APPENDIX H3 – MACROINVERTEBRATE COMMUNITY ANALYSIS FOR POND AT AOC 1

ANALYSIS OF THE AQUATIC MACROINVERTEBRATE COMMUNITY OF THE POND WITHIN THE BOUNDARIES OF THE FORMER SCHENECTADY ARMY DEPOT, GUILDERLAND, NEW YORK

Prepared for

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I. INTRODUCTION

Ichthyological Associates, Inc. (IA) was hired by Parsons Engineering Science, Inc. (Parsons), to conduct an analysis of the aquatic macroinvertebrate community of a pond within Area of Concern No. 1 (AOC-1) at the former Schenectady Army Depot in Guilderland, NY. This investigation was conducted in support of a remedial investigation of the site being performed by Parsons to address contamination at the site resulting from past operations at the depot. Aquatic macroinvertebrate samples and pertinent data on the physical and chemical characteristics of the sampling stations were collected by Parsons and provided to IA. IA processed the samples and analyzed the resultant data. This document presents the findings of IA's analysis of the pond's aquatic macroinvertebrate community.

II. METHODS

A. General Approach

The general approach used in this investigation involved replicate sampling of aquatic macroinvertebrates from the sediments of the pond from two distinct locations. A series of measures reflecting the biotic integrity of the aquatic macroinvertebrate communities from these two locations was calculated and the level of biological impairment (if any) at each sampling location was determined. Three replicate samples were collected from each sampling station to take account of the natural variability in macroinvertebrate distribution. Sample processing, macroinvertebrate identification, and data analysis followed protocols recommended in Bode et al. (2002) for Ponar grab samples from soft sediments. These protocols apply to samples collected from either riverine (stream, river) or lacustrine (lake, pond) habitats with substrates of gravel, sand, silt, and clay.

B. Sample Collection

Three replicate samples were collected from each of two stations. Parsons collected these samples using a petite ponar dredge. Dredge samples were sieved through a U.S. Standard No. 30 mesh sieve (0.59-mm opening) to remove fine sediment and preserved in 95% ethanol. Replicate samples were processed and preserved separately. The six collected samples were delivered to IA's laboratory in Lansing, NY the day after collection. Physical and chemical parameters were measured and recorded at each sampling station. These parameters included water depth, presence of aquatic vegetation, substrate composition, water temperature, dissolved oxygen, conductivity, pH, oxidation/reduction potential (ORP), and turbidity. Water chemistry parameters were measured near the water's surface and near the sediment's surface at both stations.

C. Sample Processing

Sample processing followed protocols described in Bode et al. (2002) for Ponar samples from soft sediments. In the laboratory, each sample was rinsed through a U.S. Standard No. 50 sieve (0.30-mm opening) to remove the preservative. The sample was then transferred to an enamel pan

and distributed homogeneously over the bottom of the pan. A randomly selected portion of the sample was then examined under magnification, and a subsample of 100 organisms was removed. Removed organisms were sorted into major groups and placed in vials containing 70% ethanol. Organisms were then enumerated and identified to the appropriate taxonomic level (usually genus or species) as defined in Bode et al. (2002).

D. Data Analysis and Interpretation

The aquatic macroinvertebrate community at each station was evaluated based on measures of various aspects of the macroinvertebrate community. Each measure, or metric, characterizes an aspect of the macroinvertebrate community that may be affected to varying degrees by environmental stress. This integrated approach provides a much broader perspective of the biotic integrity of a site than does use of any one metric alone. This approach is referred to as rapid bioassessment and is supported by the U.S. Environmental Protection Agency (USEPA) and used by the New York State Department of Environmental Conservation (NYSDEC) in assessing surface water quality (Barbour et al. 1999, Bode et al. 2002).

The metrics used address the taxonomic composition of the macroinvertebrate community and the overall and relative abundance of individual taxa within the community. Bode et al. (2002) recommend the use of five metrics for assessing the biotic integrity macroinvertebrate communities from soft sediment habitats. These metrics are: species richness, Hilsenhoff biotic index, Dominance-3, species diversity, and percent model affinity. A brief description of each metric follows.

