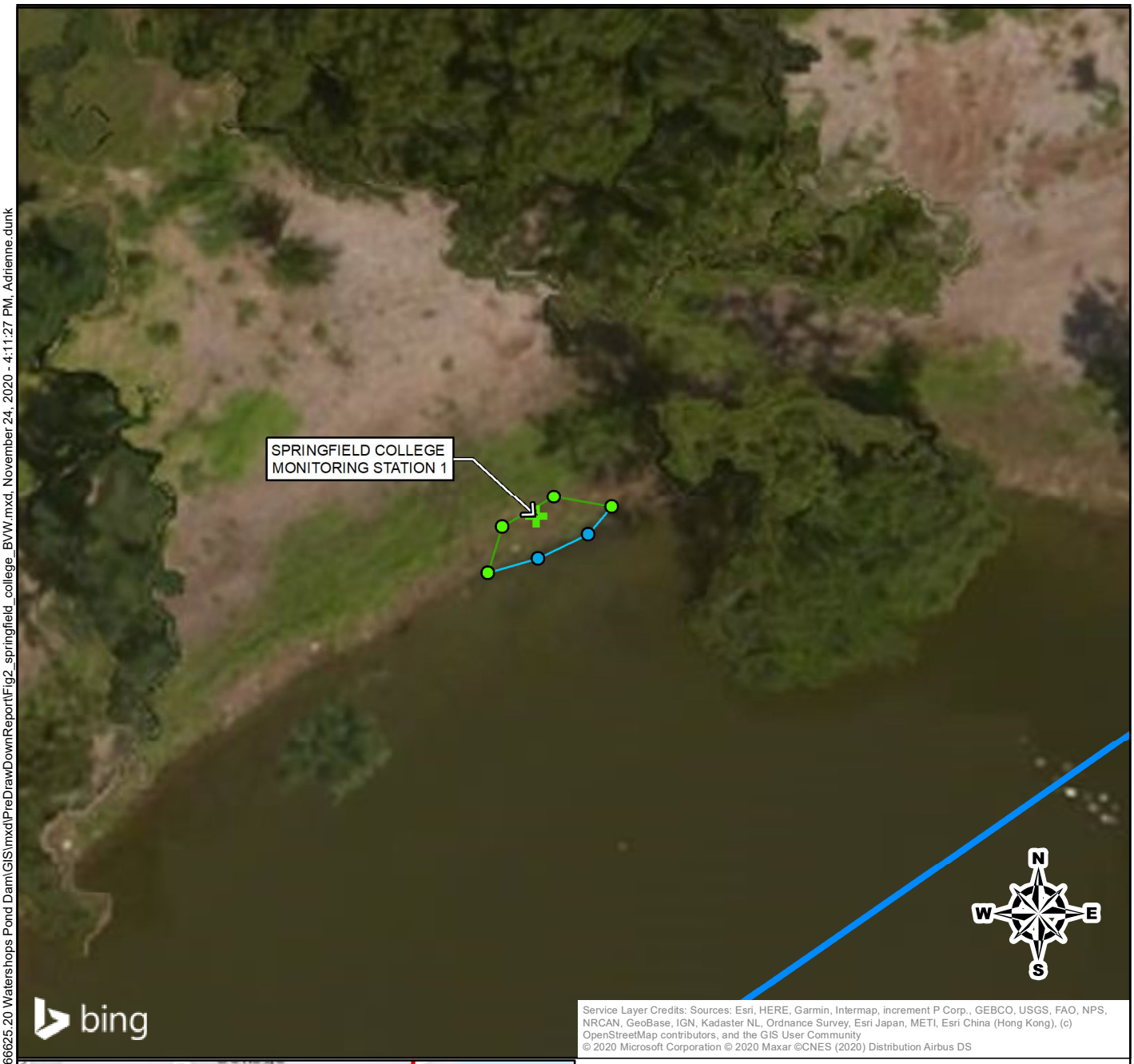
PROJ MGR: TEJ	REVIEWED BY: TEJ	CHECKED BY: SLL	FIG. 2
DESIGNED BY: JRB	DRAWN BY: ARD	SCALE: 1 in = 2,000 ft	
DATE: SEPT. 2020	PROJECT NO: 15.0166625.20	REVISION NO:	



LEGEND

- MONITORING STATION
- WETLAND BOUNDARY POINT
- OBSERVED MEAN HIGH WATER
- WETLAND BOUNDARY
- BVW SURVEY AREAS
- PROJECT AREA

0 10 20 40
SCALE IN FEET

RESILIENCY IMPROVEMENTS AT WATERSHOPS POND DAM
1 ALLEN STREET
SPRINGFIELD, MASSACHUSETTS

SPRINGFIELD COLLEGE BVW

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PROJ MGR: TEJ	REVIEWED BY: TEJ	CHECKED BY: SLL	FIG. 3
DESIGNED BY: JRB	DRAWN BY: ARD	SCALE: 1 in = 20 ft	
DATE: 11/24/2020	PROJECT NO: 15.0166625.20	REVISION NO:	

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LEGEND

- MONITORING STATION
- WETLAND BOUNDARY POINT
- WETLAND TRANSECT
- OBSERVED MEAN HIGH WATER
- WETLAND BOUNDARY
- BVW SURVEY AREAS
- PROJECT AREA

0 10 20 40
SCALE IN FEET

RESILIENCY IMPROVEMENTS AT WATERSHOPS POND DAM
1 ALLEN STREET
SPRINGFIELD, MASSACHUSETTS

SPRINGFIELD COLLEGE
EAST CAMPUS BVW

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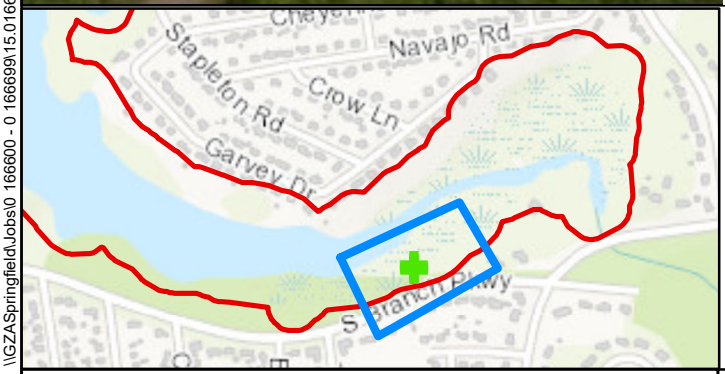
PROJ MGR: TEJ	REVIEWED BY: TEJ	CHECKED BY: SLL	FIG. 4
DESIGNED BY: JRB	DRAWN BY: ARD	SCALE: 1 in = 20 ft	
DATE: 11/25/2020	PROJECT NO: 15.0166625.20	REVISION NO:	



LEGEND

- MONITORING STATION
- WETLAND BOUNDARY POINT
- WETLAND TRANSECT
- OBSERVED MEAN HIGH WATER
- WETLAND BOUNDARY
- BVW SURVEY AREAS
- PROJECT AREA

0 15 30 60
SCALE IN FEET

RESILIENCY IMPROVEMENTS AT WATERSHOPS POND DAM
1 ALLEN STREET
SPRINGFIELD, MASSACHUSETTS

GYSGT. J. SULLIVAN PARK BVW

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PROJ MGR: TEJ	REVIEWED BY: TEJ	CHECKED BY: SLL	FIG. 5
DESIGNED BY: JRB	DRAWN BY: ARD	SCALE: 1 in = 30 ft	
DATE: 11/24/2020	PROJECT NO: 15.0166625.20	REVISION NO:	

APPENDIX 1

AQUATIC AND WETLAND RESOURCE MONITORING AND MITIGATION PLAN

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AQUATIC AND WETLAND RESOURCE MONITORING AND MITIGATION PLAN

Drawdown of Watershops Pond in Conjunction with the Resiliency Improvements at Watershops Pond Dam

August 25, 2020
(rev. 8/28/2020)

*Preamble: The City of Springfield has developed this draft "Aquatic and Wetland Resource Monitoring and Mitigation Plan," which presents a monitoring plan for the potential temporary impacts to the wetland resources of Watershops Pond associated with the 12- to 18- month period of pond drawdown necessary for the Project. The Plan, in its entirety and as revised through August 28, 2020, has been included as **Attachment 8** to the Single Environmental Impact Report (SEIR). It is anticipated that this Plan will be a dynamic program, revised as needed to reflect conditions within Watershops Pond and the marginal BVW areas, upon discussion and consultation with the Springfield Conservation Commission as the Project unfolds and the drawdown of Watershops Pond is achieved and maintained, and pond re-filled after the dam improvements have been constructed. The Plan was presented and discussed at the Conservation Commission's August 25, 2020, public hearing discussing the Notice of Intent filed for the Project.*

INTRODUCTION

In accordance with the Certificate of the Secretary of Energy and Environmental Affairs on the Expanded Environmental Notification Form (EENF) for the Resiliency Improvements at Watershops Pond Dam (EOEEA No. 16234), issued July 31, 2020, this "Aquatic and Wetland Resource Monitoring and Mitigation Plan" (the Plan) presents a monitoring strategy for the potential temporary impacts to the wetland resources of Watershops Pond associated with the 12-18 month period of pond drawdown necessary for the project to proceed. The basic elements of this Plan have been and are being developed based upon prior studies of the pond and consultations with the Springfield Conservation Commission and State and Federal regulatory officials. We anticipate that the Plan may become more detailed and include potential modifications before all project permits are issued.

This monitoring Plan is designed to address potential drawdown impacts to aquatic and wetland habitats that are dependent in whole or in part on the water levels within the pond. The purpose of the monitoring is to anticipate and identify unanticipated temporary and potential long term impacts, and recommend any necessary mitigation measures that will minimize longer term impacts, helping to ensure that the habitats associated with Watershops Pond, upon refilling of the water basin, will not suffer long-term impacts. The goal of any additional mitigation found to be necessary during the monitoring process would be to set the pond resources on an ecological trajectory to restoration to their original condition.

As outlined herein, aquatic resources (within Land Under Water Bodies and Waterways (LUWW)) to be assessed will include aquatic vegetation and dissolved oxygen levels within the water column. Vegetated wetlands (Bordering Vegetated Wetlands (BVW)) bordering the pond will also be assessed for vegetation growth and health, groundwater levels, and general habitat characteristics.

For both the aquatic (LUWW) and wetland (BVW) elements, the monitoring program will be divided into three basic phases with certain monitoring tasks to be performed within each of these phases:

- Pre-drawdown Monitoring,
- Drawdown Period Monitoring, and
- Post-drawdown Monitoring.

Because the project timetable anticipates that drawdown will be initiated in October 2020, pre-survey components of this monitoring program will be initiated during late summer 2020 to provide an adequate baseline of monitoring data for purposes of comparison with future monitoring efforts to be conducted both during and after drawdown, as outlined within this Plan. This early phase monitoring will be conducted in part prior to the completion of MEPA SEIR review process and acquisition of all necessary environmental permits. Every attempt has been made to devise and conduct the pre-drawdown monitoring in a manner that addresses the anticipated regulatory needs for this Project, although it is recognized that some of these requirements may evolve during the final permitting processes to be completed over the next weeks and months.

MONITORING PROGRAM FOR WATERSHOPS POND AQUATIC HABITAT - LUWW

Because the period of drawdown will include the 2021 growing season, it is anticipated that the aquatic vegetation and biota will be temporarily affected. As identified within the EENF, some fish displacement and mortality is unavoidable during the drawdown. The City will conduct pre-, during-, and post-drawdown evaluation of the aquatic habitat conditions as described below. Upon return of normal water levels to the waterbody, the habitat has every likelihood of being restored. MA Division of Fisheries and Wildlife (MassWildlife) has conducted fish surveys on Watershops Pond. Based upon knowledge of the pond bathymetry and discussions with MassWildlife, we anticipate that enough adult fish will survive the drawdown to reproduce post-drawdown. Importantly, no fish species are anticipated to be lost, and restocking programs would give the fish populations a "jump start" following the Project. MassWildlife stocks the pond annually for coldwater species, and the City will work will MassWildlife to assess the need for any restocking of warmwater species. As described below, the City's monitoring efforts of the aquatic environment will focus upon documenting and evaluating any alteration on the aquatic vegetation in the pond, which forms an essential part of the aquatic habitat. It is anticipated that if there is need or desire for any future fish survey that it will be conducted by MassWildlife, although the City is committed to fully supporting and facilitating any such survey.

Pre-Drawdown Monitoring Survey: During the growing season of 2020, a macrophyte survey of Watershops Pond will be conducted on the entire waterbody. This will be conducted in a similar fashion to the pre- and post-drawdown aquatic macrophyte surveys associated with the 1996-97 drawdown, identifying aquatic macrophytes within the extent of normal pond water levels. Identification will be to species level as possible. However, in accordance with more recent pond assessment protocols, the macrophytes will be additionally separated into emergent, floating leaved, submerged, and bottom species to the extent present and observed. Filamentous algae and any pond algal scums will be reported as well, including the obvious presence of green algae and bluegreen cyanobacteria (no microscopic analysis of plankton will be conducted). Data will be presented on pond maps depicting polygons with approximate percent abundance, similar to the 1996 pre-drawdown survey of the pond. During this contemporary survey, any distinctive aquatic habitat features will be noted for inclusion on the aquatic macrophyte maps. Data will be submitted in report format to the Springfield Conservation Commission and other regulatory authorities as required by permit.

During the survey of aquatic vegetation, vertical profiles will be conducted at a minimum of four (4) locations for levels of dissolved oxygen/temperature and Secchi Disk depth. Dissolved Oxygen (DO) and temperature will be recorded at one-foot intervals for the entire depth of the water column at each location. The four locations will represent repeatable GPS-determined locations within the middle section of the two coves associated with the East and West Branches of the Mill River, the deepest portion of the main body of the pond, and the deepest point in the pond located about 700 feet upstream of the dam and adjacent to Harriet Tubman Park (see attached Figure 1. Monitoring Location Map). The data will be recorded and presented in tabular form, calculating the percent of the waterbody volume with DO concentrations above 4 and 5 ppm, based upon pond bathymetry and volume at each depth.

Drawdown Period Monitoring Survey: Aquatic macrophytes will not be surveyed during the active period of drawdown. However, as noted in the EENF, even in the "full drawdown" conditions, about 20 acres of open water will remain, with depths up to 4.8 feet expected in the residual pool. DO/temperature will be monitored during the drawdown in the deepest portions of the residual pool. Monitoring will occur on a monthly basis during the growing season from March to October, inclusive, and once every two months during cold weather months, provided that winter conditions allow for safe data collection. Monitoring will be conducted within the deepest portions of the residual pool, within 2 representative vertical profiles at one-foot intervals. The action level for DO observations in

the residual pool will be 5 ppm. Average values for 75% of the residual pool volume that falls between 4 and 5 ppm will trigger weekly monitoring of DO. If DO is observed at average levels less than 4 ppm within 75% of the residual pool volume, aeration will be performed to raise oxygen levels. If aeration is performed as part of a mitigation effort, additional DO monitoring will be conducted on a biweekly basis to ensure adequate aeration and restoration of oxygen levels. The system for contingent aeration will consist of a floating aerating fountain or fountains powered by portable generator or an air compressor with self-weighted hose to diffusers on the bottom of the residual pool.

Post-Drawdown Monitoring Survey: Following the return of normal pond levels within Watershops Pond in late 2021 or early 2022, aquatic monitoring will be conducted in accordance with the same methodology used during the pre-drawdown survey. Data will be collected on aquatic macrophytes, DO/temperature, and Secchi Disk depth. Multiple surveys for DO/Temperature will be performed during the early-, mid-, and late-growing seasons, with a single sampling for macrophytes in the mid- to late-growing season. Data will be prepared in a format comparable to the pre-drawdown survey to aid in analysis of any changes. Data will be submitted to the Springfield Conservation Commission and other regulatory authorities as required by permit. Assuming the data indicate a reasonable return and ecological trajectory to recovery of pre-drawdown conditions, no additional monitoring is anticipated to be performed in subsequent years. However, any additional habitat mitigation measures will be suggested at this time if judged to be necessary to assist in waterbody habitat recovery including, but not limited to, the potential introduction of native aquatic macrophyte species.

Annual Aquatic Monitoring Report: Based upon the data collected during each growing season, an aquatic monitoring report will be prepared and submitted to the Springfield Conservation Commission by the end of that calendar year. The report will include the following elements:

- Coversheet identifying the monitoring report number;
- A description and history of the procedures followed and dates of observation;
- DO/temperature and macrophyte data presented in tabular and map format, as appropriate to the data;
- Identification of any potential problematic invasive species;
- Wildlife/aquatic habitat observations; and
- Recommendations for remedial actions.

MONITORING PROGRAM FOR WATERSHOPS POND MARGINAL WETLANDS - BVW

Because the period of drawdown will include the 2021 growing season, a temporary negative affect on groundwater hydrology in wetlands fringing on Watershops Pond cannot be ruled out. To assess the condition of the adjacent wetlands throughout this period, wetland areas will be identified and assessed for wetland hydrology and the relative health of vegetative growth before, during and after the period of drawdown. The monitoring information will be reported to the Springfield Conservation Commission and any other regulatory bodies as required by permit.

Pre-Drawdown Wetlands Monitoring Activities: During the summer 2020 growing season (prior to the intended drawdown in October 2020), the major wetland areas along the perimeter of Watershops Pond will be identified. Using GPS, a qualified wetland scientist will delineate the boundaries for the major wetland systems. Based upon prior knowledge of the pond, the major wetland areas along the pond margins are limited to the easterly extent of Dan Baker Cove at the confluence with the East Branch of the Mill River and areas fronting on Springfield College (northwest margin of the pond). In addition, there are some narrow wetland margins with dominant wetland vegetation along other margins of the pond, mostly along the northerly edge of the waterbody. It is assumed that the lower limit of the wetlands will be established at the Mean Annual High Water Line (MAHWL), as evidenced by shoreline indicators. Delineated wetlands will be shown on a GIS map as part of the monitoring reports to be developed.

Once the wetland areas are delineated, each major wetland area will have 2-3 wetland monitoring stations established along a transect, established roughly perpendicular to the shoreline in order to identify any potential gradient effect on wetland hydrology and health with distance from the pond waters. Each monitoring location will be GPS located. Shallow (3-5 feet deep) hand-placed groundwater level monitoring wells will be established at each of these monitoring locations.

During the summer 2020 growing season, the vegetation present within each monitoring location will be assessed during a single observation event. Groundwater elevations relative to ground surface will be determined at each monitoring well, at the time of monitoring well installation and monthly thereafter, with October 2020 being the last occasion of monitoring. This monitoring event will constitute the pre-drawdown wetland monitoring activity.

Drawdown Period and Post-Drawdown Wetland Monitoring: The late-2020 to early-2022 anticipated period of drawdown will include a single growing season (April 2021 – October 2021) during which the wetland monitoring will occur. As a minimum, post-drawdown Wetland Monitoring will occur through the 2022 growing season. Any additional monitoring beyond 2022 will be dependent upon recommendations and regulatory decisions that result from the 2022 monitoring report.

For all monitoring years, monitoring of groundwater levels will occur on a monthly basis from April through October, inclusive. Vegetation Monitoring will occur on two occasions, representing early- and late-growing season, with late May and August 15 - September 15 being the targeted periods. The times of monitoring will be within two weeks of the sampling under the pre-drawdown and post -drawdown monitoring time periods.

Monitoring Procedures at Each Plot Location: The detailed vegetative information to be collected at each monitoring plot location will include:

- Plant census for herbaceous, shrub/sapling, trees and lianas in accordance with USACE wetland delineation procedures (Regional Supplement of the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region, Version 2.0. U.S. Army Corps of Engineers, January 2012).
- Photo-documentation of the overall site(s) and each monitoring location (key photo vantages to be established and repeated on successive site visits to aid in monitoring changes over time);

- Groundwater levels in the observation wells;
- Vegetative conditions in the overall site, relative to plant stress and vigor;
- Notation and assessment of threatening incursion of invasive species at and nearby the plots;
- Wildlife indicators and observations;
- Factors related to establishment of various wetland functions and values;
- Any other observed factors affecting the sites' overall wetland health and vitality.

The purpose of the observation of invasive species is not to produce an exhaustive mapping of all such species within the monitoring plots, or to provide control of all such species, but to instead focus upon concentrations of such species, or localized populations that could be problematic from a management perspective. Invasive species include those vegetative species identified in the *Invasive Plants Atlas of New England,* as updated and available at the time of the surveys. The determination of such species will be limited to dominant or obvious presence, based upon the observations at the time of year. The location and approximate size of dominant patches of each invasive plant population will be recorded on a field map and incorporated into the reports and mappings. Widely distributed invasive species present throughout an area at lower population levels will also be noted.

Annual Wetland Monitoring Report: Based upon the data collected during each growing season, a wetlands monitoring report will be prepared and submitted to the Springfield Conservation Commission and any other regulatory bodies as required by permit by the end of that calendar year. The report can and likely will be combined with the aquatic monitoring report for the same calendar years. The report will include the following elements:

- Coversheet identifying the monitoring report number;
- A description and history of the sites and dates of observation;
- Groundwater and vegetative data;
- Invasive species observations;
- Wildlife observations;
- Wetland functions and values observations;
- Factors related to wetland general health and vigor, and future ecologic trajectory; and
- Recommendations for remedial actions.

Attachments to the report will include:

- Location map of detailed monitoring plots
- Invasive plant species map(s); and
- Photographic log keyed to photograph locations on wetland plan(s).

MONITORING PROGRAM SUMMARY

Table 1.

Summary of Aquatic and Wetland Monitoring Activities by Drawdown Period

Drawdown Period	Year	Season	Activities	
			Aquatic Habitat LUWW	**Wetland Habitat BVW**
Pre-Drawdown Period	2020	Summer growing season (Sep–Oct)	• DO/Temp. profiles and Secchi disk at 4 locations • Whole-pond Macrophyte Survey • Report preparation and submission	• GPS-delineate major fringing wetlands • Hand-install shallow GW wells and establish vegetative/GW transects • Monthly GW data collection • Growing Season wetland vegetative assessment at each plot • Report preparation and submission
Drawdown Period	2020-2022	Fall 2020 through spring of 2022 (With possible early re-fill in late summer-fall of 2021)	• DO/Temp. profiles at 2 locations in the residual pool. o Monthly, Mar - Oct o Bimonthly, Nov – Feb o 5 ppm and 4 ppm avg. levels trigger increase monitoring frequency and aeration (see text) • Report preparation and submission	• GW data collection. o Monthly, Apr - Oct • Wetland vegetative assessment at each plot o 2x per year, at early- and mid/late-growing season • Report preparation and submission
Post-Drawdown Period	2022	Growing season, 2022 Further year(s) as needed, in consultation with Springfield Conservation Commission	• DO/Temp. profiles and Secchi disk at 4 locations o 3x per year: at early-, mid-, and late-growing season • Whole-pond Macrophyte Survey, mid- to late-growing season • Report preparation and submission	• GW data collection. o Monthly, Apr - Oct • Wetland vegetative assessment at each plot o 2x per year, at early- and mid/late-growing season • Report preparation and submission

MITIGATION AND ADAPTIVE MANAGEMENT ALTERNATIVES

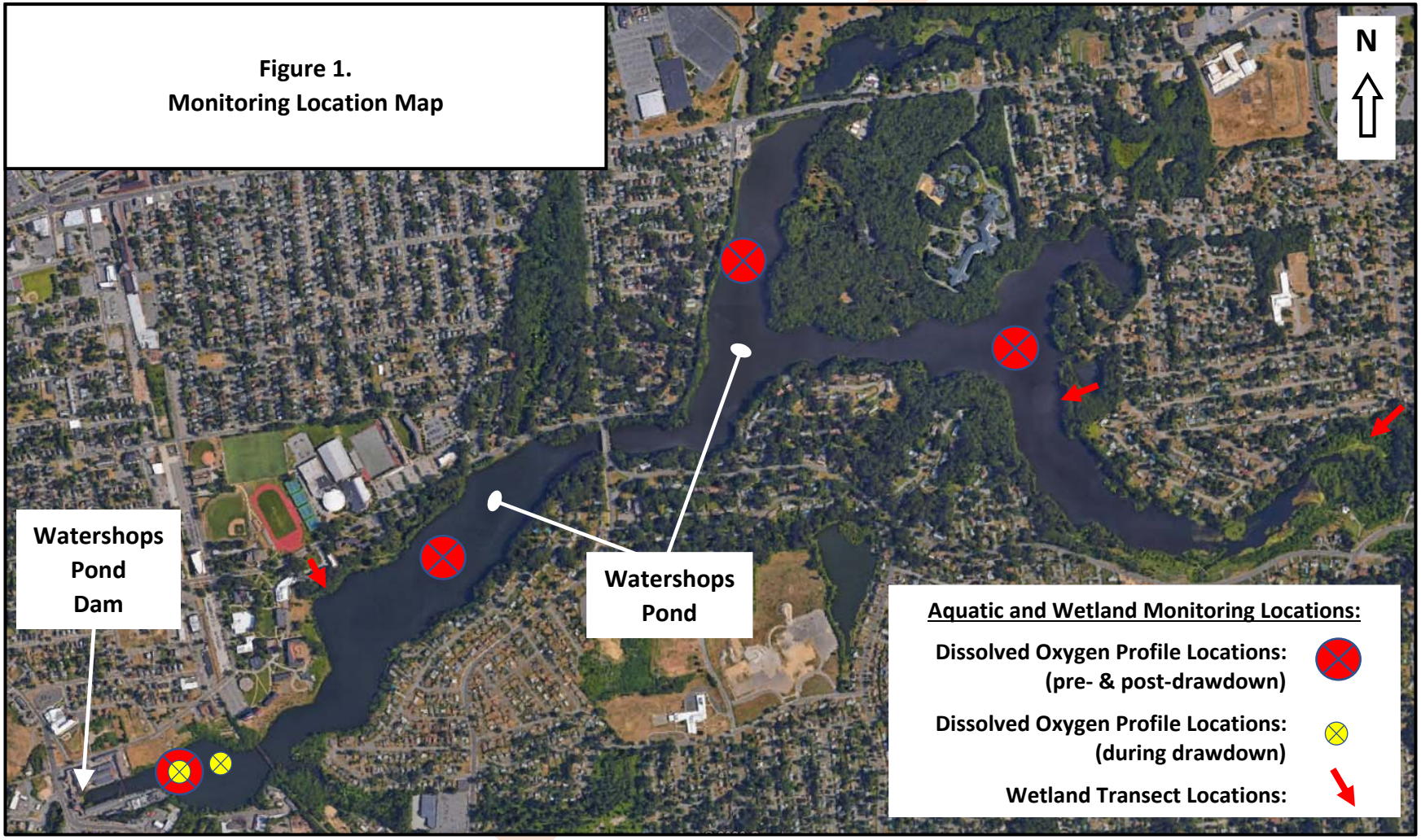
Fisheries: Based on the fish surveys conducted by MassWildlife and discussions with that agency, the City anticipates a warm-water fish species re-stocking program, following project completion and refilling of Watershops Pond. The City will work closely with MassWildlife in the design and timing of the final re-stocking program.

LUWW and BVW areas: The City envisions an adaptive approach to any potential further mitigation required for observed and documented impacts to vegetated wetlands (Bordering Vegetated Wetlands (BVW)) bordering the pond, based on the observations reported and subsequent discussions with the Springfield Conservation Commission.

The Project expectation is that wetland areas will rebound from any temporary impacts associated with the drawdown; however, the City will maintain a contingency provision for "as-needed" re-vegetation of BVW areas that exhibit signs of stress that may be alleviated by a re-planting program. Other mitigation activities will be adapted based on the documented observations.

Invasive Plants: Undoubtedly, invasive plant species currently exist within the land areas bordering Watershops Pond. Any populations of invasive plant within the BVW areas will be observed, described, and quantified in the pre-drawdown, drawdown, and post-drawdown monitoring activities, as described herein. In order to reasonably limit the new spread of invasive plants, the pre-drawdown monitoring results may recommend limited plant treatment and/or removal prior to the following growing season. Based on the observed and documented populations, specific, pro-active management strategies will be developed and implemented, based on the observations reported and subsequent discussions with the Springfield Conservation Commission.

Figure 1.
Monitoring Location Map



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APPENDIX 2

PRE-DRAWDOWN AND DRAWDOWN PERIOD MONITORING REPORTS

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RESILIENCY IMPROVEMENTS AT WATERSHOPS POND DAM

PRE-DRAWDOWN ECOLOGICAL RESOURCE MONITORING REPORT

Springfield, Massachusetts

SEPTEMBER 2020

File No. 15.0166625.20

Prepared in Compliance with:

Order of Conditions, DEP File No. 294-0607, issued 09/17/2020

Section 401 Water Quality Certification, BRP WW 08, DEP Transmittal No. X286704, issued 07/23/2021

Section 404 Permit, File No. NAE-2020-02301, issued 10/21/2020

Certificate on the SEIR, Secretary of Energy and Environmental Affairs, EOEEA No. 16234, issued 07/31/2020

PREPARED FOR:

City of Springfield
Department of Capital Asset Construction
National Disaster Resiliency Program
CDBG-NDR Grant#B-13-MS-25-0002

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TABLE OF CONTENTS

TABLE OF CONTENTS

FIGURES

APPENDICES

TABLES

1.0 INTRODUCTION

This ecological resource monitoring report is submitted in partial compliance with the permits authorizing the work conducted for the Resiliency Improvements at Watershops Pond Dam (the "Project"). Permits authorizing this work which incorporated requirements for ecological resource monitoring included the following:

- Order of Conditions issued 09/17/2020 by the Springfield Conservation Commission (DEP File No. 294-0607);
- Section 401 Water Quality Certification, BRP WW 08, issued 07/23/2021 by DEP (DEP Transmittal No. X286704);
- Section 404 Permit issued 10/21/2020 by U.S. Army Corps of Engineers, New England District (NAE-2020-02301); and
- Certificate on the SEIR, Secretary of Energy and Environmental Affairs, EOEEA No. 16234, issued 07/31/2020

Ecological resource monitoring was initially identified as a means to gauge the environmental impacts associated with a partial or full drawdown of Watershops Pond that may occur during the Project. The monitoring was discussed conceptually in the Alternatives Analysis included in the Expanded Environmental Notification Form (EENF) for the Project (EOEEA No. 16234, EENF dated June 15,2020). On July 31, 2020, the Secretary of Energy and Environmental Affairs issued her Certificate on the EENF requiring the preparation of a Single Environmental Impact Report (SEIR). In response to comments received on the EENF and in response to the Secretary's Certificate on the EENF, a detailed draft "Aquatic and Wetland Resource Monitoring and Mitigation Plan"; the "Plan") was developed in coordination with regulatory agencies and was submitted as an integral mitigation commitment detailed within the SEIR dated August 28, 2020. The Plan was referenced in the Secretary's Certificate on the SEIR (October 16, 2020) and became a mitigation requirement associated with the City of Springfield's Preferred Alternative of full pond drawdown during the Project. The basic elements of the Plan were developed based upon prior studies of the pond and consultations with the Springfield Conservation Commission and State and Federal regulatory officials. A copy of the Plan is provided in **Appendix 1**.

The monitoring Plan design addresses potential drawdown impacts to aquatic and wetland habitats that are dependent in whole or in part on the water levels within Watershops Pond. Aquatic characteristics assessed (within Land Under Water Bodies and Waterways (LUWW)) include aquatic vegetation and dissolved oxygen levels, transparency, and temperature within the water column. Vegetated wetlands fringing the pond (Bordering Vegetated Wetlands (BVW)) were also assessed for vegetation growth and health, groundwater levels, and general habitat characteristics.

For both the aquatic (LUWW) and wetland (BVW) elements, the monitoring program included a pre-drawdown monitoring phase to be conducted in late growing season of 2020, which necessitated that some of the work be conducted before final issuance of the governing permits listed above. This pre-drawdown monitoring work was performed in September 2020, in order to provide an adequate baseline of monitoring data representative of the growing season that could be reasonably compared with the results of future monitoring efforts to be conducted both during and after drawdown. The two additional phases of the monitoring Plan, drawdown period and post-drawdown, will be conducted at later dates, in accordance with the Plan and permits.

2.0 PRE-DRAWDOWN AQUATIC HABITAT MONITORING

2.1 METHODOLOGY:

In accordance with the Plan, the pre-drawdown aquatic habitat monitoring included a late-2020 growing season macrophyte survey for all of Watershops Pond and a monitoring of dissolved oxygen levels and Secchi depth (transparency/visibility) at four locations. As per the Plan, the pond surveys identified aquatic macrophytes within the extent of normal pond water levels. Identification was to species level as possible. The macrophytes were additionally separated into emergent, floating leaved, submerged, and bottom species to the extent present and observed. Filamentous algae and any pond algal scums were reported as well, including the obvious presence of green algae and bluegreen cyanobacteria (no microscopic analysis of plankton was conducted). Data was recorded and presented in tabular form on pond maps depicting polygons with approximate percent abundance, similar to the 1996 survey of the pond conducted prior to the planned 1996-97 temporary winter drawdown of the pond. Some distinctive aquatic habitat features (e.g., large fallen trees) also were noted on the aquatic macrophyte maps.

Dissolved oxygen (DO) and Secchi depth was determined at four (4) GPS-coordinate recorded locations, with DO and temperature recorded at 1-foot depth increments for the entire water column. The four locations represent locations within the middle section of the two coves associated with the North and South Branches of the Mill River, a deep portion of the main body of the pond, and a deep point in the pond located about 700 feet upstream of the dam and adjacent to Harriet Tubman Park (**Figure 1. Monitoring Location Map**). The data was recorded and presented in tabular form, and percent of the waterbody volume with DO concentrations above 4 and 5 ppm was calculated, based upon pond bathymetry and volume at each depth. The measurements of dissolved oxygen and Secchi depth were similarly recorded on September 11, 2020. DO was recorded to bottom depth at one-foot increments using a YSI DO/Temperature probe (Model No. PRO20) with graduated cable. Locations of the vertical profiles were determined by GPS recording latitude and longitude. Maximum depths of the main and lower waterbody for positioning of the vertical profiles was approximated in the field based upon multiple deployments of the weighted Secchi disk.

The survey of aquatic vegetation was conducted over a 6-hour period on September 10, 2020, by canoe, covering the entire lake and sampling by steel-tined rake to the depth of vegetation encountered. While the entire pond was covered by this survey, more detailed notes of species presence, type, and abundance were recorded at 40 locations (**Figure 2**).

2.2 RESULTS

2.2.1 Dissolved Oxygen, Temperature, and Secchi Depth:

The results of the DO, temperature, and Secchi depth sampling showed results that were somewhat typical for the year (see **Figure 1, Table 1**). The depth of the vertical profiles ranged from 6.5 to 17.0 feet, with the deepest depth encountered nearest to the dam and shallowest depth sampled in the center part of the South Branch Mill River Cove opposite Pease Cove. The North Branch Mill River cove was slightly deeper where sampled. The Main Body, central area of the pond, west of Roosevelt Bridge was 10.5 feet deep. The pond water visibility was low with the depth of Secchi disk visible at a maximum of 3 feet deep, due to high turbidity and green algae growth.

Surface water temperatures were warm from 23 to almost 25 degrees centigrade. There was relatively little thermal stratification within the upper 10 feet of the waterbody. However, at the deepest location nearest the dam, the bottom temperatures approached 16° C with an evident thermocline from 10 to 13 feet depth.

DO was highest in surface waters and lowest at depth, as would be expected. However, somewhat unexpectedly, DO was not highly correlated with temperature. At the deepest location, relatively high oxygen levels were maintained to a depth of 8 feet. Past this point, there was an abrupt oxygen depletion in the water column, beginning 2 feet higher than the thermocline temperature decline evidenced at 10 feet depth. This suggests a relatively high oxygen demand in lower waters that rose above the level of the temperature stratification. Alternatively, some factor other than temperature may have caused a density stratification above the level of the thermocline. At each of the other shallower locations, significant oxygen depletion was noted at water depths greater than 4 feet without a significant decline in water temperature. This suggests that the influence of the shallow anoxic sediments may be extending oxygen demand into the water column.

Table 2 presents upon the hypsometric data of the volume of the lake at each increment of water depth based upon bathymetric information collected when the surface water elevation was at elevation 154.5 feet above sea level, North American Vertical Datum of 1988 (NAVD88). About 50% of the lake volume is above a depth of 4 ft, with only 20% of the lake volume below a depth of 8 ft. Combining this information with the DO concentrations observed on 9/13/2020, roughly 68% of the pond volume was above 5 mg/l, generally considered a desirable minimal target for the health of fisheries, although in warm water lakes and ponds with sustainable warm water fish populations, concentrations below this level are not uncommon.

Table 1. Watershops Pond Dissolved Oxygen, Temperature, and Secchi Depth Measurements, 09/13/2020

Time of Sampling: 10:00 AM - 2:00 PM

Location: Main Body, Near Dam, East of Steel (private) Bridge 42°05.861 N; 072°33.624 W				Location: Main Body, Central Pond, West of Roosevelt Bridge 42°06.212 N; 072°33.061 W				Location: North Branch Mill River Cove 42°06.606 N; 072°32.509 W				Location: South Branch Mill River Cove, near Pease Cove 42°06.473 N; 072°32.049 W			
	Depth (ft)	DO (mg/l)	Temp °C		Depth (ft)	DO (mg/l)	Temp °C		Depth (ft)	DO (mg/l)	Temp °C		Depth (ft)	DO (mg/l)	Temp °C
Secchi Depth (ft)				Secchi Depth (ft)				Secchi Depth (ft)				Secchi Depth (ft)			
3.0	0	9.0	23.0	3.0	0	8.9	23.6	2.8	0	8.6	23.8	2.0	0	11.9	24.6
	1	8.9	23.5		1	8.7	23.8		1	8.2	23.9		1	11.7	24.6
	2	8.6	22.5		2	8.6	23.8		2	8.1	23.9		2	12.0	24.5
	3	8.5	23.4		3	8.5	23.8		3	7.7	23.8		3	9.7	24.3
	4	8.6	23.4		4	7.1	23.5		4	7.4	23.8		4	9.2	24.1
	5	8.6	23.4		5	2.7	23.4		5	5.5	23.5		5	4.6	23.8
	6	8.0	23.4		6	0.2	22.4		6	1.3	22.5		6	0.5	23.0
	7	8.4	23.3		7	0.1	21.9		7	3.4	21.7		6.5	bottom	
	8	8.2	22.8		8	0.1	21.7		7.5	bottom					
	9	1.4	22.8		9	0.1	21.4								
	10	0.3	22.2		10	0.1	21.0								
	11	0.1	21.7		10.5	bottom									
	12	0.1	20.7												
	13	0.0	19.5												
	14	0.0	16.1												
	15	0.0	16.1												
	16	0.0	16.5												
	17.0	bottom													

Table 2. Hypsometric Distribution of Lake Volume and Dissolved Oxygen by Depth

Depth (ft)	Water column volume by depth interval (CF)	% vol. of water column within depth interval	Cum. % vol. above interval depth	Avg DO (mg/l) (from Table 1)
0-1	7,256,769.20	13.96%	13.96%	9.600
1-2	6,487,711.40	12.48%	26.44%	9.375
2-3	6,099,351.90	11.73%	38.17%	9.325
3-4	5,675,736.80	10.92%	49.09%	8.600
4-5	5,178,393.90	9.96%	59.05%	8.075
5-6	4,469,620.20	8.60%	67.64%	5.350
6-7	3,593,650.40	6.91%	74.56%	2.500
7-8	2,850,450.20	5.48%	80.04%	3.967
8-9	2,321,613.80	4.47%	84.50%	4.150
9-10	1,930,250.40	3.71%	88.22%	0.750
10-11	1,650,247.50	3.17%	91.39%	0.200
11-12	1,412,099.00	2.72%	94.11%	0.100
12-13	1,135,237.40	2.18%	96.29%	0.100
13-14	860,941.90	1.66%	97.95%	0.000
14-15	623,461.00	1.20%	99.15%	0.000
15-16	335,447.70	0.65%	99.79%	0.000
16-17	96,265.60	0.19%	99.98%	0.000
17-18	11,608.40	0.02%	100.00%	
18-19	435.10	0.00%	100.00%	
Total	51,989,291.80			

2.2.2 Aquatic Macrophyte Distribution:

The distribution and abundance of aquatic macrophytes was assessed on September 10, 2020. In general, while some aquatic macrophytes were present throughout all reaches of the pond, there was a strong association with shallow depth, presumably as a result of the low light penetration in the deeper areas. The data are presented in **Table 3 (a – f)** and graphically on **Figure 2** and **Figure 3**. Dense or moderately dense aggregations of macrophytes were observed only in the areas of the pond where depth was less than 4 feet deep, reflecting the 3-foot Secchi Depth and inability of macrophytes to establish significantly below this depth. Therefore, for much of the waterbody and especially westward (downgradient) of Roosevelt Bridge, the macrophytes were limited to the margins of the pond since the pond depths rapidly drop off in these areas. Highest concentrations were observed in the shallower cove areas.

As another general observation, diversity of macrophyte species in this 200± acre waterbody is low, again likely associated with the strong light limitation, in part due to algal growth, and the presence of one highly competitive dominant macrophyte species, Coontail (*Ceratophyllum demersum*). Visible planktonic (non-filamentous) green algae growth was present throughout the pond and clearly associated with the light limitation. In some shallow cove areas, wind driven accumulations formed a surface scum. The dominant macrophyte Coontail is a native species but can be an aggressive grower. When present, Coontail approached densities of 80% within the pond. The growth is apparent on the surface and in the shallow water column, with modified portions of the bottom vegetation lightly attaching in the sediments. Coontail is capable is extending growth to depths exceeding 12 feet, so their limited shallow distribution would seem to be associated with the light limitation, resulting from competition with the water column growth of green algae. Filamentous green algae was also present as floating scum, often attached to the surface-floating portions of Coontail. It was also present as a mat on the bottom sediments and sometimes as a vacuolated floating scum independent of the Coontail.