1. **Species richness** reflects the health of the macroinvertebrate community through a measurement of the variety of taxa (total number of taxonomic entities) present. This value generally decreases with decreasing environmental quality, habitat diversity, and habitat suitability (Barbour et al. 1999). Stress due to the presence of toxic substances would also cause this value to decline (Klemm et al. 1990).

2. **Hilsenhoff biotic index (HBI)** is a value based on the tolerance of each taxon present to organic pollution and other environmental perturbations. Each taxon has a pre-assigned value based on its tolerance. The index is calculated by multiplying the number of individuals of each taxon by its assigned tolerance value, summing these products, and dividing by the total number of individuals in the sample. The HBI can range from 0-10, with zero being most intolerant of perturbation and 10 being most tolerant.

3. **Dominance-3** is the combined percent contribution of the three most numerous species in the community. High dominance values indicate unbalanced communities strongly dominated by one or more very abundant species (Bode et al. 2002).

4. **Species diversity** is a measure of the balance and distribution of numbers among the different taxa collected at a station. Several diversity indices are available; the Shannon-Wiener index (calculated with log base 2) was used in this investigation. High species diversity values usually indicate diverse, well-balanced communities, while low values indicate stress or impact (Bode et al. 2002).

5. **Percent model affinity** is a measure of similarity to a model non-impaired community based on the percent abundance in six (for Ponar samples) major groups of organisms. For Ponar samples, the model community is: 20% Oligochaeta, 15% Mollusca, 15% Crustacea, 20% non-Chironomidae, and 10% other (Bode et al. 2002). This model community is representative of a non-impaired community from riverine or lacustrine habitats with soft sediments. The level of impairment increases with increasing dissimilarity to the model community.

Each metric was calculated for each replicate sample. Values from replicate samples were averaged to obtain mean individual metric values for each sampling station. A qualitative assessment of the condition (level of biological impairment) of the macroinvertebrate community was then made by converting the mean metric values to a common scale (0-10, with 10 being the best possible score) and comparing the mean of the scores for each station with the biological assessment profile presented in Bode et al. (2002) for Ponar samples from soft sediments. The

biological assessment profile scale of impairment for Ponar samples from soft sediments takes into account the fact that the species composition of aquatic macroinvertebrate communities of lacustrine and slow-flowing riverine habitats naturally differs from that of communities from typical riverine habitats.

III. RESULTS

Collection of aquatic macroinvertebrate samples was conducted on July 20, 2004. Three replicate samples were collected from each of two stations. Station 1 was located near the northeast corner of the pond and was represented by samples SED-13, SED-14, and SED-15. Station 2 was located near the southwest corner of the pond and was represented by samples SED-16, SED-17, and SED-18.

A. Physical Attributes of Sampling Stations

A summary of the physical and chemical attributes of the two sampling stations is provided in Table 1. The pond itself is shallow (up to about 2.5 ft deep in the center), heavily vegetated with bladderwort (*Utricularia* sp.), and relatively clear. The sampling stations reflected these conditions. The two sampling stations were very similar physically, except that sand and gravel were present in the substrate at station 1 and generally absent from the substrate at station 2. Water quality measurements were somewhat different between the two stations, with station 1 having higher dissolved oxygen, water temperature, and pH and lower conductivity and ORP than station 2, at least near the water's surface where disturbed sediment did not interfere with the measurements. Despite the differences in water quality parameters at the two stations, water quality values were in a range that could support a desirable aquatic community.

B. Assessment of Biotic Integrity

The mean and range of values for each of the five metrics calculated for each sampling station are presented in Table 2. The taxonomic classifications and numbers of organisms identified from the three replicate samples from each station are provided in Appendix A. There was considerably more variability in metric values among the three replicates collected from station 1 than among the three replicates from station 2. In all cases, the mean metric value for station 1 was better than that of station 2.