Other species observed included Duckweed (*Lemna minor*) and Watermeal (*Wolffia* sp.). Occasional patches of White Water Lily (*Nymphaea odorata*) and Spadderdock (*Nuphar sp.*) were scattered along the pond margins. Dense expanses of Spadderdock are located in the shallow areas at the western extreme of Dan Baker Cove where the South Branch of the Mill River enters the basin. There are also dense stands of cattail along the margins of the pond in this area. Waterweed was occasionally abundant along the southern margin of the main waterbody and in areas of Dan Baker Cove. One species of Pond Weed (*Potomogeton diversifolious*) and Najas (N*ajas marina*) were observed in small numbers.

2.2.3 Aquatic Habitat Observations:

Watershops Pond, as a 200± acre waterbody in an urban setting, provides an important local wildlife habitat area, and acts as one part of an archipelago of urban wildlife "oases" largely formed by the public parks located throughout the city limits. Despite the urban setting, the pond is surrounded mostly by wooded vegetation often on public or private lands or otherwise somewhat densely-wooded private residential properties. The steep slopes, mostly on the south side of the pond, are largely undeveloped and densely wooded and a larger woodland exists on the west side of the cove where the South Branch of the Mill River enters the basin. There is a narrow band of emergent vegetation along many areas of the shoreline. **Table 4** lists the dominant shoreline vegetation observed, and **Figure 3** depicts the location of the habitat zones along the perimeter of the pond, divided into "Dominant Tree & Shrub Zone" and "Dominant Shrub Vegetation". These highly-vegetated margins of the pond provide an important buffer from the urban development surrounding the waterbody, allowing for filtration of overland stormwater runoff and giving a refuge for urban-associated wildlife, as well as nesting habitat and food sources for bird and mammal species. Unlabeled margins of the pond are developed as residential, institutional (Springfield College), and/or commercial areas without significant habitat value.

Within the pond basin, the aquatic habitat is characterized as having a relatively steep drop off in bathymetry along most of the shoreline, with shallower habitat present in the cove areas where the South and North Branches of the Mill River enter the basin. At the western portion of Dan Baker Cove, where the South Branch enters the pond, there are extensive deltaic shallows with abundant floating leaved vegetation that are used by carp as basking and nesting areas based upon direct observation.

There are many significant tree falls with major trunks and limbs extending into the pond basin that provide important fisheries/aquatic habitat. The approximate locations of some of the more significant of these features are shown on **Figure 3**.

Wildlife observed on September 10 and 11 during the DO and aquatic macrophyte surveys included Common Cormorant (several), Mallard Duck (few), Wood Duck (few), Great Blue Heron (several), Canada Geese (many) and Painted Turtle

(many). Fish distribution was not sampled; however, many 2-foot-long carp in the Dan Baker Cove shallows were incidentally observed.

Table 3a. Aquatic Macrophyte Distribution and Abundance in Watershops Pond, 09/11/2020

Location			Estimated Percent Composition by Station and Vegetative Strata										Notes
Station#	Sample Strata	Overall Plant Percent Abundance	Coontail (*Ceratophyllum demersum*)	FGA Filamentous Green Algae	Watermeal (Wolffia sp.)	Duckweed (Lemna minor)	White Water Lily (Nym-	Spatterdock (Nuphar sp.)	Waterweed (Elodea cana- densis)	Pond weed (Potomogeton diversifolious)	Najas (Najas marina)	Green algal scum (non-fil- amentous)	
1	EM	0											FGA attached to Coontail
	FL	0-100			10							0-100	
	SU	80	80	25									
	BO	50	50	50									
2	EM	0											
	FL	50		20								30	
	SU	0											
	BO	50		50									
3	EM	0											
	FL	25			0-50	0-10							
	SU	5	0-10	0-10									
	BO	5	0-10	0-10									
4	EM	0											
	FL	25			0-50	10							Shoreline fringe veg- etation only
	SU	5	0-10	0-10									
	BO	5	0-10	0-10									
5	EM	0											
	FL	10			0-50	0-10							20' margin only
	SU	30	50	0-50									
	BO	20	20	20									
6	EM	0											
	FL	T			0-5	T						T	Fringe GA scum
	SU	15	10-30	0-50									
	BO	10	5-20	5-20									
7	EM	0											
	FL	0					5						
	SU	10-30	10-30										
	BO	5-15											

T = Trace. Strata: EM =emergent; FL =floating; SU =Submerged; BO =Bottom

Table 3b. Aquatic Macrophyte Distribution and Abundance in Watershops Pond, 09/11/2020

Location			Estimated Percent Composition by Station and Vegetative Strata										Notes
Station#	Sample Strata	Overall Plant Percent Abundance	Coontail (*Ceratophyllum demersum*)	FGA Filamentous Green Algae	Watermeal (Wolffia sp.)	Duckweed (Lemna minor)	White Water Lily (Nym-	Spatterdock (Nuphar sp.)	Waterweed (Elodea cana-densis)	Pond weed (Potomo-geton diversifolious)	Najas (Najas marina)	Green algal scum (non-fil-amentous)	
8	EM	0											
	FL	0			0-5								
	SU	0-10	0-10	5									
	BO	0-5	0-5	5									
9	EM												Steep drop off. Nar-row fringe only.
	FL											T	
	SU	0-5	0-5	T	T								
	BO	0-5		T									
10	EM												Steep drop off. Nar-row fringe only.
	FL												
	SU	0-10	0-10	T	T							T	
	BO	0-5		T									
11	EM	0											Steep drop off
	FL	0		T	T	T						T	
	SU	10-30	0-30										
	BO	5-15	0-15										
12	EM	0											Steep drop off
	FL	T					0-10					T	
	SU	20-40	20-40	20									
	BO	10-50	10-20	0-50									
13	EM	0											Steep drop off
	FL	0			T							T	
	SU	0-5	0-5	T									
	BO	0-5		0-5									
14	EM	0											Steep drop off
	FL	0		T	T	T						T	
	SU	0-5	T	T									
	BO	0.5											

T = Trace. Strata: EM =emergent; FL =floating; SU =Submerged; BO =Bottom

Table 3c. Aquatic Macrophyte Distribution and Abundance in Watershops Pond, 09/11/2020

Location		Overall Plant Percent Abundance	Estimated Percent Composition by Station and Vegetative Strata										Notes
Station#	Sample Strata		Coontail (*Ceratophyllum demersum*)	FGA Filamentous Green Algae	Watermeal (Wolffia sp.)	Duckweed (Lemna minor)	White Water Lily (Nym-	Spatterdock (Nuphar sp.)	Waterweed (Elodea cana-densis)	Pond weed (Potomo-geton diversifolious)	Najas (Najas marina)	Green algal scum (non-fil-amentous)	
15	EM	0											Steep drop off. Nar-row fringe only.
	FL	0			T							T	
	SU	0-20	0-20	0-20							T		
	BO	0-10	0-10	0-10									
16	EM	0											Steep drop off. Nar-row fringe only.
	FL	0			T	T						T	
	SU	40	0-80	T					T				
	BO	20	0-40										
17	EM	0											Steep drop off. Nar-row fringe only.
	FL	0											
	SU	50	50						50				
	BO	20	20						20				
18	EM	0											Steep drop off. Nar-row fringe only.
	FL	0											
	SU	50	50						50				
	BO	20	20						20				
19	EM	0											Steep drop off. Nar-row fringe only.
	FL	0											
	SU	50	50						50				
	BO	20	20						20				
20	EM	0											Steep drop off. Nar-row fringe only.
	FL	0		T	T	T						T	
	SU	20	20	T					T				
	BO	10	10	5					T				
21	EM	0											
	FL	T		T	T							T	
	SU	20	10-50	T					T				
	BO	10	5-15	5									

T = Trace. Strata: EM =emergent; FL =floating; SU =Submerged; BO =Bottom

Table 3d. Aquatic Macrophyte Distribution and Abundance in Watershops Pond, 09/11/2020

Location		Overall Plant Percent Abundance	Estimated Percent Composition by Station and Vegetative Strata										Notes
Station#	Sample Strata		Coontail (*Ceratophyllum demersum*)	FGA Filamentous Green Algae	Watermeal (Wolffia sp.)	Duckweed (Lemna minor)	White Water Lily (Nym-	Spatterdock (Nuphar sp.)	Waterweed (Elodea canadensis)	Pond weed (Potomogeton diversifolious)	Najas (Najas marina)	Green algal scum (non-filamentous)	
22	EM	0											
	FL	10			T	T						10	
	SU	5-20	5-20	T									
	BO	5-10	5-10	T									
23	EM	0											
	FL	0											
	SU	0-10	0-10										
	BO	0-10	0-10	T									
24	EM	0											
	FL	10										10	
	SU	10-20	10-20	10									
	BO	10-20	10-20	10									
25	EM	0											
	FL	5-10			5-10	5-10							
	SU	10-30	10-30	10									
	BO	50	50	20									
26	EM	0											
	FL	20-30			20-30	20-30							
	SU	20-30	20-30	15									
	BO	10-20	10-20	10									
27	EM	0											
	FL	100			25	25		100					
	SU	25	5	25									
	BO	10	5	10									
28	EM	0											
	FL	100			25	25		100					
	SU	25	25	10									
	BO	20	15	20									

T = Trace. Strata: EM =emergent; FL =floating; SU =Submerged; BO =Bottom

Table 3e. Aquatic Macrophyte Distribution and Abundance in Watershops Pond, 09/11/2020

Location		Overall Plant Percent Abundance	Estimated Percent Composition by Station and Vegetative Strata										Notes
Station#	Sample Strata		Coontail (*Ceratophyllum demersum*)	FGA Filamentous Green Algae	Watermeal (Wolffia sp.)	Duckweed (Lemna minor)	White Water Lily (Nym-	Spatterdock (Nuphar sp.)	Waterweed (Elodea canadensis)	Pond weed (Potomogeton diversifolious)	Najas (Najas marina)	Green algal scum (non-filamentous)	
29	EM	0											
	FL	20	5	20	20								
	SU	50	25	25									
	BO	25		25									
30	EM	0											
	FL	5-100			5-100	5-100							
	SU	0											
	BO	50		50									
31	EM												
	FL	T			T	T						T	
	SU	5	5-10										
	BO	5	5-10	5									
32	EM												
	FL	10-100			10-100	10-100							
	SU	25	25	25									
	BO	20	20	20									
33	EM												
	FL	T			T	T						T	
	SU	5	5-10										
	BO	5	5-10	5									
34	EM												
	FL	T			T	T						T	
	SU	5	5-10										
	BO	5	5-10	5									
35	EM												
	FL	10-100			10-100	10-100							
	SU	25	25	25									
	BO	20	20	20									

T = Trace. Strata: EM =emergent; FL =floating; SU =Submerged; BO =Bottom

Table 3f. Aquatic Macrophyte Distribution and Abundance in Watershops Pond, 09/11/2020

Location		Overall Plant Percent Abundance	Estimated Percent Composition by Station and Vegetative Strata										Notes
Station#	Sample Strata		Coontail (*Ceratophyllum demersum*)	FGA Filamentous Green Algae	Watermeal (Wolffia sp.)	Duckweed (Lemna minor)	White Water Lily (Nymphaea oderata)	Spatterdock (Nuphar sp.)	Waterweed (Elodea canadensis)	Pond weed (Potomogeton diversifolious)	Najas (Najas marina)	Green algal scum (non-filamentous)	
36	EM												
	FL	T			T	T						T	
	SU	0-5	0-15	T					T				
	BO	0-5	0-5	0-5									
37	EM	21											
	FL	T			T	T						T	
	SU	5	5-10										
	BO	5	5-10	5									
38	EM												
	FL	T			T	T						T	
	SU	5	5-10										
	BO	5	5-10	5									
39	EM												
	FL												
	SU	10	10	10						5	T		
	BO		5										
40	EM												
	FL												
	SU	10	10	10						5	T		
	BO		5										

T = Trace. Strata: EM =emergent; FL =floating; SU =Submerged; BO =Bottom

Table 4. Dominant Shoreline Vegetation

Growth type	Species Name	Common Name
Emergent Shoreline		
Herbaceous	**Iris pseudacorus*	Yellow Flag Iris
	**Lythrum salicaria*	Purple Loosestrife
	Persicaria maculosa	Smartweed
	Pontedaria cordata	Pickerel Weed
	Sagittaria latifolia	Arrowhead
	Scirpus atrovirens	Giant Bulrush
	Sparganium americanum	American Bur-reed
	Typha latifolia	Common Cattail
Terrestrial Immediate Shoreline		
Herbaceous	**Fallopia japonica*	Japanese Knotwood
	Impatiens capensis	Jewell weed
	Onoclea sensibiliis	Sensitive Fern
	Persicaria maculosa	Smartweed
Shrubs	*Alnus rugosa*	Speckled Alder
	Cephalanthus occidentalis	Buttonbush
	Cornus ammomum	Silky Dogwood
	Cornus alba	Red osier dogwood
Trees	*Acer rubrum*	Red Maple
	Acer saccharinum	Silver Maple
	**Ailanthus altissima*	Tree of Heaven
	Betula paperyfera	Grey Birch
	Carya ovata	Shagbark Hickory
	Catalpa bignonioides	Catalpa
	**Gleditsia triacanthos*	Honey Locust
	Quercus alba	White Oak
	Quercus palustris	Pin Oak
	Quercus rubra	Red Oak
	Rhus typhina	Staghorn Sumac
	Robinia pseudoacacia	Black Locust
	Salix babylonica	Weeping Willow
	Salix nigra	Black Willow
	Ulmus americana	American Elm
Lianas	**Celastrus orbiculatus*	Oriental Bittersweet
	Toxicodendron radicans	Poison Ivy
	Vitis aestivalis	Summer Grape
	Vitis labrusca	Fox Grape
	Vitis riparia	Riverbank Grape

**invasive*

3.0 PRE-DRAWDOWN WETLAND MONITORING

GZA completed a Pre-drawdown wetland monitoring survey at three discrete BVW locations around Watershops Pond in late September 2020. The survey objective was to collect baseline data about the BVW areas including species composition and diversity, general habitat type, and relative cover of dominant species. Observations of groundwater hydrology were also recorded by measuring the depth to standing water within observation holes from the ground surface.

The Plan includes the collection of data prior to the drawdown activities, during the drawdown, and post-drawdown to determine what effects may have occurred within the BVW including changes in species composition and density. The presence of invasive plant species are assessed at each of the monitoring stations.

The Plan (**Appendix 1**) specified monitoring of fringing wetland in locations (**Figure 5**) where wetlands were previously documented. The three locations are:

1. Springfield College, Main Campus
2. Springfield College – East Campus
3. Gunnery Sergeant Thomas J. Sullivan Park

3.1 METHODOLOGY

At each of the three wetland locations, a GZA wetland scientist delineated the boundary of the landward edge of the bordering vegetated wetland (BVW) by placing sequentially-labeled survey flagging on vegetation to demarcate the BVW boundary. The wetland flags were GPS located for documentation of the wetland limits in future surveys. The BVW extends landward from the edge of Bank resource, and the top of the Bank is a well-defined area due to the outlet control maintaining a consistent water elevation; therefore, a separate delineation of the Bank was not performed. The well-defined water level helps to differentiate the limits of the wetland resource types at each of the three locations. The Bank or top of ordinary high water is coincident with the mean annual high water (MAHW) line at Watershops Pond. Flagging of the BVW boundary was completed but because the Bank is more clearly defined by the edge of water, it was considered unnecessary to place separate flagging for the Bank which was GPS located and shown on the enclosed figures.

3.1.1 Monitoring Stations

Two to three monitoring stations were established along a transect that is aligned to be perpendicular to delineation with the intention of identifying potential gradient effects on wetland hydrology from the temporary pond drawdown. GZA hand-augured 2-inch diameter observation holes to a depth that exposed the groundwater. The data collected at the observation holes provides a baseline of the supporting hydrology within the wetland. The use of established monitoring wells was not implemented as the soils are sandy and relatively free of hydraulic restriction. Therefore, any free water in the soil stratum easily migrates to the open observation hole allowing for an accurate measure of the apparent groundwater level at the time of the observations. A new observation hole will be developed at each station at each of the monitoring periods.

The Plan described transects being established through the wetlands to document the potential hydraulic gradient within the wetland in a pre-drawdown condition. Based upon the lateral extent of the wetlands observed at Locations 2 and 3, transects with 2 to 3 stations were able to be established. Location 1 was too narrow and a multiple-station transect would not have provided more data than a single station.

The vegetation at each of these monitoring stations was inventoried to species level. The monitoring stations were flagged in the field and GPS-located to support consistent data gathering at subsequent surveys.

In September 2020, two GZA wetland scientists visited the three survey locations described above to complete a pre-drawdown wetland survey. The wetlands were delineated using criteria that is consistent with the 1995 Massachusetts Department of Environmental Protection (MassDEP) Handbook titled, *Delineating Bordering Vegetated Wetlands Under the Massachusetts Wetland Protection Act*. The delineation methodology was also consistent with the 2012 Regional Supplement to the 1987 Army Corps of Engineers Wetland Delineation Manual. The boundaries of each BVW were geo-located by sub-meter GPS and are depicted on **Figures 5 - 7**. In addition to delineating the wetland boundary, the Bank and MAHW were observed and mapped based on site conditions and aerial interpretation in accordance 310 CMR 10.54(2) and 10.58(2).

The wetland vegetation was inventoried at each sample location using the stratum definitions and survey plot sizes as described by the U.S. Army Corps of Engineers for wetland determination. Representative photographs of each sample location are included in **Appendix 2.**

3.2 RESULTS

3.2.1 Location 1: "Springfield College BVW"

The BVW adjacent to Springfield College was delineated to be approximately 80-square feet (SF) and is located on a small projection of land into the Pond as mapped in **Figure 5**. Given the small size of the wetland, one monitoring station was established. The Bank on the Pond side of the Springfield College BVW was a near-vertical feature, indicating that the Pond level rises and falls without changing its surface area near this wetland. Due to this configuration, only the MAHW was mapped.

Based on the hand boring, the depth to groundwater in Springfield College BVW was approximately 12 inches deep. This coincides with the height of the ground surface above the Pond water surface. Given this and the size of the wetland, it is likely that the Pond controls the wetland hydrology and water table. Wetland vegetation was evaluated within the small wetland and along the water's edge for the larger survey plots. The dominant species by strata are summarized in **Table 5**.

Table 5: Summary of Dominant Vegetation at Springfield College BVW

Stratum	Dominant Vegetation
Tree	Red maple *(Acer rubrum)*
Shrub/Sapling	Staghorn sumac *(Rhus typhina)*, Black locust *(Robinia pseudo-acacia)*
Herb	Wild mint *(Mentha arvensis),* Virginia Creeper *(Parthenocissus quinquefolia)*
Woody Vines	Grape *(Vitis spp.)*

The Springfield College BVW is a narrow strip of scrub/shrub vegetation along the Pond edge up to the BVW boundary and transitioning abruptly to the adjacent upland to the north.

3.2.2 Location 2: "Springfield College – East Campus BVW"

The Springfield College – East Campus BVW is located near Garvey Promontory at the confluence of the North Branch and Dan Baker Cove portions of Watershops Pond, as mapped in **Figure 6.** This wetland was delineated to be approximately 4,000 square feet (SF) in area. Similar to the Springfield College BVW, the Bank in this area was nearly vertical, so only the MAHW was mapped. Two monitoring stations were established in this East Campus BVW. The wetland contains two distinct wetland communities based on vegetation assemblage which are summarized below in **Table 6**.

Monitoring Station 1 is located within a lower elevation wetland which supports largely emergent vegetation. The depth to groundwater in this portion of the wetland was three (3) inches below ground and the soils were observed to be a saturated mucky-mineral material. On the north side of the wetland, there was a low point in the Bank which appears to facilitate surface inundation into the BVW during periods of high water.

Monitoring Station 2 is located in a shrub-dominated wetland which is higher in surface elevation compared to Monitoring Station 1. The surface level in this portion of the wetland was approximately five (5) inches above Monitoring Station 1. This was directly reflected in the depth to water which was observed at eight (8) inches below ground surface. The evidence of hydrology within the top 12 inches of the soil clearly qualifies the area as a regulated wetland.

Table 6: Summary of Dominant Vegetation at the East Campus BVW

Stratum	Dominant Vegetation Monitoring Station 1	Dominant Vegetation Monitoring Station 2
Tree	Red maple, Gray birch *(Betula populifoila)*	Red maple
Shrub/Sapling	Highbush blueberry *(Vaccinium corymbosum),* Winterberry Holly *(Ilex verticillata)*	Highbush blueberry, Winterberry holly
Herb	Clearweed *(Pilea pumila),* Barberpole Sedge *(Scirpus rubrotinctus)*	Shallow sedge *(Carex lurida),* Tussock sedge *(Carex stricta),* Spinulose wood fern *(Drypoteris carthusiana),* Pennsylvania sedge *(Carex Pensylvanica),* Swamp azalea *(Rhododendron viscuosum)*
Woody Vines	None	None

The Springfield College – East Campus BVW is connected to Watershops Pond by surface hydrology; however, its geomorphic position is within a lower landscape at the toe of a slope, so the wetland also receives surface runoff from the surrounding area.

3.2.3 Location 3: "GYSGT J. Sullivan Park BVW"

The Gunnery Sergeant J. Sullivan Park BVW is a large wetland complex located along the southern side of Dan Baker Cove as mapped in **Figure 7**. Approximately 150 linear feet of the BVW boundary was delineated as a reference location for this study. The Bank in this area is sufficiently wide that monitoring stations are located along the MAWH and within the Bank.

GZA mapped the Bank features based on GPS-data and aerial interpretation as portions of the Bank were not safely accessible from land. Three monitoring stations were established along a perpendicular transect from the upland toward the water's edge. The dominant vegetation at the three monitoring stations is summarized in **Table 7**.

3.2.3.1 Groundwater Observations

Monitoring Station 1 is located between the BVW boundary and the Bank/MAHW. The depth to groundwater was observed to be six (6) inches below the ground surface. The ground surface was approximately ten (10) inches above the observed Pond surface water. Monitoring Station 1 is a relatively drier portion of the wetland due to a higher surface elevation compared with the other monitoring stations at GYSGT J. Sullivan Park BVW.

Monitoring Station 2 is located near the Bank/MAHW. At the time of the survey, there was approximately 0.5 inches of surface water present at this station. The area supported mainly emergent vegetation and appears to be commonly inundated. The ground surface was consolidated, and the soils appeared to have a high organic component and a mucky texture. Depth to groundwater was not measured, as this station was inundated with water that was observed to be above the ground surface.

Monitoring Station 3 is located within the emergent vegetation; however, the water level at this location may indicate that this station is likely to be within the extent of Bank that is contained between the high water and low water levels of the Pond. At the time of the survey event, there was approximately six (6) inches of surface water present at this station. The area supported emergent and aquatic vegetation and appears to be commonly inundated. The ground surface appeared to be principally made of cattail rhizomes with minimal soil development. Rather, the inundated nature of this area results in a highly organic substrate with a mucky soil texture. Depth to groundwater was not measured due to the level of inundation at this station.

Table 7: Summary of Dominant Vegetation at the GYSGT J. Sullivan Park BVW

Stratum	Dominant Vegetation Monitoring Station 1	Dominant Vegetation Monitoring Station 2	Dominant Vegetation Monitoring Station 3
Tree	None	None	None
Shrub/Sapling	Speckled alder *(Alnus incana)*	Speckled alder, Black elderberry *(Sambucus nigra)*	None
Herb	Fringed sedge *(Carex crinita),* Clearweed, Jewelweed *(Impatiens capensis)*, Silky dogwood *(Cornus amomum)*	Clearweed, Common reed *(Phragmites australis),* Broadleaf cattail *(Typha latifolia)*	Broadleaf cattail, Common duckweed *(Lemna minor)*
Woody Vines	None	None	None

3.3 SUMMARY

The observations made at each of the monitoring stations within the three different wetlands indicate a healthy wetland ecosystem at each monitoring station. The plant density was high and signs of stress or mortality were not readily observed. The wetland sizes and observed depths to water are summarized in **Table 8**.

Table 8: Summary of Observed Depths to Groundwater, September 2020

Depth to Groundwater	Springfield College	Springfield College East Campus	GYSGT J. Sullivan Park
Monitoring Station 1	-12 inches	-3 inches	-6 inches
Monitoring Station 2	NA	-8 inches	+0.5 inches
Monitoring Station 3	NA	NA	+6 inches

NOTE: Negative values represent groundwater below ground surface and positive values represent water above the ground surface.

Additional monitoring events will occur during the drawdown period and following the completion of the resiliency improvements and refilling of the Pond. It is anticipated that during the drawdown period, the BVWs will be hydraulically supported by rainwater and runoff from the adjacent land; however, we anticipate that the BVWs will appear drier and the depth to groundwater is expected to temporarily increase. The potential change to the supporting hydrology may result in a temporal shift in the vegetative community, but the potential change would be limited to the drawdown time frame and upon refilling of the pond, the establishing vegetation is expected to die back due to inundation.

Following the completion of work and refilling of the Pond, the observed wetland systems are anticipated to return to their pre-drawdown conditions. If more upland plant species invaded during the drawdown period, they will likely be outcompeted once the water level returns. Should the upland species persist following the completion of the drawdown and refilling of the Pond, this document will provide baseline data for potential restoration efforts.

Table 9: Vegetation Abundance in Surveyed BVW, September 2020

Common Name	*Scientific Name*	*Wetland Indicator Status*	Springfield College	Springfield College - East Campus		GYSGT J. Sullivan Park		
			Monitoring Station 1	Monitoring Station 1	Monitoring Station 2	Monitoring Station 1	Monitoring Station 2	Monitoring Station 3
Tree Stratum (2,800 SF Survey Area) *["*" indicates invasive plant species]*								
Red Maple	*Acer rubrum*	*FAC*	30%	60%	90%			
Gray Birch	*Betula populifolia*	*FAC*		40%	5%			
Red Oak	*Quercus rubra*	*FACU*			2%			

Common Name	*Scientific Name*	*Wetland Indicator Status*	Springfield College	Springfield College - East Campus		GYSGT J. Sullivan Park		
			Monitoring Station 1	Monitoring Station 1	Monitoring Station 2	Monitoring Station 1	Monitoring Station 2	Monitoring Station 3
Shrub/Sapling Stratum (800 SF Survey Area) *["*" indicates invasive plant species]*								
Staghorn Sumac	*Rhus typhina*	*NI*	30%					
Black Locust	*Robinia pseudoacacia*	*FACU*	30%					
Multiflora Rose*	*Rosa multiflora*	*FACU*	10%					
Black Elderberry	*Sambucus nigra*	*FACW*	10%			5%	10%	
Black Cherry	*Prunus serotina*	*FACU*	5%					
Purple Loosestrife*	*Lythrum salicaria*	*OBL*	5%					
Highbush Blueberry	*Vaccinium corymbosum*	*FACW*		20%	30%			
Winterberry Holly	*Ilex verticillata*	*FACW*		10%	30%			
Glossy Buckthorn*	*Frangula alnus*	*FAC*		5%				
Speckled Alder	*Alnus incana*	*FACW*				70%	10%	
Gray Birch	*Betula populifolia*	*FAC*				10%		
Silver Maple	*Acer saccharinum*	*FACW*				5%		
Herb Stratum (80 SF Survey Area)								
Wild Mint	*Mentha arvensis*	*FACW*	55%					
Virginia Creeper	*Parthenocissus quinquefolia*	*FACU*	40%					
Fleabane Daisy	*Erigeron annuus*	*FACU*	trace					
Shallow Sedge	*Carex lurida*	*OBL*		5%				
Tussock sedge	*Carex stricta*	*OBL*		5%	5%			
Glossy Buckthorn*	*Frangula alnus*	*FAC*		2%	5%			
Arrowwood	*Viburnum dentatum*	*FAC*		2%				
Clearweed	*Pilea pumila*	*FACW*		15%		10%	30%	trace
Red Oak	*Quercus rubra*	*FACU*		1%				
Barberpole Sedge	*Scirpus rubrotinctus*	*OBL*		15%				
Iris	*Iris spp.*	*OBL*		2%				
Skunk Cabbage	*Symplocarpus foetidus*	*OBL*		trace				
Spinulose Wood Fern	*Drypoteris carthusiana*	*FACW*			5%	5%		
Pennsylvania Sedge	*Carex Pensylvanica*	*NI*			5%			
Swamp Azalea	*Rhododendron viscosum*	*FACW*			5%			
Jewelweed	*Impatiens capensis*	*FACW*				10%		
Silky Dogwood	*Cornus amomum*	*FACW*				10%		
Blackberry	*Rhubus spp.*					2%		
Common Reed	*Phragmites australis*	*FACW*				trace	30%	

Common Name	*Scientific Name*	*Wetland Indicator Status*	Springfield College	Springfield College - East Campus		GYSGT J. Sullivan Park		
			Monitoring Station 1	Monitoring Station 1	Monitoring Station 2	Monitoring Station 1	Monitoring Station 2	Monitoring Station 3
Herb Stratum (80 SF Survey Area) *[continued]* *["*" indicates invasive plant species]*								
Sensitive Fern	*Onoclea sensibilis*	*FACW*				5%	10%	
Purple Loosestrife*	*Lythrum salicaria*	*OBL*					10%	
Arrowleaf Tear-thumb	*Persicaria sagittata*	*OBL*					5%	
Fringed Sedge	*Carex crinita*	*OBL*				15%	5%	
Broadleaf Cattail	*Typha latifolia*	*OBL*					20%	95%
Arrow Arum	*Peltandra virginica*	*OBL*					3%	
Black Nightshade	*Solanum nigrum*	*NI*					3%	
American Bur-reed	*Sparganium ameri-canum*	*OBL*					3%	
Swamp Beggar's Tick	*Bidens discoidea*	*FACW*					trace	2%
Common Duck-weed	*Lemna minor*	*OBL*						85%
Woody Vines (2,800 SF Survey Area) *["*" indicates invasive plant species]*								
Grape	*Vitis spp.*		20%					

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RESILIENCY IMPROVEMENTS AT WATERSHOPS POND DAM
DRAWDOWN PERIOD MONITORING REPORT #1

DECEMBER 15, 2020

For Compliance with:

Order of Conditions, DEP File No. 294-0607, issued 09/17/2020

Section 401 Water Quality Certification, BRP WW 08, DEP Transmittal No. X286704, issued 07/23/2021

Section 404 Permit, File No. NAE-2020-02301, issued 10/21/2020

Certificate on the SEIR, Secretary of Energy and Environmental Affairs, EOEEA No. 16234, issued 07/31/2020

Prepared by: Paul G. Davis, PhD, Adrienne Dunk
Reviewed by: Tom Jenkins, P.E.

INTRODUCTION AND METHODOLOGY

In compliance with authorized procedures approved under the above-referenced permits and authorizations, GZA is monitoring dissolved oxygen levels, temperature, and transparency during the period of drawdown associated with the Resiliency Improvements at Watershops Pond Dam Project. This report presents the results of the first monitoring event conducted during the period of drawdown, which commenced with the opening of the low-level outlets at the dam on October 26, 2020. During the winter drawdown period, dissolved oxygen monitoring will occur at a frequency of once every 2 months. From March through October, during the growing season, monitoring will occur monthly.

Ecological resource monitoring was initially identified as a means to gauge the environmental impacts associated with a partial or full drawdown of Watershops Pond that may occur during the Project. The monitoring was discussed conceptually in the Alternatives Analysis included in the Expanded Environmental Notification Form (EENF) for the Project (EOEEA No. 16234, EENF dated June 15,2020). On July 31, 2020, the Secretary of Energy and Environmental Affairs issued her Certificate on the EENF requiring the preparation of a Single Environmental Impact Report (SEIR). In response to comments received on the EENF and in response to the Secretary's Certificate on the EENF, a detailed draft "Aquatic and Wetland Resource Monitoring and Mitigation Plan"; the "Plan") was developed in coordination with regulatory agencies and was submitted as an integral mitigation commitment detailed within the SEIR dated August 28, 2020. The Plan was referenced in the Secretary's Certificate on the SEIR (October 16, 2020) and became a mitigation requirement associated with the City of Springfield's Preferred Alternative of full pond drawdown during the Project. The basic elements of the Plan were developed based upon prior studies of the pond and consultations with the Springfield Conservation Commission and State and Federal regulatory officials.

A copy of the Plan was provided in **Appendix 1**. to the "Pre-Drawdown Ecological Monitoring Report," GZA, September 2020.

Monitoring was conducted on December 15, 2020, per the methodology presented in the "Pre-Drawdown Ecological Monitoring Report." Monitoring occurred within the drawdown residual pool at two representative locations, one of which approximately replicated the pre-drawdown location within this area. Vertical profiles were conducted at the two locations, and Dissolved Oxygen (DO) and Temperature (°C) were measured at one-foot depth intervals. Secchi disk depth and GPS location were recorded at each site.

GZA assessed DO at two locations within the residual pool basin; the westerly sampling location is located about 900 feet west of the railroad bridge, and the easterly location is located about 500 feet east of the railroad bridge. These locations were shifted slightly based on observed field conditions to find locations with maximum local depth for profiling DO. The westerly location was shifted slightly to the west from what was proposed in the Plan (GZA, August 28, 2020). The easterly location was also moved from the sampling location proposed in the Plan based on a review of field conditions. The residual pool was shallower than anticipated and had a fairly uniform depth of only 1.5 to 2.0± feet in the area of the originally-proposed easterly point. Pool depth was measured in multiple locations between the original easterly Plan location and the eastern portions of the residual pool, searching for a deeper area of the residual pool which would provide a more robust profile for future monitoring during the drawdown period. Ultimately, a new easterly monitoring location was selected because it was deeper than other locations, with a total observed water depth of approximately 2.2 feet. The modified locations are depicted on **Figure 1** and will be used for future monitoring events.

RESULTS

The Watershops Pond residual pool encompasses about 17 acres upgradient of the dam where the water exits the pond basin through the dam's low-level sluice gates. The maximum pool depth is slightly over 4 feet, with most of the pool area less than 2 feet deep. The height of the pool was determined by measuring the surface water elevation below the deck of the privately-owned steel bridge located approximately 200 feet upstream of the dam. The measured surface water elevation was at Elevation 140.70 feet± on the date of sampling (NAVD88 vertical datum).

The water within the pool basin was uniformly turbid based upon a Secchi Disk depth recorded at 1.0 feet. Dissolved oxygen levels were relatively high and uniform throughout the shallow water column. DO exceeded 12.0 mg/l, with a water temperature of just above 2° C (**Table 1**).

Photo 1: View to West from boat launch (Springfield College). Bridge shown is the unused "railroad bridge."

Photo 2: View to East from the boat launch.

Table 1. Watershops Pond Drawdown Pool Dissolved Oxygen, Temperature, and Secchi Depth Measurements
Date of Data Collection: 12/15/2020 10:00AM – 12:00 PM

Location: Main Body, Near Dam, East of Steel (private) Bridge; 42°05.861 N; 072°33.624 W				Location: Main Body, Central Pond, East of Railroad Bridge; 42°05.940 N; 072°33.345 W			
Secchi Depth (ft)	Depth (ft)	DO (mg/l)	Temp °C	Secchi Depth (ft)	Depth (ft)	DO (mg/l)	Temp °C
1.0	0	12.9	2.3	1.0	0	12.6	2.0
	1	12.9	2.3		1	12.5	2.2
	2	12.7	2.3		2	12.0	2.3
	3	12.5	2.3		2.2 - bottom	12.0	2.3
	4.0 - bottom	12.1	2.1				

The average DO concentration at each depth range of the water column is shown in Table 2. Because the DO concentration changed very little over depth, the entire water column was above 12 mg/l.

Table 2. Hypsometric Distribution of Lake Volume and Dissolved Oxygen by Depth

Depth (ft)	Acres Encompassed by Contour Depth	Water column volume by depth interval (CF)	% vol. of water column within depth interval	Cum. % vol. above interval depth	Average DO (mg/l) (from Table 1)
0-1	17.2	623,461.0	58.4	58.4	12.75
1-2	11.6	335,447.7	31.4	89.8	12.70
2-3	4.3	96,265.6	9.0	98.8	12.35
3-4	0.63	11,608.4	1.1	99.9	12.25
4-5	0.01	435.1	0.04	100	12.10
Total		1,067,217.8			
Water elevation at time of monitoring: 140.70 ft					

DISCUSSION

The Plan suggested the action level for DO should be 5 mg/l for at least 75% of the surface waters in the residual pool. During the December 2020 monitoring event, this standard was readily met, as the average DO concentration exceeded 12 mg/l at all contour elevations. This is an unsurprising result during the non-growing season with low water column temperatures.

During the growing season, it is likely that DO levels will markedly decrease. Based upon the average DO concentration observed at the end of the 2020 growing season in late September, there might be reason to reconsider this action level. The average DO concentration observed in late September under normal pond conditions indicated approximately 67% of the pond volume met the suggested minimum DO of 5 mg/l. This indicates that the Watershops Pond biota likely experience lower average DO concentrations across a large percentage of the basin on a normal basis, especially since the September sampling event represented less extreme conditions than those likely to be encountered during peak summer months. While no change of the standard is recommended at this time, the action level to trigger mitigation measures such as aeration may want to be reconsidered as the 2021 growing season progresses. Nevertheless, with about 90% of the residual pool basin less than 2 feet deep, shallow adequate DO levels may persist due to wind perturbation of the pool

surface. GZA will continue to monitor the pond conditions and initiate discussions should the DO not meet the attainment standards provided in the Plan.

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RESILIENCY IMPROVEMENTS AT WATERSHOPS POND DAM
DRAWDOWN PERIOD MONITORING REPORT #2

FEBRUARY 23, 2021

For Compliance with:

Order of Conditions, DEP File No. 294-0607, issued 09/17/2020

Section 401 Water Quality Certification, BRP WW 08, DEP Transmittal No. X286704, issued 07/23/2021

Section 404 Permit, File No. NAE-2020-02301, issued 10/21/2020

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Prepared by: Paul G. Davis, PhD, Adrienne Dunk
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INTRODUCTION AND METHODOLOGY

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Ecological resource monitoring was initially identified as a means to gauge the environmental impacts associated with a partial or full drawdown of Watershops Pond that may occur during the Project. The monitoring was discussed conceptually in the Alternatives Analysis included in the Expanded Environmental Notification Form (EENF) for the Project (EOEEA No. 16234, EENF dated June 15,2020). On July 31, 2020, the Secretary of Energy and Environmental Affairs issued her Certificate on the EENF requiring the preparation of a Single Environmental Impact Report (SEIR). In response to comments received on the EENF and in response to the Secretary's Certificate on the EENF, a detailed draft "Aquatic and Wetland Resource Monitoring and Mitigation Plan"; the "Plan") was developed in coordination with regulatory agencies and was submitted as an integral mitigation commitment detailed within the SEIR dated August 28, 2020. The Plan was referenced in the Secretary's Certificate on the SEIR (October 16, 2020) and became a mitigation requirement associated with the City of Springfield's Preferred Alternative of full pond drawdown during the Project. The basic elements of the Plan were developed based upon prior studies of the pond and consultations with the Springfield Conservation Commission and State and Federal regulatory officials.

A copy of the Plan was provided in **Appendix 1**. to the "Pre-Drawdown Ecological Monitoring Report," GZA, September 2020.

Monitoring was conducted on February 23, 2021, per the methodology presented in the "Pre-Drawdown Ecological Monitoring Report." Monitoring occurred within the drawdown pool at the two locations selected during the first sampling event, conducted December 15, 2020 (see **Figure 1** for data collection locations). Vertical profiles were conducted at the two locations and Dissolved Oxygen (DO) and Temperature (°C) were measured at one-foot depth intervals. Secchi disk depth was recorded at each site.

RESULTS

The Watershops Pond residual pool encompasses about 22 acres upgradient of the dam where the water exits the pond basin through the dam's low-level sluice gates. The maximum pool depth is slightly over 4 feet, with most of the pool area less than 2 feet deep. The height of the pool was determined by measuring the surface water elevation below the deck of the privately-owned steel bridge located approximately 200 feet upstream of the dam. The measured surface water elevation was at Elevation 141.05± which is approximately 0.35± feet higher than the water surface elevation that was measured in December 2020.

The water within the pool basin was less turbid than in December, with Secchi Disk depths recorded at 2.5 and 2 feet deep compared to 1 foot during December 2020. Though portions of the pond were ice covered, the water temperature was approximately 1.2° C warmer than previously recorded and averaged approximately 3.2° C with a range of 2.8° C to 4.5°C. The DO exceeded 12.0 mg/l for all samples (**Table 1**).

Table 1. Watershops Pond Drawdown Pool Dissolved Oxygen, Temperature, and Secchi Depth Measurements
Date of Data Collection: 02/23/2021 09:30 AM – 12:00 PM

Tuesday, 02-23-2021; 10:30 AM				**Tuesday, 02-23-2021; 09:30 AM**			
Surface Water Elevation: 141.05' (Note: chisel mark on pond side of pier made at 12.00' below bridge deck)							
Location: Main Body, Near Dam, East of Steel (private) Bridge; 42°05.861 N; 072°33.624 W				**Location: Main Body, Central Pond, East of Railroad Bridge; 42°05.940 N; 072°33.345 W**			
Secchi Depth (ft)	**Depth (ft)**	**DO (mg/l)**	**Temp °C**	**Secchi Depth (ft)**	**Depth (ft)**	**DO (mg/l)**	**Temp °C**
2.5	0	13.3	2.8	2.2	0	12.5	4.5
	1	13.0	2.7		1	12.2	3.9
	2	12.8	2.7		2	12.4	3.9
	3	12.6	2.7		2.2 - bottom		
	4.0 - bottom	12.4	2.4				

The average DO concentration at each depth range of the water column is shown in **Table 2**. Because the DO concentration changed very little over depth, the entire water column was above 12 mg/l.