The biological assessment profile analysis based on the mean metric scores for each station

indicates that the aquatic macroinvertebrate community of the pond at both stations is *slightly impaired* (Table 3). Such an assessment indicates that water and sediment quality is generally good, but the macroinvertebrate community is significantly altered from the pristine state (Bode et al 1991). The overall mean biological assessment profile value for station 1 was 7.3, only slightly below the value of 7.5 indicative of *non-impaired* conditions. Station 2 had a biological assessment profile value of 5.8, well below the 7.5 value indicative of *non-impaired* conditions but still above the value of 5.0 defining the lower end of the *slightly impaired* range.

The biological assessment profile values for individual metrics all fell within the *slightly* to *non-impaired* categories, except for the percent model affinity values for both stations (Figure 1). Percent model affinity scored in the poorer half of the *moderately impaired* range for both stations. The reason that this metric scored considerably poorer than the others is the lack of crustaceans (amphipods, isopods, crayfish) and oligochaetes (worms) in the sampled community. These groups of organisms typically constitute about 35% of an unimpaired aquatic macroinvertebrate community from soft sediments but were absent from all samples collected in this investigation. The absence of these two groups of organisms results in an imbalance in the community, lower species richness, and usually lower species diversity.

The biological assessment of the two sampling stations as *slightly impaired* is not unexpected given the waterbody sampled. The pond is a man-made environment, and as such is inherently a disturbed site. The shoreline and pond bottom are structurally monotonous, and the aquatic plant community is dominated by a single species, bladderwort. The land surrounding the pond also is not in a natural state. These over-arching habitat limitations are likely a contributing factor to the *slightly impaired* assessment of the pond's biological community.

IV. CONCLUSIONS

1. Analysis of the aquatic macroinvertebrate community of the pond in AOC-1 at the former Schenectady Army Depot property showed the community to be *slightly impaired*. This assessment indicates generally good water and sediment quality, but with a macroinvertebrate community that is significantly altered from a *non-impaired* state.

2. The level of impairment of the aquatic macroinvertebrate community was more pronounced at station 2 than at station 1. Biological assessment profile values for station 1 were generally in the *non-impaired* range, whereas biological assessment profile values for station 2 were generally in the *slightly impaired* range.

3. The lack of crustaceans and oligochaetes in the sampled community contributed to poor values for the percent model affinity metric, and also likely resulted in lower species richness and species diversity values.

4. The biological assessment of the two sampling stations as *slightly impaired* is not unexpected given the generally disturbed, monotonous nature of the pond. Over-arching habitat limitations are likely a contributing factor to the *slightly impaired* assessment of the pond's biological community.

V. LITERATURE CITED

Barbour, M. T., J. Gerritsen, B. D. Snyder, and J. B. Stribling. 1999. Rapid bioassessment protocols for use in streams and wadeable rivers: periphyton, benthic macroinvertebrates, and fish, second edition. EPA 841-B-99-002. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

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Table 1. Habitat parameters of the two stations sampled for aquatic macroinvertebrates in the pond in AOC-1 at the former Schenectady Army Depot property, July 20, 2004.

Parameter	Sampling Station	
	Station 1	Station 2
Date	7/20/04	7/20/04
Time	1010-1110	1140-1240
Depth (ft)	1.7	1.5
Substrate composition	dark gray silt and organics, trace gravel	dark gray silt and organics, trace shells
Aquatic vegetation	bladderwort	bladderwort
Water temperature (^{o}C):		
near surface	28.8	25.3
near bottom	26.2	23.4
Dissolved oxygen (ppm):		
near surface	15.09	10.78
near bottom	10.00+	6.30
Conductivity (S/m):		
near surface	0.985	1.19
near bottom	1.23	1.28
Turbidity (NTU):		
near surface	5.8	13.8
near bottom	323[a]	197[a]
ORP (mV):		
near surface	15	27
near bottom	172[a]	211[a]
pH:		
near surface	8.63	8.26
near bottom	7.59	7.25

[a] - The large differences between turbidity and ORP values near the surface versus near the bottom may be due to disturbance of silt on vegetation near the bottom by the water-quality probe.