Table 2. Hypsometric Distribution of Lake Volume and Dissolved Oxygen by Depth

Depth (ft)	Acres Encompassed by Contour Depth	Water column volume by depth interval (CF)	% vol. of water column within depth interval	Cum. % vol. above interval depth	Average DO (mg/l) (from Table 1)
0-1	22.5	860,941.9	44.7	44.7	12.9
1-2	17.2	623,461.0	32.3	77.0	12.6
2-3	11.6	335,447.7	17.4	94.4	12.6
3-4	4.3	96,265.6	5.0	99.4	12.6
4-5	0.63	11,608.4	0.6	100	12.4
Total		1,927,724.6			
Water elevation at time of monitoring: 141.15 ft					

DISCUSSION

The Plan suggested the action level for DO should be 5 mg/l for at least 75% of the surface waters in the residual pool. During the February 2021 monitoring event, this standard was readily met as the average DO concentration exceeded 12 mg/l at all contour elevations. This is an unsurprising result during the non-growing season with low water column temperatures.

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RESILIENCY IMPROVEMENTS AT WATERSHOPS POND DAM
DRAWDOWN PERIOD MONITORING REPORT #3

MARCH 23, 2021

For Compliance with:

Order of Conditions, DEP File No. 294-0607, issued 09/17/2020

Section 401 Water Quality Certification, BRP WW 08, DEP Transmittal No. X286704, issued 07/23/2021

Section 404 Permit, File No. NAE-2020-02301, issued 10/21/2020

Certificate on the SEIR, Secretary of Energy and Environmental Affairs, EOEEA No. 16234, issued 07/31/2020

Prepared by: Paul G. Davis, PhD, Adrienne Dunk
Reviewed by: Tom Jenkins, P.E.

INTRODUCTION AND METHODOLOGY

In compliance with authorized procedures approved under the above-referenced permits and authorizations, GZA is monitoring dissolved oxygen levels, temperature, and transparency during the period of drawdown associated with the Resiliency Improvements at Watershops Pond Dam Project. This report presents the results of the third monitoring event conducted during the period of drawdown, which commenced with the opening of the low-level outlets at the dam on October 26, 2020. During the winter drawdown period, dissolved oxygen monitoring will occur at a frequency of once every 2 months. From March through October, during the growing season, monitoring will occur monthly.

Ecological resource monitoring was initially identified as a means to gauge the environmental impacts associated with a partial or full drawdown of Watershops Pond that may occur during the Project. The monitoring was discussed conceptually in the Alternatives Analysis included in the Expanded Environmental Notification Form (EENF) for the Project (EOEEA No. 16234, EENF dated June 15,2020). On July 31, 2020, the Secretary of Energy and Environmental Affairs issued her Certificate on the EENF requiring the preparation of a Single Environmental Impact Report (SEIR). In response to comments received on the EENF and in response to the Secretary's Certificate on the EENF, a detailed draft "Aquatic and Wetland Resource Monitoring and Mitigation Plan"; the "Plan") was developed in coordination with regulatory agencies and was submitted as an integral mitigation commitment detailed within the SEIR dated August 28, 2020. The Plan was referenced in the Secretary's Certificate on the SEIR (October 16, 2020) and became a mitigation requirement associated with the City of Springfield's Preferred Alternative of full pond drawdown during the Project. The basic elements of the Plan were developed based upon prior studies of the pond and consultations with the Springfield Conservation Commission and State and Federal regulatory officials.

A copy of the Plan was provided in **Appendix 1**. to the "Pre-Drawdown Ecological Monitoring Report," GZA, September 2020.

The current monitoring event was conducted on March 23, 2021. Monitoring was repeated at the two locations selected during the first sampling event, conducted December 15, 2020. A new, third sampling location nearer the dam was added to take advantage of deeper residual pool depth at this location for monitoring (see **Figure 1A** for data collection locations).

RESULTS

The Watershops Pond residual pool encompasses about 22 acres upgradient of the dam where the water exits the pond basin through the sluice gates. The maximum pool depth is slightly over 4 feet, with most of the pool area less than 2 feet deep. The height of the pool was determined by measuring the surface water elevation below the deck of the privately-owned steel bridge located approximately 200 feet upstream of the dam. The measured surface water elevation was at Elevation 141.30± which is approximately 0.25± feet higher than the water surface elevation that was measured in February 2021 and approximately 0.60± feet higher than measured in December 2020.

Based upon the Secchi Disk depth, the water within the pool basin was observed to be the least turbid of the three sampling events; Secchi Disk depths recorded at 4.0 feet deep. Watershops Pond was clear of ice with an average temperature of 7.6° C for locations measured. The measured temperatures ranged from 7.0° C to 8.7° C. The DO exceeded 10 mg/l for all samples (**Table 1**).

Table 1. Watershops Pond Drawdown Pool Dissolved Oxygen, Temperature, and Secchi Depth Measurements
Date of Data Collection: 03/23/2021 10:00AM – 12:00 PM

Tuesday, 03-23-2021; 10:30 AM											
Surface Water Elevation: 141.30' Note: chisel mark on pond side of pier made at 12.00' below bridge deck											
Location: Main Body, Near Dam, East of Steel (private) Bridge; 42°05.861 N; 072°33.624 W				**Location: Main Body, Central Pond, East of RR Bridge; 42°05.940 N; 072°33.345 W**				**Location: Main Body, Near Dam, 100'± West of Steel (private) Bridge; 42°05.848 N; 072°33.735 W***			
Secchi Depth (ft)	**Depth (ft)**	**DO (mg/l)**	**Temp °C**	**Secchi Depth (ft)**	**Depth (ft)**	**DO (mg/l)**	**Temp °C**	**Secchi Depth (ft)**	**Depth (ft)**	**DO (mg/l)**	**Temp °C**
4.0	0	10.7	7.4	To bottom	0	12.7	8.7	4.0	0	10.6	8.0
	1	10.8	7.2		1	12.5	8.5		1	10.6	7.7
	2	10.7	7.1		1.2 - bottom	12.2	8.4		2	10.6	7.6
	3	10.8	7.1						3	10.6	7.5
	4	10.7	7.1						4	10.6	7.3
	4.5 - bottom	10.7	7.0						4.2 - bottom	10.3	7.3

The average DO concentration at each depth range of the water column is shown in **Table 2**. Because the DO concentration changed very little over depth, the entire water column was above 10 mg/l.

Table 2. Hypsometric Distribution of Lake Volume and Dissolved Oxygen by Depth

Depth (ft)	Acres Encompassed by Contour Depth	Water column volume by depth interval (CF)	% vol. of water column within depth interval	Cum. % vol. above interval depth	Average DO (mg/l) (from Table 1)
0-1	22.5	860,941.9	44.7	44.7	11.3
1-2	17.2	623,461.0	32.3	77	11.3
2-3	11.6	335,447.7	17.4	94.4	11.2
3-4	4.3	96,265.6	4.99	99.39	10.7
4-5	0.63	11,608.4	0.60	99.99	10.7
5-6	0.03	435.0	0.02	100	10.5
Total		1,927,709.6			
Water elevation at time of monitoring: 141.30 ft					

DISCUSSION

The Plan suggested the action level for DO should be 5 mg/l for at least 75% of the surface waters in the residual pool. During the March 2021 monitoring event, this standard was readily met as the average DO concentration exceeded 10 mg/l at all contour elevations. This is an unsurprising result during the non-growing season with low water column temperatures.

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RESILIENCY IMPROVEMENTS AT WATERSHOPS POND DAM
DRAWDOWN PERIOD MONITORING REPORT #4

APRIL 14, 2021

For Compliance with:

Order of Conditions, DEP File No. 294-0607, issued 09/17/2020

Section 401 Water Quality Certification, BRP WW 08, DEP Transmittal No. X286704, issued 07/23/2021

Section 404 Permit, File No. NAE-2020-02301, issued 10/21/2020

Certificate on the SEIR, Secretary of Energy and Environmental Affairs, EOEEA No. 16234, issued 07/31/2020

Prepared by: Paul G. Davis, PhD, Adrienne Dunk
Reviewed by: Tom Jenkins, P.E.

INTRODUCTION AND METHODOLOGY

In compliance with authorized procedures approved under the above-referenced permits and authorizations, GZA is monitoring dissolved oxygen levels, temperature, and transparency during the period of drawdown associated with the Resiliency Improvements at Watershops Pond Dam Project. This report presents the results of the fourth monitoring event conducted during the period of drawdown, which commenced with the opening of the low-level outlets at the dam on October 26, 2020. During the winter drawdown period, dissolved oxygen monitoring will occur at a frequency of once every 2 months. From March through October, during the growing season, monitoring will occur monthly.

Ecological resource monitoring was initially identified as a means to gauge the environmental impacts associated with a partial or full drawdown of Watershops Pond that may occur during the Project. The monitoring was discussed conceptually in the Alternatives Analysis included in the Expanded Environmental Notification Form (EENF) for the Project (EOEEA No. 16234, EENF dated June 15,2020). On July 31, 2020, the Secretary of Energy and Environmental Affairs issued her Certificate on the EENF requiring the preparation of a Single Environmental Impact Report (SEIR). In response to comments received on the EENF and in response to the Secretary's Certificate on the EENF, a detailed draft "Aquatic and Wetland Resource Monitoring and Mitigation Plan"; the "Plan") was developed in coordination with regulatory agencies and was submitted as an integral mitigation commitment detailed within the SEIR dated August 28, 2020. The Plan was referenced in the Secretary's Certificate on the SEIR (October 16, 2020) and became a mitigation requirement associated with the City of Springfield's Preferred Alternative of full pond drawdown during the Project. The basic elements of the Plan were developed based upon prior studies of the pond and consultations with the Springfield Conservation Commission and State and Federal regulatory officials.

A copy of the Plan was provided in **Appendix 1**. to the "Pre-Drawdown Ecological Monitoring Report," GZA, September 2020.

During the winter drawdown period, dissolved oxygen monitoring has occurred at a frequency of once every 2 months. From March through October, during the growing season, dissolved oxygen and groundwater monitoring occurs monthly. Within the Pond, vertical profiles are being conducted at the three locations, and Dissolved Oxygen (DO) and Temperature (°C) were measured at one-foot depth intervals. Secchi disk depth is recorded at each site. Groundwater monitoring is being conducted at the six stations located at the three BVWs identified during the pre-drawdown report and depicted on **Figures 2 through 4**. This report presents the results of the fourth monitoring event conducted during the period of drawdown, which commenced with the opening of the low-level outlets at the dam on October 26, 2020.

The current monitoring event was conducted on April 14, 2021. Monitoring was repeated at the two locations selected during the first sampling event, conducted December 15, 2020, and a third sampling location near the dam which was added on March 23, 2021, to take advantage of deeper residual pool depth for monitoring (see **Figure 1A** for data collection locations).

RESULTS

The Watershops Pond residual pool encompasses about 17 acres upgradient of the dam where the water exits the pond basin through the sluice gates. The maximum pool depth is slightly over 4 feet, with most of the pool area less than 2 feet deep. The height of the pool was determined by measuring the surface water elevation below the deck of the privately-owned steel bridge located approximately 200 feet upstream of the dam. The measured surface water elevation was at Elevation 140.80± which is approximately 0.5± feet lower than the water surface elevation that was measured in March 2021 and approximately 0.1± feet higher than measured in December 2020.

Based upon the Secchi Disk depth, the water within the pool basin was observed to be more turbid than the March sampling event; Secchi Disk depths recorded at 3.3 feet deep. Watershops Pond had an average temperature of 12.6° C for locations measured. The measured temperatures ranged from 12.0° C to 14.0° C. The DO exceeded 9 mg/l for all samples (**Table 1**) except at the bottom sediment surface at one location.

Table 1. Watershops Pond Drawdown Pool Dissolved Oxygen, Temperature, and Secchi Depth Measurements
Date of Data Collection: 04/14/2021 10:00AM – 12:00 PM

Wednesday 04-14-2021; 10:30 AM											
Surface Water Elevation: 140.80' Note: chisel mark on pond side of pier made at 12.00' below bridge deck											
Location: Main Body, Near Dam, East of Steel (private) Bridge; 42°05.861 N; 072°33.624 W				**Location: Main Body, Central Pond, East of RR Bridge; 42°05.940 N; 072°33.345 W**				**Location: Main Body, Near Dam, 100'± West of Steel (private) Bridge; 42°05.848 N; 072°33.735 W**			
Secchi Depth (ft)	**Depth (ft)**	**DO (mg/l)**	**Temp °C**	**Secchi Depth (ft)**	**Depth (ft)**	**DO (mg/l)**	**Temp °C**	**Secchi Depth (ft)**	**Depth (ft)**	**DO (mg/l)**	**Temp °C**
3.0	0	9.0	12.4	>1.5	0	9.7	14.0	3.3 ft	0	9.5	12.8
	1	9.0	12.3		1	9.9	13.9		1	9.5	12.4
	2	9.1	12.2		1.5-bottom	10.0	13.9		2	9.3	12.2
	3	9.1	12.1						3	9.2	12.1
	3.3 - bottom	8.7	12						4	9.2	12.1
									4.3-bottom	9.8	12.1

The average DO concentration at each depth range of the water column is shown in **Table 2**. Because the DO concentration changed very little over depth, the entire water column was above 9 mg/l. The slight elevation of DO at the bottom surface at two locations is suggestive of initial start of growth of bottom filamentous green algae.

Table 2. Hypsometric Distribution of Lake Volume and Dissolved Oxygen by Depth

Depth (ft)	Acres Encompassed by Contour Depth	Water column volume by depth interval (CF)	% vol. of water column within depth interval	Cum. % vol. above interval depth	Average DO (mg/l) (from Table 1)
0-1	17.2	623,461.0	58.4	58.4	9.4
1-2	11.6	335,447.7	31.3	89.8	9.5
2-3	4.3	96,265.6	9.0	98.8	9.5
3-4	0.63	11,608.4	1.1	99.9	9.2
4-5	0.03	435.0	0	99.9	9.0
5-6	0	0	0	99.9	9.8
Total		1067217.7			

Groundwater levels were measured at the six stations by auguring a 3-inch diameter hole to a depth of at least 24 inches and allowing time for equilibration. The observed depths to groundwater are shown in **Table 3**.

Table 3. Watershops Pond Drawdown Groundwater Monitoring Measurements (inches below ground surface)
Date of Data Collection: 04/14/2021 11:00AM – 1:00 PM

	Springfield College	Springfield College East Campus		GYSGT J. Sullivan Park		
Date	**Station 1**	**Station 1**	**Station 2**	**Station 1**	**Station 2**	**Station 3**
4/14/2021	-27+	-27+	-27+	-6	-6	-27+
Note: Depths denoted with a "+" indicate that groundwater was not observed at this depth						

DISCUSSION

The Plan suggested the action level for DO should be 5 mg/l for at least 75% of the surface waters in the residual pool. During the April 2021 monitoring event, this standard was met as the average DO concentration exceeded 9.0 mg/l at all contour elevations. This is an unsurprising result during the early-growing season with low water column temperatures.

The groundwater levels in the wetlands were expected to drop with the Watershops Pond drawdown. Groundwater depths will continue to be monitored throughout the growing season. These data will be discussed and analyzed further in the annual wetland monitoring report. Following the refilling of the pool, wetland impacts and potential mitigation measures will be discussed.

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RESILIENCY IMPROVEMENTS AT WATERSHOPS POND DAM
DRAWDOWN PERIOD MONITORING REPORT #5

MAY 27, 2021 (with followup monitoring on JUNE 2, 2021)

For Compliance with:

Order of Conditions, DEP File No. 294-0607, issued 09/17/2020

Section 401 Water Quality Certification, BRP WW 08, DEP Transmittal No. X286704, issued 07/23/2021

Section 404 Permit, File No. NAE-2020-02301, issued 10/21/2020

Certificate on the SEIR, Secretary of Energy and Environmental Affairs, EOEEA No. 16234, issued 07/31/2020

Prepared by: Paul G. Davis, PhD, Adrienne Dunk
Reviewed by: Tom Jenkins, P.E.

INTRODUCTION AND METHODOLOGY

In compliance with authorized procedures approved under the above-referenced permits and authorizations, GZA is monitoring dissolved oxygen levels, temperature, and transparency during the period of drawdown associated with the Resiliency Improvements at Watershops Pond Dam Project. This report presents the results of the fifth monitoring event conducted during the period of drawdown, which commenced with the opening of the low-level outlets at the dam on October 26, 2020. During the winter drawdown period, dissolved oxygen monitoring will occur at a frequency of once every 2 months. From March through October, during the growing season, monitoring will occur monthly.

Ecological resource monitoring was initially identified as a means to gauge the environmental impacts associated with a partial or full drawdown of Watershops Pond that may occur during the Project. The monitoring was discussed conceptually in the Alternatives Analysis included in the Expanded Environmental Notification Form (EENF) for the Project (EOEEA No. 16234, EENF dated June 15,2020). On July 31, 2020, the Secretary of Energy and Environmental Affairs issued her Certificate on the EENF requiring the preparation of a Single Environmental Impact Report (SEIR). In response to comments received on the EENF and in response to the Secretary's Certificate on the EENF, a detailed draft "Aquatic and Wetland Resource Monitoring and Mitigation Plan"; the "Plan") was developed in coordination with regulatory agencies and was submitted as an integral mitigation commitment detailed within the SEIR dated August 28, 2020. The Plan was referenced in the Secretary's Certificate on the SEIR (October 16, 2020) and became a mitigation requirement associated with the City of Springfield's Preferred Alternative of full pond drawdown during the Project. The basic elements of the Plan were developed based upon prior studies of the pond and consultations with the Springfield Conservation Commission and State and Federal regulatory officials.

A copy of the Plan was provided in **Appendix 1**. to the "Pre-Drawdown Ecological Monitoring Report," GZA, September 2020.

During the winter drawdown period, dissolved oxygen monitoring occurred at a frequency of once every 2 months. From March through October, during the growing season, dissolved oxygen and groundwater monitoring occurs monthly. Within the Pond, vertical profiles are being conducted at the three locations and Dissolved Oxygen (DO) and Temperature (°C) were measured at one-foot depth intervals. Secchi disk depth is recorded at each site. Vegetation community monitoring occurs twice per growing season, in late May and between August 15 and September 15. Groundwater and vegetation community monitoring is being conducted at the six stations located at the three BVWs identified during the pre-drawdown report and depicted on **Figures 2 through 4**. This report presents the results of the fifth monitoring event conducted during the period of drawdown, which commenced with the opening of the low-level outlets at the dam on October 26, 2020.

The current monitoring event was conducted on May 27, 2021. Monitoring was repeated at the two locations selected during the first sampling event, conducted December 15, 2020, and at a third sampling location near the dam which was added on March 23, 2021, to take advantage of deeper residual pool depth for monitoring (see **Figure 1A** for data collection locations).

RESULTS

The Watershops Pond residual pool encompasses about 29.8 acres upgradient of the dam where the water exits the pond basin through the sluice gates. The maximum pool depth observed was slightly over 6 feet, with most of the pool area less than 3 feet deep. The height of the pool was determined by measuring the surface water elevation below the deck of the privately-owned steel bridge located approximately 200 feet upstream of the dam. The measured surface water elevation was at Elevation 142.7± which is approximately 1.9± feet higher than the water surface elevation that was measured in April 2021 and approximately 2.0± feet higher than measured in December 2020.

Based upon the Secchi Disk depth, the water within the pool basin was observed to be much more turbid than earlier sampling events; Secchi Disk depths recorded at 0.8 feet deep in May as opposed to 1.5-3.0 feet in April and 4.0 feet in March. Watershops Pond had an average temperature of 21.0° C for locations measured. The measured temperatures ranged from 20.5° C to 22.4° C. The maximum DO observed was 5.0 at one location (**Table 1**). It should be noted that there was a significant rainfall event in the watershed on the 24-hour period to the May sampling that likely affected turbidity and the Biochemical Oxygen Demand during this sampling.

Table 1. Watershops Pond Drawdown Pool Dissolved Oxygen, Temperature, and Secchi Depth Measurements
Date of Data Collection: 05/27/2021 10:00AM – 11:00 AM

Thursday 05-27-2021; 10:30 AM											
Surface Water Elevation: 142.70 Note: chisel mark on pond side of pier made at 12.00' below bridge deck											
Location: Main Body, Near Dam, East of Steel (private) Bridge; 42°05.861 N; 072°33.624 W				**Location: Main Body, Central Pond, East of RR Bridge; 42°05.940 N; 072°33.345 W**				**Location: Main Body, Near Dam, 100'± West of Steel (private) Bridge; 42°05.848 N; 072°33.735 W**			
Secchi Depth (ft)	**Depth (ft)**	**DO (mg/l)**	**Temp °C**	**Secchi Depth (ft)**	**Depth (ft)**	**DO (mg/l)**	**Temp °C**	**Secchi Depth (ft)**	**Depth (ft)**	**DO (mg/l)**	**Temp °C**
0.6	0	3.6	21.5	0.68	0	5	22.4	0.8	0	3.5	21.1
	1	3.6	21.4		1	5	22.2		1	3.4	21
	2	3.6	20.8		2	4.9	21.3		2	3.3	21
	3	3.6	20.6		2.2 bottom	4.9	21.5		3	3.3	20.8
	4	3.7	20.6						4	3.2	20.6
	4.75 bottom	3.4	20.5						5	3.2	20.5
									6	3.3	20.5
									6.25 bottom	3.1	20.5

A second sampling event was performed on June 2, 2021, to verify if the May 27, 2021, data was representative of a trend to high turbidity and low dissolved oxygen, or an episodic result of an intense watershed rainfall event and pollen washoff. This second round of sampling *(***Table 2**) indicates that the water quality rebounded following the rain event. The average temperate lowered from 21.0° C to 19.3° C and the minimum recorded DO was 7.6.

Table 2. Watershops Pond Drawdown Pool Dissolved Oxygen, Temperature, and Secchi Depth Measurements
Date of Data Collection: 06/02/2021 10:00AM – 11:00 AM

Wednesday 06-02-2021; 2:30 PM											
Surface Water Elevation: 142.20 Note: chisel mark on pond side of pier made at 12.00' below bridge deck											
Location: Main Body, Near Dam, East of Steel (private) Bridge; 42°05.861 N; 072°33.624 W				**Location: Main Body, Central Pond, East of RR Bridge; 42°05.940 N; 072°33.345 W**				**Location: Main Body, Near Dam, 100'± West of Steel (private) Bridge; 42°05.848 N; 072°33.735 W**			
Secchi Depth (ft)	**Depth (ft)**	**DO (mg/l)**	**Temp °C**	**Secchi Depth (ft)**	**Depth (ft)**	**DO (mg/l)**	**Temp °C**	**Secchi Depth (ft)**	**Depth (ft)**	**DO (mg/l)**	**Temp °C**
1.5	0	7.8	20.8	1	0	7.6	21.5	1.5	0	7.9	20.6
	1	7.8	20.8		1	7.8	21.5		1	8.1	20.4
	2	7.8	20.4		2	7.9	21		2	8.2	18.6
	3	7.9	18.7		2.25 bottom	7.6	21		3	8.2	18.1
	4	8	17.3						4	8.2	17.3
	4.5 bottom	8.1	17.1						5	8.1	16.4
									6.0 bottom	8	16

The average DO concentration at each depth range of the water column is shown in **Table 3**. Though the May data meets the threshold for mitigative action, the June data, obtained one-week later, indicates an improved water quality with results above action thresholds. Given that there appears to be an association between the DO concentration and watershed rainfall events, followed by rapid recovery, it would seem to suggest that aeration would not provide significant mitigation of the transient low DO conditions, which appear to rebound as the watershed response to the rainfall lessens. Additional sampling of the inflow water from at least the North Branch of the Mill River might be helpful to distinguish between watershed and in-pond low DO events and determine when more aggressive mitigation measures are appropriate if threshold conditions are encountered (see discussion).

Table 3. Hypsometric Distribution of Lake Volume and Dissolved Oxygen by Depth

Depth (ft)	Acres Encompassed by Contour Depth	Water column volume by depth interval (CF)	% vol. of water column within depth interval	Cum. % vol. above interval depth	Average DO (mg/l) May 27, 2021	Average DO (mg/l) June 2, 2021
0-1	29.8	1,135,237.4	37.1	37.1	4.0	7.8
1-2	22.5	860,941.9	28.1	65.2	4.0	7.9
2-3	17.2	623,461.9	20.4	85.6	3.9	8.0
3-4	11.6	335,447.7	11	96.6	3.9	7.9
4-5	4.3	96,265.6	3.1	99.7	3.5	8.1
5-6	0.63	11,608.4	0.4	100.1	3.3	8.1
6+	0.03	435.0	0	100.1	3.1	8.0
Total		3,063,397.9				

Groundwater levels were measured at the six stations by auguring a 3-inch diameter hole to a depth of at least 24 inches and allowing time for equilibration. The observed depths to groundwater are shown in **Table 4**.

Table 4. Watershops Pond Drawdown Groundwater Monitoring Measurements (inches below ground surface)
Date of Data Collection: 05/27/2021 11:00AM – 1:00 PM

	Springfield College	Springfield College East Campus		GYSGT J. Sullivan Park		
Date	**Station 1**	**Station 1**	**Station 2**	**Station 1**	**Station 2**	**Station 3**
05/27/2021	-24+	-24+	-24+	-16	-8	-2
Note: Depths denoted with a "+" indicate that groundwater was not observed at this depth						

Vegetation was also inventoried with percent cover estimated for each observed species at the six stations. No change in species or percent composition was observed in the tree canopy, shrub/sapling, or vine layers. Changes in the herbaceous layer are shown in **Table 5**.

Table 5. Watershops Pond Drawdown Wetland Vegetation Monitoring Herbaceous Vegetation Change
Date of Data Collection: 05/27/2021 11:00AM – 1:00PM

Species		Springfield College	Springfield College East Campus		GYSGT J. Sullivan Park		
Common Name	**Scientific Name**	**Station 1**	**Station 1**	**Station 2**	**Station 1**	**Station 2**	**Station 3**
Fleabane Daisy	*Erigeron annuus*	-trace					
Purple Loosestrife*	*Lythrum salicaria*	-5%				-7%	
Thistle	*Cirsium sp.*	+2%					

Glossy Buckthorn*	*Frangula alnus*		+3%				
Clearweed	*Pilea pumila*		-5%		-5%	-15%	
Barberpole Sedge	*Scirpus rubrotinctus*		-15%**				
Skunk cabbage	*Symplocarpus foetidus*		+5%	+5%			
Fringed Sedge	*Carex crinita*		+trace				
Swamp Beggar's Tick	*Bidens discoidea*		+2%				-2%
Awl-fruit sedge	*Carex stipata*		+3%				
Arrowwood	*Viburnum dentatum*			+3%			
Red Oak	*Quercus rubra*			+trace			
Spinulous Wood Fern	*Drypoteris carthusiana*			-5%			
Pennsylvania Sedge	*Carex Pensylvanica*			-5%**			
Swamp Azalea	*Rhododendron viscosum*			-5%**			
Princess Pine	*Lycopodium obsurum*			+2%			
Jewelweed	*Impatiens capensis*				+5%	+10%	
Sensitive Fern	*Onoclea sensibilis*				+15%		
Arrow Arum	*Peltandra virginica*					-3%	
Black Nightshade	*Solanum nigrum*					-3%	
Greater Water Dock	*Rumex Britannica*					+2%	
Forget-me-not	*Myosotis verna*					+2%	
Duckweed	*Lemna minor*						-85%

Note:
"+" indicates an increase in percent cover from pre-drawdown conditions
"-" indicates a decrease in percent cover from pre-drawdown conditions
* indicates the species is considered invasive in Massachusetts
** indicates that the species may have previously been misidentified

DISCUSSION

The Plan suggested the action level for DO should be 5 mg/l for at least 75% of the surface waters in the residual pool. The measured May DO level was 4 mg/l or less for at least 75% of the surface waters. Per the Plan, this DO level should have triggered mitigation (i.e., aeration); however, the sampling event immediately followed a rain event with local rainfall recordings ranging from 0.53 inches (reported via wunderground.com at Bradley International Airport Station) and 0.774 inches (reported via localconditions.com for Springfield MA). GZA observed significantly increased turbidity from the April 2021, sampling event and hypothesized that the DO was depressed due to a watershed event and not in association with a drawdown-induced seasonal event. Increased turbidity from sediment and/or pollen within the watershed and basin could have resulted in a higher than usual Biochemical Oxygen Demand (BOD), but under such circumstances, DO would be expected to return to normal conditions as the storm-induced turbidity lessened and the sediment settled. In consultation with the Springfield Conservation Commission, GZA performed a second sampling event one week later, on June 2, 2021, to verify if DO had returned to non-threshold levels. On June 2, 2021, the turbidity in Watershops Pond had decreased, and the DO levels had risen to 7.8 mg/l or greater for all contour elevations. This result is more in line with the anticipated gradual fall in DO as the weather and water warms. The return of more normal expected DO levels observed on this date, even though there were some smaller rainfall amounts between May 29 and May 31 preceding the second sampling which ranged from a rainfall total of 0.993 inches (reported via localconditions.com for Springfield MA) and 2.70 inches (reported via wunderground.com at Bradley International Airport Station).

The groundwater levels in the wetlands were expected to drop with the Watershops Pond drawdown. Groundwater depths will continue to be monitored throughout the growing season. Due to this drop, there may be a short-term shift in some herbaceous vegetation. More permanent vegetation in the tree canopy, shrub/sapling, and vine layers are not anticipated to change from the drawdown. The observed changes herbaceous vegetation composition was not significant when accounting for time of year with the exception of duckweed. The percentage of duckweed coverage at Sullivan Park Station 3 decreased by 85%. Duckweed is an aquatic plant which floats at the top of the water column; however, there is no standing or ponded water at this sample station currently. The duckweed is anticipated to return when the pond is refilled. These data will be discussed and analyzed further in the annual wetland monitoring report. Following the refilling of the pool, wetland impacts, and potential mitigation measures will be discussed.

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RESILIENCY IMPROVEMENTS AT WATERSHOPS POND DAM
DRAWDOWN PERIOD MONITORING REPORT #6

JUNE 24, 2021

For Compliance with:

Order of Conditions, DEP File No. 294-0607, issued 09/17/2020

Section 401 Water Quality Certification, BRP WW 08, DEP Transmittal No. X286704, issued 07/23/2021

Section 404 Permit, File No. NAE-2020-02301, issued 10/21/2020

Certificate on the SEIR, Secretary of Energy and Environmental Affairs, EOEEA No. 16234, issued 07/31/2020

Prepared by: Paul G. Davis, PhD, Adrienne Dunk
Reviewed by: Tom Jenkins, P.E.

INTRODUCTION AND METHODOLOGY

In compliance with authorized procedures approved under the above-referenced permits and authorizations, GZA is monitoring dissolved oxygen levels, temperature, and transparency during the period of drawdown associated with the Resiliency Improvements at Watershops Pond Dam Project. This report presents the results of the sixth monitoring event conducted during the period of drawdown, which commenced with the opening of the low-level outlets at the dam on October 26, 2020. During the winter drawdown period, dissolved oxygen monitoring will occur at a frequency of once every 2 months. From March through October, during the growing season, monitoring will occur monthly.

Ecological resource monitoring was initially identified as a means to gauge the environmental impacts associated with a partial or full drawdown of Watershops Pond that may occur during the Project. The monitoring was discussed conceptually in the Alternatives Analysis included in the Expanded Environmental Notification Form (EENF) for the Project (EOEEA No. 16234, EENF dated June 15,2020). On July 31, 2020, the Secretary of Energy and Environmental Affairs issued her Certificate on the EENF requiring the preparation of a Single Environmental Impact Report (SEIR). In response to comments received on the EENF and in response to the Secretary's Certificate on the EENF, a detailed draft "Aquatic and Wetland Resource Monitoring and Mitigation Plan"; the "Plan") was developed in coordination with regulatory agencies and was submitted as an integral mitigation commitment detailed within the SEIR dated August 28, 2020. The Plan was referenced in the Secretary's Certificate on the SEIR (October 16, 2020) and became a mitigation requirement associated with the City of Springfield's Preferred Alternative of full pond drawdown during the Project. The basic elements of the Plan were developed based upon prior studies of the pond and consultations with the Springfield Conservation Commission and State and Federal regulatory officials.

A copy of the Plan was provided in **Appendix 1**. to the "Pre-Drawdown Ecological Monitoring Report," GZA, September 2020.

During the winter drawdown period, dissolved oxygen monitoring occurred at a frequency of once every 2 months. From March through October, during the growing season, dissolved oxygen and groundwater monitoring occurs monthly. Within the Pond, vertical profiles are being conducted at the three locations and Dissolved Oxygen (DO) and Temperature (°C) were measured at one-foot depth intervals. Secchi disk depth is recorded at each site. Vegetation community monitoring occurs twice per growing season, in late May and between August 15 and September 15. Groundwater and vegetation community monitoring is being conducted at the six stations located at the three BVWs identified during the pre-drawdown report and depicted on **Figures 2 through 4**. This report presents the results of the sixth monitoring event conducted during the period of drawdown, which commenced with the opening of the low-level outlets at the dam on October 26, 2020.

The current monitoring event was conducted on June 24, 2021. Monitoring was repeated at the two locations selected during the first sampling event, conducted December 15, 2020 and a third sampling location near the dam which was added on March 23, 2021 to take advantage of deeper residual pool depth for monitoring (see **Figure 1A** for data collection locations). On June 24, 2021, additional DO and Temperature readings were taken at the culvert inlet of the North Branch of the Mill River to Watershops Pond

RESULTS

The Watershops Pond residual pool encompasses about 17.2 acres upgradient of the dam where the water exits the pond basin through the sluice gates. The maximum pool depth observed was slightly over 4 feet, with most of the pool area less than 3 feet deep. The height of the pool was determined by measuring the surface water elevation below the deck of the privately-owned steel bridge located approximately 200 feet upstream of the dam. The measured surface water elevation was at Elevation 140.70± which is approximately 2.0± feet lower than the water surface elevation that was measured on May 27, 2021 and approximately the same as measured in December 2020.

Based upon the Secchi Disk depth, the water within the pool basin was observed to be less turbid than the May sampling events and more similar to prior efforts; Secchi Disk depths recorded at >0.5 - 2.7 feet deep in June as opposed to 0.8 feet deep in May, 1.5-3.0 feet in April, and 4.0 feet in March. Watershops Pond had an average temperature of 19.7° C for locations measured. The measured temperatures ranged from 17.3° C to 22.2° C. The maximum DO observed was 9.3 at one location (**Table 1**).

Table 1. Watershops Pond Drawdown Pool Dissolved Oxygen, Temperature, and Secchi Depth Measurements
Date of Data Collection: 06/24/2021 12:30 PM – 1:30 PM

Thursday 06-24-2021; 12:45 PM											
Surface Water Elevation: 140.70 Note: chisel mark on pond side of pier made at 12.00' below bridge deck											
Location: Main Body, Near Dam, East of Steel (private) Bridge; 42°05.861 N; 072°33.624 W				Location: Main Body, Central Pond, East of RR Bridge; 42°05.940 N; 072°33.345 W				Location: Main Body, Near Dam, 100'± West of Steel (private) Bridge; 42°05.848 N; 072°33.735 W			
Secchi Depth (ft)	Depth (ft)	DO (mg/l)	Temp °C	Secchi Depth (ft)	Depth (ft)	DO (mg/l)	Temp °C	Secchi Depth (ft)	Depth (ft)	DO (mg/l)	Temp °C
2.7	0	8.0	20.8	>0.5	0	7.6	21.5	2.5	0	8.2	22.2
	1	8.0	20.8		0.5 bottom	7.1	21.5		1	8.5	21.2
	2	8.2	20.4						2	8.9	18.8
	3	8.8	18.7						3	9.1	18.1
	3.7 bottom	8.4	17.3						4	9.3	17.5
									4.5 bottom	9.2	17.5

Additional temperature and DO data was collected up- and down-gradient of the Wilbraham Road culvert along the North Branch of the Mill River for comparison to the drawdown pool water measurements. The temperature was slightly cooler and the DO slightly higher than the averages observed in the pool; however, they were not outside the range of observations (**Table 2**).

Table 2. North Branch of the Mill River – Wilbraham Road Culvert Dissolved Oxygen and Temperature Measurements
Date of Data Collection: 06/24/2021 1:30 PM

North Branch of Mill River Wilbraham Road Culvert			
Sampling Location	**Channel depth**	**DO (mg/l)**	**Temp °C**
20'± upgradient of culvert, mid channel	<1 ft	8.8	19.2
20'± downgradient of culvert, mid channel	<1 ft	9.2	19.2

The average DO concentration at each depth range of the water column is shown in **Table 3**. Because the DO concentration changed little over depth, the entire water column is above 7.1 mg/l; well above the action level of 5.0 mg/l. The slight elevation of DO near the bottom surface at two locations is suggestive of initial start of growth bottom filamentous green algae.

Table 3. Hypsometric Distribution of Lake Volume and Dissolved Oxygen by Depth

Depth (ft)	Acres Encompassed by Contour Depth	Water column volume by depth interval (CF)	% vol. of water column within depth interval	Cum. % vol. above interval depth	Average DO (mg/l)
0-1	17.2	623,461.9	58.4	58.4	7.7
1-2	11.6	335,447.7	31.4	89.8	8.3
2-3	4.3	96,265.6	9.0	98.8	8.6
3-4	0.63	11,608.4	1.1	99.9	8.8
4-5	0.03	435.0	0	99.9	9.3
Total		1,067,218.6			

Groundwater levels were measured at the six stations by auguring a 3-inch diameter hole to a depth of at least 24 inches and allowing time for equilibration. The observed depths to groundwater are shown in **Table 4**.

Table 4. Watershops Pond Drawdown Groundwater Monitoring Measurements (inches below ground surface)
Date of Data Collection: 05/24/2021 11:00AM – 12:30 PM

	Springfield College	Springfield College East Campus		GYSGT J. Sullivan Park		
Date	**Station 1**	**Station 1**	**Station 2**	**Station 1**	**Station 2**	**Station 3**
06/24/2021	-24+	-24+	-24+	-24	-14	-8
Note: Depths denoted with a "+" indicate that groundwater was not observed at this depth						

DISCUSSION

The Plan suggested the action level for DO should be 5 mg/l for at least 75% of the surface waters in the residual pool. During the June 2021 monitoring event, this standard was met as the average DO concentration exceeded 7.7 mg/l at all contour elevations. This result is more in line with expectations than the May 27, 2021, sampling event and indicates that the water temperature is slowly increasing with increased air temperatures.

As temperatures continue to increase, it is likely that DO levels will markedly decrease. Based upon the average DO concentration observed at the end of the 2020 growing season in late September, there might be reason to reconsider the "5 mg/l for at least 75% of the surface waters" action level. The average DO concentration observed in late September under normal pond conditions indicated approximately 67% of the pond volume met the suggested minimum DO of 5 mg/l. This indicates that the Watershops Pond biota likely experience lower average DO concentrations across a large percentage of the basin on a normal basis, especially since the September sampling event represented less extreme conditions than those likely to be encountered during peak summer months. While no change of the standard is recommended at this time, the action level to trigger mitigation measures such as aeration may want to be reconsidered as the 2021 growing season progresses. Nevertheless, with about 90% of the residual pool basin less than 2 feet deep, shallow adequate DO levels may persist due to wind perturbation of the pool surface.

Further, while the May DO level was below the mitigation threshold, the rapid and sustained rebound of DO level by June 2 and June 24 supports the hypothesis that the DO results in May were a result of a watershed event and were not a drawdown-induced seasonal event.

The groundwater levels in the wetlands were expected to drop with the Watershops Pond drawdown. Groundwater depths will continue to be monitored throughout the growing season. These data will be discussed and analyzed further in the annual wetland monitoring report. Following the refilling of the pool, wetland impacts, and potential mitigation measures will be discussed.

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RESILIENCY IMPROVEMENTS AT WATERSHOPS POND DAM
DRAWDOWN PERIOD MONITORING REPORT #7

JULY 19, 2021

For Compliance with:

Order of Conditions, DEP File No. 294-0607, issued 09/17/2020

Section 401 Water Quality Certification, BRP WW 08, DEP Transmittal No. X286704, issued 07/23/2021

Section 404 Permit, File No. NAE-2020-02301, issued 10/21/2020

Certificate on the SEIR, Secretary of Energy and Environmental Affairs, EOEEA No. 16234, issued 07/31/2020

Prepared by: Adrienne Dunk , Paul G. Davis, PhD
Reviewed by: Tom Jenkins, P.E.

INTRODUCTION AND METHODOLOGY

In compliance with authorized procedures approved under the above-referenced permits and authorizations, GZA is monitoring dissolved oxygen levels, temperature, and transparency during the period of drawdown associated with the Resiliency Improvements at Watershops Pond Dam Project. This report presents the results of the seventh monitoring event conducted during the period of drawdown, which commenced with the opening of the low-level outlets at the dam on October 26, 2020. During the winter drawdown period, dissolved oxygen monitoring will occur at a frequency of once every 2 months. From March through October, during the growing season, monitoring will occur monthly.

Ecological resource monitoring was initially identified as a means to gauge the environmental impacts associated with a partial or full drawdown of Watershops Pond that may occur during the Project. The monitoring was discussed conceptually in the Alternatives Analysis included in the Expanded Environmental Notification Form (EENF) for the Project (EOEEA No. 16234, EENF dated June 15,2020). On July 31, 2020, the Secretary of Energy and Environmental Affairs issued her Certificate on the EENF requiring the preparation of a Single Environmental Impact Report (SEIR). In response to comments received on the EENF and in response to the Secretary's Certificate on the EENF, a detailed draft "Aquatic and Wetland Resource Monitoring and Mitigation Plan"; the "Plan") was developed in coordination with regulatory agencies and was submitted as an integral mitigation commitment detailed within the SEIR dated August 28, 2020. The Plan was referenced in the Secretary's Certificate on the SEIR (October 16, 2020) and became a mitigation requirement associated with the City of Springfield's Preferred Alternative of full pond drawdown during the Project. The basic elements of the Plan were developed based upon prior studies of the pond and consultations with the Springfield Conservation Commission and State and Federal regulatory officials.