Table 2. Mean and range of metric values for each sampling station in the pond in AOC-1 at the former Schenectady Army Depot, July 20, 2004.

Metric	Station 1	Station 2
Species richness		
Mean:	17.7	17.0
Range:	16.0-22.0	15.0-18.0
Hilsenhoff biotic index		
Mean:	6.89	7.27
Range:	6.24-7.39	6.54-7.81
Dominance-3		
Mean:	48.3	68.7
Range:	35.0-60.0	65.0-75.0
Species Diversity		
Mean:	3.57	2.92
Range:	3.15-4.07	2.70-3.14
Percent model affinity		
Mean:	47.7	43.0
Range:	41.0-56.0	42.0-44.0

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Table 3. Biological assessment profile scores for mean metric values calculated for each sampling station in the pond in AOC-1 at the former Schenectady Army Depot property, July 20, 2004.

Metric	Station 1	Station 2
Species richness	6.7	6.4
Hilsenhoff biotic index	7.8	6.8
Dominance-3	9.4	6.1
Species Diversity	8.9	7.1
Percent model affinity	3.5	2.6
OVERALL MEAN SCORE	7.3	5.8
OVERALL ASSESSMENT	Slightly impaired	Slightly impaired

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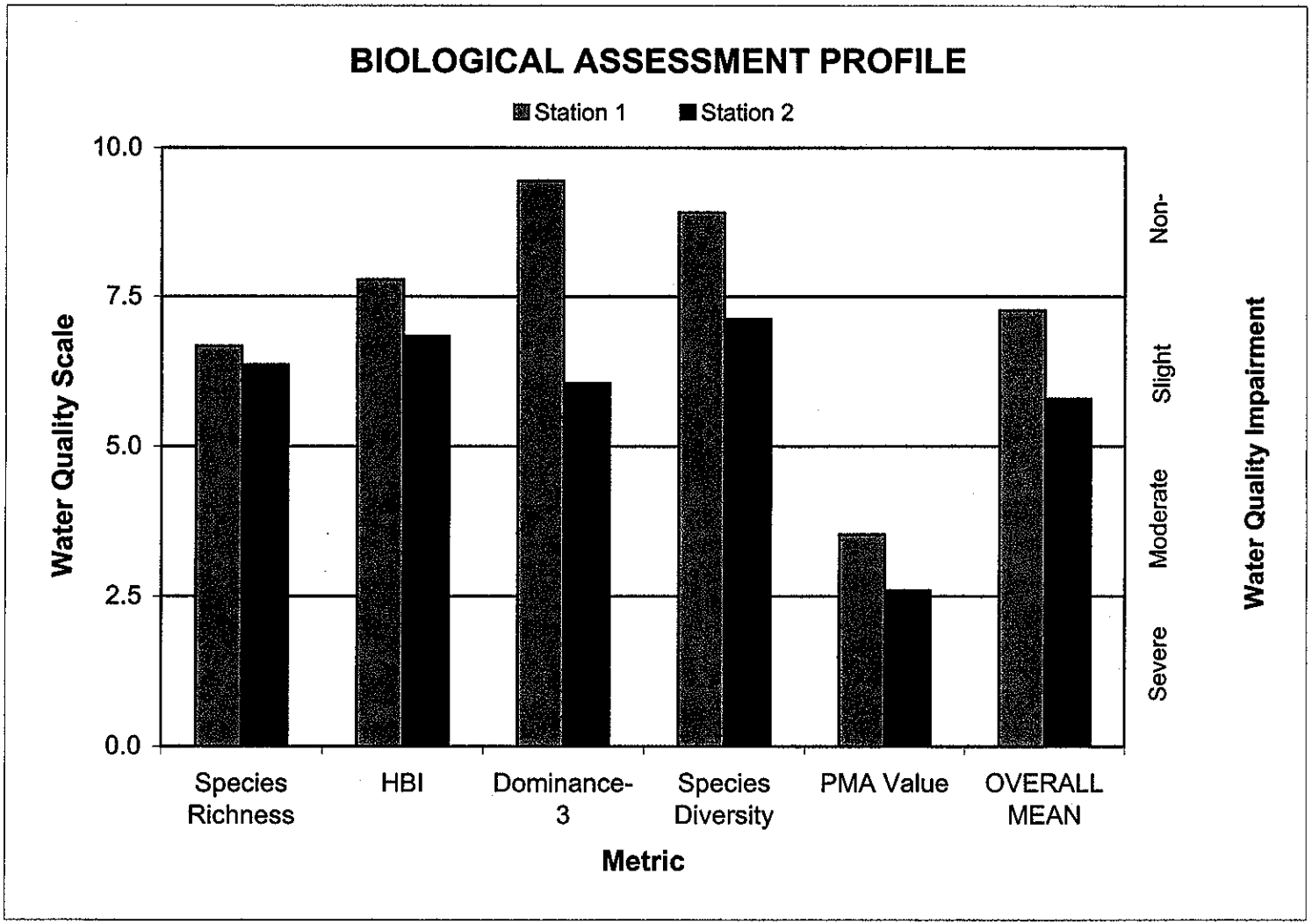