A copy of the Plan was provided in **Appendix 1**. to the "Pre-Drawdown Ecological Monitoring Report," GZA, September 2020.

During the winter drawdown period, dissolved oxygen monitoring occurred at a frequency of once every 2 months. From March through October, during the growing season, dissolved oxygen and groundwater monitoring occurs monthly. Within the Pond, vertical profiles are being conducted at the three locations and Dissolved Oxygen (DO) and Temperature (°C) were measured at one-foot depth intervals. Secchi disk depth is recorded at each site. Vegetation community monitoring occurs twice per growing season, in late May and between August 15 and September 15. Groundwater and vegetation community monitoring is being conducted at the six stations located at the three BVWs identified during the pre-drawdown report and depicted on **Figures 2 through 4**. This report presents the results of the seventh monitoring event conducted during the period of drawdown, which commenced with the opening of the low-level outlets at the dam on October 26, 2020.

The current monitoring event was conducted on July 19, 2021. Monitoring was repeated at the two locations selected during the first sampling event, conducted December 15, 2020 and a third sampling location near the dam which was added on March 23, 2021, to take advantage of deeper residual pool depth for monitoring (see **Figure 1A** for data collection locations).

RESULTS

The Watershops Pond residual pool encompasses about 125.5 acres upgradient of the dam where the water exits the pond basin through the sluice gates. The maximum pool depth observed was 15 feet deep, with most of the pool area ranging from 12 to 15 feet deep. The height of the pool was determined by measuring the surface water elevation below the deck of the privately-owned steel bridge located approximately 200 feet upstream of the dam. The measured surface water elevation was at Elevation 150.95± which is approximately 10.25± feet higher than the water surface elevation that was measured on May 27, 2021, or as measured in December 2020. Between July 1 and July 19, 2021, approximately 10.2± inches of rain have fallen in the Springfield area.

Based upon the Secchi Disk depth, the water within the pool basin was observed to be more turbid than the April or June sampling events which had Secchi Disk depths recorded at 1.5-3.0 feet and >0.5-2.7 feet respectively.

Watershops Pond had an average temperature of 22.2° C for locations measured. The measured temperatures ranged from 21.3° C to 23.7° C. The maximum DO observed was 5.8 at multiple locations (**Table 1**).

Table 1. Watershops Pond Drawdown Pool Dissolved Oxygen, Temperature, and Secchi Depth Measurements
Date of Data Collection: 07/19/2021 1:30 PM – 2:30 PM

Date: 07/19/2021 Time: 1:20 PM											
Surface Water Elevation: 150.95 ' (note: chisel mark on pond side of pier made at 12.00' below bridge deck)											
Location: Main Body, Near Dam, East of Steel (private) Bridge; 42°05.861 N; 072°33.624 W				**Location: Main Body, Central Pond, East of RR Bridge; 42°05.940 N; 072°33.345 W**				**Location: Main Body, Near Dam, 100'± West of Steel (private) Bridge; 42°05.848 N; 072°33.735 W**			
Secchi Depth (ft)	**Depth (ft)**	**DO (mg/l)**	**Temp °C**	**Secchi Depth (ft)**	**Depth (ft)**	**DO (mg/l)**	**Temp °C**	**Secchi Depth (ft)**	**Depth (ft)**	**DO (mg/l)**	**Temp °C**
1.75	0	5.7	23.7	2.1	0	5.6	22.7	1.75	0	5.7	22.9
	1	5.8	23.7		1	5.5	22.5		1	5.8	22.7
	2	5.6	23.2		2	5.5	22.4		2	5.8	22.6
	3	5.5	22.5		3	5.5	22.5		3	5.7	22.5
	4	5.5	22.3		4	5.4	22.4		4	5.7	22.5
	5	5.5	22.3		5	5.5	22.4		5	5.7	22.4
	6	5.5	22.3		6	5.4	22.0		6	5.7	22.4
	7	5.5	22.2		7	5.5	21.6		7	5.6	22.4
	8	5.5	22.0		8	5.5	21.5		8	5.6	22.3
	9	5.5	21.9		9	5.5	21.4		9	5.6	22.1
	10	5.4	21.8		10	5.4	21.4		10	5.55	22.0
	11	5.4	21.8		11	5.4	21.4		11	5.6	21.9
	12	5.4	21.8		12	5.4	21.4		12	5.5	21.9
	13.0 bottom	5.4	21.8		12.5 bottom	5.2	21.3		13	5.6	21.8
									14	5.5	21.8
									15.0 bottom	5.3	21.8

*Aerator installed near this location in mid-July 2021; however, it was not operating at time of sampling.

The average DO concentration at each depth range of the water column is shown in **Table 3**. Because the DO concentration changed little over depth, the entire water column is above 5.2 mg/l; above the action level of 5.0 mg/l. The slight elevation of DO near the bottom surface at two locations is suggestive of initial start of growth bottom filamentous green algae.

Table 3. Hypsometric Distribution of Lake Volume and Dissolved Oxygen by Depth

Depth (ft)	Acres Encompassed by Contour Depth	Water column volume by depth interval (CF)	% vol. of water column within depth interval	Cum. % vol. above interval depth	Average DO (mg/l)
0-1	125.5	5,178,393.9	19.6	19.6	5.7
1-2	112.4	4,469,620.2	16.9	36.5	5.7
2-3	93.1	3,593,650.4	13.6	50.1	5.6
3-4	72.3	2,850,450.2	10.8	60.9	5.6
4-5	58.8	2,321,613.8	8.8	69.7	5.5
5-6	48.0	1,930,250.4	7.2	76.9	5.6
6-7	40.7	1,650,247.5	6.2	83.1	5.5
7-8	35.1	1,412,099.0	5.3	88.4	5.5
8-9	29.8	1,135,237.4	4.2	92.6	5.5
9-10	22.5	860,941.9	3.3	95.9	5.5
10-11	17.2	623,461.9	2.4	98.3	5.5
11-12	11.6	335,447.7	1.3	99.6	5.4
12-13	4.3	96,265.6	0.4	100	5.4
13-14	0.63	11,608.4	0.0	100	5.5
14-15	0.03	435.0	0.0	100	5.3
Total		26,469,722.4			

Additional temperature and DO data collection was conducted at the sixth monitoring event up- and downgradient of the Wilbraham Road culvert along the North Branch of the Mill River for comparison to the drawdown pool water measurements in the May 2021 report. These data were not collected in July 2021 as the water level was too high and safety concerns prohibited sampling in these locations.

Groundwater levels were measured at the six stations by auguring a 3-inch diameter hole to a depth of at least 24 inches and allowing time for equilibration. The observed depths to groundwater are shown in **Table 4**.

Table 4. Watershops Pond Drawdown Groundwater Monitoring Measurements (inches below ground surface)
Date of Data Collection: 7/19/2021 11:00AM – 12:30 PM

	Springfield College	Springfield College East Campus		GYSGT J. Sullivan Park		
Date	**Station 1**	**Station 1**	**Station 2**	**Station 1**	**Station 2**	**Station 3**
7/19/2021	-24+	-24+	-24+	-12	-5	-1
Note: Depths denoted with a "+" indicate that groundwater was not observed at this depth						

DISCUSSION

The Plan suggested the action level for DO should be 5 mg/l for at least 75% of the surface waters in the residual pool. During the July 19, 2021, monitoring event, this standard was met as the average DO concentration exceeded 5.3 mg/l at all contour elevations. This result is in line with expectations and indicates that the water temperature is slowly increasing and DO decreasing with increased air temperatures.

As temperatures continue to increase, it is likely that DO levels will markedly decrease. Based upon the average DO concentration observed at the end of the 2020 growing season in late September, there might be reason to reconsider the "5 mg/l for at least 75% of the surface waters" action level. The average DO concentration observed in late September under normal pond conditions indicated approximately 67% of the pond volume met the suggested minimum DO of 5 mg/l. This indicates that the Watershops Pond biota likely experience lower average DO concentrations across a large percentage of the basin on a normal basis, especially since the September sampling event represented less extreme conditions than those likely to be encountered during peak summer months. While no change of the standard is recommended at this time, the action level to trigger mitigation measures such as aeration may want to be reconsidered as the 2021 growing season progresses. Nevertheless, with about 90% of the residual pool basin less than 2 feet deep, during most 2021 sampling events, shallow adequate DO levels may persist due to wind perturbation of the pool surface. GZA will continue to monitor the pond conditions and initiate discussions should the DO not meet the currently suggested attainment standards.

Though increased water elevation was anticipated due to the significant precipitation in the first half of July, the 10-foot range exceeded expectations. Future sampling events are unlikely to encounter this water elevation again. The sustained rainfall over time did not result in as significant an increase in turbidity and decrease in DO as observed in May. This may be due to the frequency of rain events. In May, the rainfall was preceded by dry weather, where July has had rainfall every or every-other day. This consistent rainfall may not mobilize as much sediment, or it may flush the water through the system more quickly. Additionally, the rain may result in more oxygenated water entering the pond, or the surface perturbation may be sustaining DO levels above the action threshold.

The groundwater levels in the wetlands were expected to drop with the Watershops Pond drawdown. Given the significant rainfall in July, these depths to groundwater decreased at three stations within the sampled depth. Groundwater depths will continue to be monitored throughout the growing season. These data will be discussed and analyzed further in the annual wetland monitoring report. Following the refilling of the pool, wetland impacts, and potential mitigation measures will be discussed.

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RESILIENCY IMPROVEMENTS AT WATERSHOPS POND DAM
DRAWDOWN PERIOD MONITORING REPORT #8

August 9, 2021

For Compliance with:

Order of Conditions, DEP File No. 294-0607, issued 09/17/2020

Section 401 Water Quality Certification, BRP WW 08, DEP Transmittal No. X286704, issued 07/23/2021

Section 404 Permit, File No. NAE-2020-02301, issued 10/21/2020

Certificate on the SEIR, Secretary of Energy and Environmental Affairs, EOEEA No. 16234, issued 07/31/2020

Prepared by: Adrienne Dunk , Paul G. Davis, PhD
Reviewed by: Tom Jenkins, P.E.

INTRODUCTION AND METHODOLOGY

In compliance with authorized procedures approved under the above-referenced permits and authorizations, GZA is monitoring dissolved oxygen levels, temperature, and transparency during the period of drawdown associated with the Resiliency Improvements at Watershops Pond Dam Project. This report presents the results of the eighth monitoring event conducted during the period of drawdown, which commenced with the opening of the low-level outlets at the dam on October 26, 2020. During the winter drawdown period, dissolved oxygen monitoring will occur at a frequency of once every 2 months. From March through October, during the growing season, monitoring will occur monthly.

Ecological resource monitoring was initially identified as a means to gauge the environmental impacts associated with a partial or full drawdown of Watershops Pond that may occur during the Project. The monitoring was discussed conceptually in the Alternatives Analysis included in the Expanded Environmental Notification Form (EENF) for the Project (EOEEA No. 16234, EENF dated June 15,2020). On July 31, 2020, the Secretary of Energy and Environmental Affairs issued her Certificate on the EENF requiring the preparation of a Single Environmental Impact Report (SEIR). In response to comments received on the EENF and in response to the Secretary's Certificate on the EENF, a detailed draft "Aquatic and Wetland Resource Monitoring and Mitigation Plan"; the "Plan") was developed in coordination with regulatory agencies and was submitted as an integral mitigation commitment detailed within the SEIR dated August 28, 2020. The Plan was referenced in the Secretary's Certificate on the SEIR (October 16, 2020) and became a mitigation requirement associated with the City of Springfield's Preferred Alternative of full pond drawdown during the Project. The basic elements of the Plan were developed based upon prior studies of the pond and consultations with the Springfield Conservation Commission and State and Federal regulatory officials.

A copy of the Plan was provided in **Appendix 1**. to the "Pre-Drawdown Ecological Monitoring Report," GZA, September 2020.

During the winter drawdown period, dissolved oxygen monitoring occurred at a frequency of once every 2 months. From March through October, during the growing season, dissolved oxygen and groundwater monitoring occurs monthly. Within the Pond, vertical profiles are being conducted at the three locations and Dissolved Oxygen (DO) and Temperature (°C) were measured at one-foot depth intervals. Secchi disk depth is recorded at each site. Vegetation community monitoring occurs twice per growing season, in late May and between August 15 and September 15. Groundwater and vegetation community monitoring is being conducted at the six stations located at the three BVWs identified during the pre-drawdown report and depicted on **Figures 2 through 4**. This report presents the results of the eighth monitoring event conducted during the period of drawdown, which commenced with the opening of the low-level outlets at the dam on October 26, 2020.

The current monitoring event was conducted on August 9, 2021. Monitoring was repeated at the two locations selected during the first sampling event, conducted December 15, 2020 and a third sampling location near the dam which was added on March 23, 2021 to take advantage of deeper residual pool depth for monitoring (see **Figure 1A** for data collection locations).

RESULTS

The Watershops Pond residual pool encompasses about 22.5 acres upgradient of the dam where the water exits the pond basin through the sluice gates. The maximum pool depth observed was 5 feet deep, with most of the pool area ranging from 3 to 5 feet deep. The height of the pool was determined by measuring the surface water elevation below the deck of the privately-owned steel bridge located approximately 200 feet upstream of the dam. The measured surface water elevation was at Elevation 141.95± which is approximately 9± feet lower than the water surface elevation that was measured on July 19, 2021 and is approximately 1.25± higher than measured in December 2020. Between July 1 and July 19, 2021, approximately 10.2± inches of rain fell in the Springfield area; however, since July 20, 2021, less than one (1) inch of rain fell.

Based upon the Secchi Disk depth, the water within the pool basin was observed to be similarly turbid to the July sampling event which recorded Secchi Disk depths of 1.75-2.1 feet.

Watershops Pond had an average temperature of 22.8° C for locations measured. The measured temperatures ranged from 19.6° C to 24.5° C. The maximum DO observed was 9.6 at one location (**Table 1**).

Table 1. Watershops Pond Drawdown Pool Dissolved Oxygen, Temperature, and Secchi Depth Measurements
Date of Data Collection: 08/09/2021 13:00 PM – 14:00 PM

Date: 08/09/2021 Time: 1:20 PM											
Surface Water Elevation: 141.95' (note: chisel mark on pond side of pier made at 12' below bridge deck)											
Location: Main Body, Near Dam, East of Steel Bridge; 42°05.861 N; 072°33.624 W				**Location: Main Body, Central Pond, East of RR Bridge; 42°05.940 N; 072°33.345 W**				**Location: Main Body, Near Dam, 100'± West of Steel Bridge; 42°05.843 N; 072°33.960 W***			
Secchi Depth (ft)	**Depth (ft)**	**DO (mg/l)**	**Temp °C**	**Secchi Depth (ft)**	**Depth (ft)**	**DO (mg/l)**	**Temp °C**	**Secchi Depth (ft)**	**Depth (ft)**	**DO (mg/l)**	**Temp °C**
1.5	0	9.4	24.2	1.5	0	9.6	24.5	1.5	0	9.2	24.0
	1	9.4	24.2		1	9.5	24.5		1	9.2	23.9
	2	9.2	23.4		2.0 bottom	7.3	24.5		2	9.0	22.9
	3	8.5	20.8						3	8.6	22.4
	4	8.4	19.9						4	8.3	21.7
	5.0 bottom	7.9	19.6						5.0 bottom	8.0	21.5

*Aerator installed near this location in mid-July 2021; aerator was in operation at time of sampling.

The average DO concentration at each depth range of the water column is shown in **Table 3**. Because the DO concentration changed little over depth, the entire water column is above 7.3 mg/l; well above the action level of 5.0 mg/l. The slight depression of DO near the bottom surface at two locations is suggestive of the influence of the anoxic sediments and decomposition of benthic organic material.

Table 3. Hypsometric Distribution of Lake Volume and Dissolved Oxygen by Depth

Depth (ft)	**Acres Encompassed by Contour Depth**	**Water column volume by depth interval (CF)**	**% vol. of water column within depth interval**	**Cum. % vol. above interval depth**	**Average DO (mg/l)**
0-1	22.5	860,941.9	44.7	44.7	9.4
1-2	17.2	623,461.9	32.3	77	9.4
2-3	11.6	335,447.7	17.4	94.4	8.5
3-4	4.3	96,265.6	5.0	99.4	8.6
4-5	0.63	11,608.4	0.6	100.0	8.4
5-6	0.03	435.0	0.0	100.0	8.0
Total		1,928,160.5			

Groundwater levels were measured at the six stations by auguring a 3-inch diameter hole to a depth of at least 24 inches and allowing time for equilibration. The observed depths to groundwater are shown in **Table 4**.

Table 4. Watershops Pond Drawdown Groundwater Monitoring Measurements (inches below ground surface)
Date of Data Collection: 08/09/2021 14:00 PM – 15:30 PM

	Springfield College	Springfield College East Campus		GYSGT J. Sullivan Park		
Date	**Station 1**	**Station 1**	**Station 2**	**Station 1**	**Station 2**	**Station 3**
8/9/2021	-24+	-24+	-24+	-17	-11	-3
Note: Depths denoted with a "+" indicate that groundwater was not observed at this depth						

DISCUSSION

The Plan suggested the action level for DO should be 5 mg/l for at least 75% of the surface waters in the residual pool. During the August 2021 monitoring event, this standard was met as the average DO concentration exceeded 8.0 mg/l at all contour elevations. This result demonstrates an increase in DO from July and may be reflective of increased flow through the pond which was noted to be the strongest to date.

As temperatures continue to increase, it is likely that DO levels will decrease again. Based upon the average DO concentration observed at the end of the 2020 growing season in late September, there might be reason to reconsider the "5 mg/l for at least 75% of the surface waters" action level. The average DO concentration observed in late September under normal pond conditions indicated approximately 67% of the pond volume met the suggested minimum DO of 5 mg/l. This indicates that the Watershops Pond biota likely experience lower average DO concentrations across a large percentage of the basin on a normal basis, especially since the September sampling event represented less extreme conditions than those likely to be encountered during peak summer months. While no change of the standard is recommended at this time, the action level to trigger mitigation measures such as aeration may want to be reconsidered as the 2021 growing season progresses. Nevertheless, with about 90% of the residual pool basin less than 2 feet deep, during most 2021 sampling events, shallow adequate DO levels may persist due to wind perturbation of the pool surface.

The groundwater levels in the wetlands were expected to drop with the Watershops Pond drawdown. Given the lack of rain since mid-July, the depths to groundwater decreased from the July sampling event, which were at a seasonal high. These data will be discussed and analyzed further in the annual wetland monitoring report. Following the refilling of the pool, wetland impacts, and potential mitigation measures will be considered, if necessary.

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RESILIENCY IMPROVEMENTS AT WATERSHOPS POND DAM
DRAWDOWN PERIOD MONITORING REPORT #9

SEPTEMBER 14, 2021

For Compliance with:

Order of Conditions, DEP File No. 294-0607, issued 09/17/2020

Section 401 Water Quality Certification, BRP WW 08, DEP Transmittal No. X286704, issued 07/23/2021

Section 404 Permit, File No. NAE-2020-02301, issued 10/21/2020

Certificate on the SEIR, Secretary of Energy and Environmental Affairs, EOEEA No. 16234, issued 07/31/2020

Prepared by: Paul G. Davis, PhD, Adrienne Dunk
Reviewed by: Tom Jenkins, P.E.

INTRODUCTION AND METHODOLOGY

In compliance with authorized procedures approved under the above-referenced permits and authorizations, GZA is monitoring dissolved oxygen levels, temperature, and transparency during the period of drawdown associated with the Resiliency Improvements at Watershops Pond Dam Project. This report presents the results of the ninth monitoring event conducted during the period of drawdown, which commenced with the opening of the low-level outlets at the dam on October 26, 2020. During the winter drawdown period, dissolved oxygen monitoring will occur at a frequency of once every 2 months. From March through October, during the growing season, monitoring will occur monthly.

Ecological resource monitoring was initially identified as a means to gauge the environmental impacts associated with a partial or full drawdown of Watershops Pond that may occur during the Project. The monitoring was discussed conceptually in the Alternatives Analysis included in the Expanded Environmental Notification Form (EENF) for the Project (EOEEA No. 16234, EENF dated June 15, 2020). On July 31, 2020, the Secretary of Energy and Environmental Affairs issued the Certificate on the EENF requiring the preparation of a Single Environmental Impact Report (SEIR). In response to comments received on the EENF and in response to the Secretary's Certificate on the EENF, a detailed draft "Aquatic and Wetland Resource Monitoring and Mitigation Plan"; the "Plan") was developed in coordination with regulatory agencies and was submitted as an integral mitigation commitment detailed within the SEIR dated August 28, 2020. The Plan was referenced in the Secretary's Certificate on the SEIR (October 16, 2020) and became a mitigation requirement associated with the City of Springfield's Preferred Alternative of full pond drawdown during the Project. The basic elements of the Plan were developed based upon prior studies of the pond and consultations with the Springfield Conservation Commission and State and Federal regulatory officials.

A copy of the Plan was provided in **Appendix 1** to the "Pre-Drawdown Ecological Monitoring Report," GZA, September 2020.

During the winter drawdown period, dissolved oxygen monitoring occurred at a frequency of once every 2 months. From March through October, during the growing season, dissolved oxygen and groundwater monitoring occurs monthly. Within the Pond, vertical profiles are being conducted at the three locations and Dissolved Oxygen (DO) and Temperature (°C) are measured at one-foot depth intervals. Secchi disk depth is recorded at each site. Vegetation community monitoring occurs twice per growing season, in late May and between August 15 and September 15. Groundwater and vegetation community monitoring is being conducted at the six stations located at the three BVWs identified during the pre-drawdown report and depicted on **Figures 2 through 4**. This report presents the results of the ninth monitoring event conducted during the period of drawdown, which commenced with the opening of the low-level outlets at the dam on October 26, 2020.

The second 2021 growing-season vegetation community monitoring took place on September 8, 2021.

The current water quality monitoring event was conducted on September 14, 2021. Monitoring was repeated at the two locations selected during the first sampling event, conducted December 15, 2020, and at a third sampling location near the dam which was added on March 23, 2021, to take advantage of deeper residual pool depth for monitoring (see **Figure 1A** for data collection locations).

RESULTS

The Watershops Pond residual pool encompasses 23± acres upgradient of the dam where the water exits the pond basin through the sluice gates. At low water, the maximum pool depth observed was 4.5 feet, with most of the pool area less than 3 feet deep. However, pool depths tend to vary during monitoring dates due to slight variations in monitoring locations as well as variable head height at the dam outlet due to rainfall and stream flow variation. The height of the pool was determined by measuring the surface water elevation below the deck of the privately-owned steel bridge located approximately 200 feet upstream of the dam. The measured surface water elevation was at Elevation 141.3± which is approximately 0.65± feet lower than the water surface elevation that was measured in August 2021 and approximately 0.60± feet higher than measured in December 2020.

Based upon the Secchi Disk depth, the water within the pool basin was observed to be less turbid than the August sampling event which recorded Secchi Disk depths of 1.5 feet.

Watershops Pond had an average temperature of 21.2° C for locations measured. The measured temperatures ranged from 20.6° C to 23.2° C. The maximum DO observed was 9.1 at one location (**Table 1**).

Table 1. Watershops Pond Drawdown Pool Dissolved Oxygen, Temperature, and Secchi Depth Measurements
Date of Data Collection: 09/14/2021 2:30-3:30 PM

Date: 09-14-2021			**Time: 2:40 PM**								
Surface Water Elevation: 141.30 (Note: chisel mark on pond side of pier made at 12.00' below bridge deck)											
Location: Main Body, Near Dam, East of Steel Bridge; 42°05.861 N; 072°33.624 W				**Location: Main Body, Central Pond, East of RR Bridge; 42°05.940 N; 072°33.345 W**				**Location: Main Body, Near Dam, 100'± West of Steel Bridge; 42°05.848 N; 072°33.735 W***			
Secchi Depth (ft)	**Depth (ft)**	**DO (mg/l)**	**Temp °C**	**Secchi Depth (ft)**	**Depth (ft)**	**DO (mg/l)**	**Temp °C**	**Secchi Depth (ft)**	**Depth (ft)**	**DO (mg/l)**	**Temp °C**
2.5	0	8.8	21.2	<1	0	8.6	23.2	2.25	0	8.8	21.1
	1	8.9	21.1		1.0 bottom	7.7	23.5		1	9.1	20.8
	2	8.8	21						2	9.1	20.7
	3	8.8	20.9						3	9.0	20.7
	4	8.8	20.6						4	8.9	20.6
	4.5 bottom	3.8	20.6						4.5 bottom	8.8	20.6

The average DO concentration at each depth range of the water column is shown in **Table 2**. Because the DO concentration changed little over depth, with the exception of one measurement, the average DO within the water column is above the action level of 5.0 mg/l. The depression of DO near the bottom surface at the sampling location east of the steel bridge is suggestive of the influence of the anoxic sediments and decomposition of benthic organic material.

Table 2. Hypsometric Distribution of Lake Volume and Dissolved Oxygen by Depth

Depth (ft)	**Acres Encompassed by Contour Depth**	**Water column volume by depth interval (CF)**	**% vol. of water column within depth interval**	**Cum. % vol. above interval depth**	**Average DO (mg/l)**
0-1	22.5	860,941.9	44.7	44.7	8.7
1-2	17.2	623,461.9	32.3	77.0	8.6
2-3	11.6	335,447.7	17.4	94.4	9.0
3-4	4.3	96,265.6	4.99	99.39	8.9
4-5	0.63	11,608.4	0.60	99.99	8.9
5-6	0.03	435.0	0.02	100	6.3
Total		1,927,709.6			

Groundwater levels were measured at the six stations by auguring a 3-inch diameter hole to a depth of at least 24 inches and allowing time for equilibration. The observed depths to groundwater are shown in **Table 3**.

Table 3. Watershops Pond Drawdown Groundwater Monitoring Measurements (inches below ground surface)
Date of Data Collection: 09/08/2021 11:00 AM – 1:00 PM

	Springfield College	**Springfield College East Campus**		**GYSGT J. Sullivan Park**		
Date	**Station 1**	**Station 1**	**Station 2**	**Station 1**	**Station 2**	**Station 3**
09/08/2021	-24+	-24+	-24+	-13	-6	0
Note: Depths denoted with a "+" indicate that groundwater was not observed at this depth						

Vegetation was also inventoried with percent cover estimated for each observed species at the six stations. No change in species or percent composition was observed in the tree canopy, shrub/sapling, or vine layers since the initial inventor in September 2020. Changes in the herbaceous layer are shown in **Table 4**.

Table 4. Watershops Pond Drawdown Wetland Vegetation Monitoring Herbaceous Vegetation Change
Date of Data Collection: 09/08/2021 11:00AM – 1:00PM

Species		Springfield College	Springfield College East Campus		GYSGT J. Sullivan Park		
Common Name	**Scientific Name**	**Station 1**	**Station 1**	**Station 2**	**Station 1**	**Station 2**	**Station 3**
Fleabane Daisy	*Erigeron annuus*	-trace					
Purple Loosestrife*	*Lythrum salicaria*				+trace	-9%	
Thistle	*Cirsium sp.*	+5%					
Glossy Buckthorn*	*Frangula alnus*		+8%				
Clearweed	*Pilea pumila*		-15%		-5%	+30%	
Barberpole Sedge	*Scirpus rubrotinctus*		-15%**				
Skunk cabbage	*Symplocarpus foetidus*		+5%	+5%			
Fringed Sedge	*Carex crinita*		+trace			+5%	
Swamp Beggar's Tick	*Bidens discoidea*		+2%			-trace	
Awl-fruit sedge	*Carex stipata*		+3%				
Arrowwood	*Viburnum dentatum*		-1%	+trace			
Red Oak	*Quercus rubra*			+trace			
Spinulous Wood Fern	*Drypoteris carthusiana*			-4%			
Pennsylvania Sedge	*Carex Pensylvanica*			-4%**			
Swamp Azalea	*Rhododendron vis-cosum*			-5%**			
Princess Pine	*Lycopodium obsurum*		+2%	+2%			
Jewelweed	*Impatiens capensis*				+5%	+40%	
Sensitive Fern	*Onoclea sensibilis*				+20%	-7%	
Duckweed	*Lemna minor*						-85%
Highbush Blueberry	*Vaccinium corymbosum*			+3%			
Bindweed	*Convolvulus spp.*			+5%		+5%	
Arrow-leaf Tear-thumb	*Persicaria sagittata*					+45%	
American Bur-reed	*Sparganium Ameri-canum*					-3%	
Broadleaf Cattail	*Typha latifolia*					-15%	
Smartweed	*Polygonum spp.*					+10%	
Water Horehound	*Lycopus americanus*		+3%				

Note:
"+" indicates an increase in percent cover from pre-drawdown conditions
"-" indicates a decrease in percent cover from pre-drawdown conditions
* indicates the species is considered invasive in Massachusetts
** indicates that the species may have previously been misidentified

DISCUSSION

The Plan suggested an action level for DO of 5 mg/l for at least 75% of the surface waters in the residual pool, with lesser values potentially triggering mitigation action. During the September 2021 monitoring event, this standard was met as the average DO concentration exceeded 6.3 mg/l at all contour elevations, and was 8.6 mg/l or greater for most elevations. This result demonstrates a similar DO level from August and may be reflective of continued flow through the pond given recent rain events.

As temperatures remain stable and then begin to lower, it is likely that the DO will continue to increase as the fall season approaches. Due to short-term low DO concentrations experienced in May 2021, a fountain aerator was installed in the lower pool area above the dam as a mitigation measure. While mitigation requirements have not been triggered since that time, the aerator has been in near continuous operation except during occasional periods of operational failure to due power outage.

The groundwater levels in the wetlands were expected to drop with the Watershops Pond drawdown. Given recent rain events, including Hurricane Henri and Tropical Storm Ida, the depths to groundwater decreased from August and were similar to the seasonal high water observed in July. Groundwater depths will continue to be monitored throughout the growing season and there may be a short-term shift in some herbaceous vegetation. More permanent vegetation in the tree canopy, shrub/sapling, and vine layers are not anticipated to change from the drawdown.

Most observed changes in herbaceous vegetation composition were not significant with the exception of duckweed. The percentage of duckweed coverage at Sullivan Park Station 3 decreased by 85%. Duckweed is an aquatic plant which floats at the top of the water column; however, there is no standing or ponded water at this sample station currently. The duckweed is anticipated to return when the pond is refilled. Other herbaceous vegetation which shifted over 20% included an increase of clearweed, sensitive fern, jewelweed, and arrow-leaf tear-thumb at Sullivan Park. These increases indicate that the wetland is receiving sufficient surface inundation and groundwater inputs to sustain a wetland habitat despite the drawdown. These data will be discussed and analyzed further in the annual wetland monitoring report. Following the refilling of the pool, wetland impacts, and potential mitigation measures will be discussed.

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RESILIENCY IMPROVEMENTS AT WATERSHOPS POND DAM
DRAWDOWN PERIOD MONITORING REPORT #10

OCTOBER 15, 2021

For Compliance with:

Order of Conditions, DEP File No. 294-0607, issued 09/17/2020

Section 401 Water Quality Certification, BRP WW 08, DEP Transmittal No. X286704, issued 07/23/2021

Section 404 Permit, File No. NAE-2020-02301, issued 10/21/2020

Certificate on the SEIR, Secretary of Energy and Environmental Affairs, EOEEA No. 16234, issued 07/31/2020

Prepared by: Paul G. Davis, PhD, Adrienne Dunk
Reviewed by: Tom Jenkins, P.E.

INTRODUCTION AND METHODOLOGY

In compliance with authorized procedures approved under the above-referenced permits and authorizations, GZA is monitoring dissolved oxygen levels, temperature, and transparency during the period of drawdown associated with the Resiliency Improvements at Watershops Pond Dam Project. This report presents the results of the tenth monitoring event conducted during the period of drawdown, which commenced with the opening of the low-level outlets at the dam on October 26, 2020. During the winter drawdown period, dissolved oxygen monitoring will occur at a frequency of once every 2 months. From March through October, during the growing season, monitoring will occur monthly.

Ecological resource monitoring was initially identified as a means to gauge the environmental impacts associated with a partial or full drawdown of Watershops Pond that may occur during the Project. The monitoring was discussed conceptually in the Alternatives Analysis included in the Expanded Environmental Notification Form (EENF) for the Project (EOEEA No. 16234, EENF dated June 15, 2020). On July 31, 2020, the Secretary of Energy and Environmental Affairs issued the Certificate on the EENF requiring the preparation of a Single Environmental Impact Report (SEIR). In response to comments received on the EENF and in response to the Secretary's Certificate on the EENF, a detailed draft "Aquatic and Wetland Resource Monitoring and Mitigation Plan"; the "Plan") was developed in coordination with regulatory agencies and was submitted as an integral mitigation commitment detailed within the SEIR dated August 28, 2020. The Plan was referenced in the Secretary's Certificate on the SEIR (October 16, 2020) and became a mitigation requirement associated with the City of Springfield's Preferred Alternative of full pond drawdown during the Project. The basic elements of the Plan were developed based upon prior studies of the pond and consultations with the Springfield Conservation Commission and State and Federal regulatory officials.

A copy of the Plan was provided in **Appendix 1** to the "Pre-Drawdown Ecological Monitoring Report," GZA, September 2020.

During the winter drawdown period, dissolved oxygen monitoring occurred at a frequency of once every 2 months. From March through October, during the growing season, dissolved oxygen and groundwater monitoring occurs monthly. Within the Pond, vertical profiles are being conducted at the three locations and Dissolved Oxygen (DO) and Temperature (°C) are measured at one-foot depth intervals. Secchi disk depth is recorded at each site. Vegetation community monitoring occurs twice per growing season, in late May and between August 15 and September 15. Groundwater and vegetation community monitoring is being conducted at the six stations located at the three BVWs identified during the pre-drawdown report and depicted on **Figures 2 through 4**. This report presents the results of the tenth monitoring event conducted during the period of drawdown, which commenced with the opening of the low-level outlets at the dam on October 26, 2020.

The current water quality monitoring event was conducted on October 15, 2021. Monitoring was repeated at the two locations selected during the first sampling event, conducted December 15, 2020, and at a third sampling location near the dam which was added on March 23, 2021 (see **Figure 1A** for data collection locations).

RESULTS

The Watershops Pond residual pool encompasses 23± acres upgradient of the dam where the water exits the pond basin through the sluice gates. At low water, the maximum pool depth observed was 4.5 feet, with most of the pool area less than 3 feet deep. However, pool depths tend to vary during monitoring dates due to slight variations in monitoring locations as well as variable head height at the dam outlet due to rainfall and stream flow variation. In addition, it appears there may have been some minor sediment repositioning within the shallower portions of the drawn-down basin presumably due to high-flow rainfall events. The height of the pool was determined by measuring the surface water elevation below the deck of the privately-owned steel bridge located approximately 200 feet upstream of the dam. The measured surface water elevation was at Elevation 140.95± which is approximately 0.45± feet lower than the water surface elevation that was measured in September 2021 and approximately 0.25± feet higher than measured in December 2020.

Based upon the Secchi Disk depth, the water within the pool basin was observed to be similarly turbid to the September sampling event which recorded Secchi Disk depths of 2.25–2.50 feet.

Watershops Pond had an average temperature of 18.5° C for locations measured. The measured temperatures ranged from 17.6° C to 21.7° C. The maximum DO observed was 9.2 mg/l (**Table 1**).

Table 1. Watershops Pond Drawdown Pool Dissolved Oxygen, Temperature, and Secchi Depth Measurements
Date of Data Collection: 10/15/2021 1:00 – 2:00 PM

Date: 10-15-2021			**Time: 1:30 PM**								
Surface Water Elevation: 140.95 (Note: chisel mark on pond side of pier made at 12.00' below bridge deck)											
Location: Main Body, Near Dam, East of Steel Bridge; 42°05.861 N; 072°33.624 W				**Location: Main Body, Central Pond, East of RR Bridge; 42°05.940 N; 072°33.345 W***				**Location: Main Body, Near Dam, 100'± West of Steel Bridge; 42°05.848 N; 072°33.735 W****			
Secchi Depth (ft)	**Depth (ft)**	**DO (mg/l)**	**Temp °C**	**Secchi Depth (ft)**	**Depth (ft)**	**DO (mg/l)**	**Temp °C**	**Secchi Depth (ft)**	**Depth (ft)**	**DO (mg/l)**	**Temp °C**
2.5	0	8.9	18.8	>0.5	0	8.6	21.7	2.5	0	9.2	17.8
	1	9.0	18.4		1	8.2	21.2		1	9.2	17.8
	2	9.0	18.2						2	9.2	17.8
	3	8.9	18.0						3	9.2	17.8
	4	8.9	17.8						4	9.2	17.7
	4.5	8.8	17.8						4.5	9.1	17.6

Note: * = Bottom sediment roiled by multiple carp at this sampling location; ** = Aerator in operation <10' downgradient of sampling point

The average DO concentration at each depth range of the water column is shown in **Table 2**. Because the DO concentration changed little over depth, the average DO within the water column is well above the action level of 5.0 mg/l.

Table 2. Hypsometric Distribution of Lake Volume and Dissolved Oxygen by Depth

Depth (ft)	**Acres Encompassed by Contour Depth**	**Water column volume by depth interval (CF)**	**% vol. of water column within depth interval**	**Cum. % vol. above interval depth**	**Average DO (mg/l)**
0-1	22.5	860,941.9	44.7	44.7	8.9
1-2	17.2	623,461.9	32.3	77.0	8.8
2-3	11.6	335,447.7	17.4	94.4	9.1
3-4	4.3	96,265.6	4.99	99.39	9.1
4-5	0.63	11,608.4	0.60	99.99	9.1
5-6	0.03	435.0	0.02	100	9.0
Total		1,927,709.6			

Groundwater levels were measured at the six stations by auguring a 3-inch diameter hole to a depth of at least 24 inches and allowing time for equilibration. The observed depths to groundwater are shown in **Table 3**.

Table 3. Watershops Pond Drawdown Groundwater Monitoring Measurements (inches below ground surface)
Date of Data Collection: 10/15/2021 2:00 PM – 3:00 PM

	Springfield College	**Springfield College East Campus**		**GYSGT J. Sullivan Park**		
Date	**Station 1**	**Station 1**	**Station 2**	**Station 1**	**Station 2**	**Station 3**
10/15/2021	-24+	-24+	-24+	-18	-13	-1
Note: Depths denoted with a "+" indicate that groundwater was not observed at this depth						

DISCUSSION

The Plan suggested an action level for DO of 5 mg/l for at least 75% of the surface waters in the residual pool, with lesser values potentially triggering mitigation action. During the October 2021 monitoring event, this standard was met as the average DO concentration exceeded 8.8 mg/l at all contour elevations. This result demonstrates an increased DO level from September and may be reflective of decreasing average temperatures and daylight.

As temperatures begin to lower, it is likely that the DO will continue to increase as the fall season progresses. Due to short-term low DO concentrations experienced in May 2021, a fountain aerator was installed in the lower pool area up-stream of the dam as a mitigation measure. While mitigation requirements have not been triggered since that time, the aerator has been in near continuous operation except during occasional periods of operational failure to due power out-age.

The groundwater levels in the wetlands were expected to drop with the Watershops Pond drawdown. Given the modest rain accumulation in early October, the depths to groundwater increased from September and are similar to the average depths observed throughout the drawdown period. Groundwater depths will continue to be monitored throughout the growing season. These data will be discussed and analyzed further in the annual wetland monitoring report. Following the refilling of the pool, wetland impacts, and potential mitigation measures will be discussed.

APPENDIX 3

WATERSHOPS POND VOLUME CALCULATIONS

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VOLUME CALCULATIONS

PER THE BATHYMETRIC DATA ACQUIRED BY CRE, INC.
MAY 12-19, 2020

ELEVATIONS AND ELEVATION AREAS PER CRE's GRID SURFACES:		VOLUME CALCULATIONS BY THE CONIC METHOD, IN CUBIC FEET	
ELEVATION	ELEVATION (Contour) AREA (SQFT)	INCREMENTAL VOLUME (BY CONIC METHODS, in Cubic Feet)	CUMULATIVE VOLUME (BY CONIC METHODS, in Cubic Feet)
135.5	0.0		0.0
136.5	1,305.3	435.1	435.1
137.5	27,525.7	11,608.4	12,043.5
138.5	189,120.8	96,265.6	108,309.1
139.5	507,437.0	335,447.7	443,756.8
140.5	**747,192.0**	**623,461.0**	**1,067,217.8**
141.5	**979,943.4**	**860,941.9**	**1,928,159.7**
142.5	1,297,967.9	1,135,237.4	3,063,397.1
143.5	1,529,392.5	1,412,099.0	4,475,496.1
144.5	1,774,128.3	1,650,247.5	6,125,743.6
145.5	2,090,701.5	1,930,250.4	8,055,994.0
146.5	2,560,453.5	2,321,613.8	10,377,607.8
147.5	3,150,639.2	2,850,450.2	13,228,057.9
148.5	4,055,681.0	3,593,650.4	16,821,708.3
149.5	4,896,758.4	4,469,620.2	21,291,328.5
150.5	5,465,231.1	5,178,393.9	26,469,722.4
151.5	5,888,878.0	5,675,736.8	32,145,459.2
152.5	6,312,275.4	6,099,351.9	38,244,811.2
153.5	6,664,743.4	6,487,711.4	44,732,522.6
154.5	7,865,357.8	7,256,769.2	51,989,291.8

GZA GeoEnvironmental, Inc.