Figure 1. Biological assessment profile values for metrics calculated for station1 and station 2 in the pond in AOC-1 at the former Schenectady Army Depot, July 20, 2004.

Appendix A. Classification, tolerance, and numbers of organisms identified from 100-organism subsamples from each of three replicate samples collected from two sampling stations within the pond in AOC-1 of the former Schenectady Army Depot Pond.

TAXON	TOLERANCE*	STATION					
		SED-13	SED-14	SED-15	SED-16	SED-17	SED-18
MOLLUSCA							
Physidae							
Physa gyrina	8	14	4	1	1	2	3
ACARIFORMES							
Eremaeidae							
Hydrozetes sp.	6	1		1	1		
Limnesiidae							
Limnesia sp.	6					1	1
EPHEMEROPTERA							
Caenidae							
Caenis diminuta	6	16	10	7	25	31	46
ODONATA							
Libellulidae							
Leucorrhinia sp.	2	4	2	5	3		1
TRICHOPTERA							
Hydroptilidae							
Orthotrichia sp.	6		3	6	5	2	8
Leptoceridae							
Nectopsyche sp.	3	1		1			5
Oecetis sp.	5	2				1	
CHIRONOMIDAE							
Chironominae							
Chironomini	6				2	1	
Apedilum sp.	6		1	11			3
Chironomus sp.	10	20	30	6	32	40	4
Cladopelma sp.	9			1			
Dicrotendipes modestus	8	1		2	9	4	
Lauterborniella sp.	8						1
Parachironomus sp.	10				1		11
Paratanytarsus sp.	6	7	10	12		3	
Pseudochironomus sp.	5			1	1	2	
Polypedilum flavum	6	4					
Tanytarsini	6					1	
Tanytarsus sp.	6	5					
Tanytarsus glabrescens gr.	6		2	2	1		1
Tanytarsus guerlus gr.	6	10	1	12	4	3	1
Orthocladiinae							
Cricotopus festivellus gr.	7		1				
Parakiefferiella sp.	4	3	12	9	1		1
Psectrocladius psilopterus	8			2	2		1
Psectrocladius vernalis	8		1				
Tanypodinae	7					1	
Ablabesmyia sp.	8		1	3	2	1	3
Ablabesmyia mallochi	8	10	18	9	1	1	
Ablabesmyia rhamphe gr.	8			2		3	
Guttipelopia sp.	5				1		2
Labrundinia sp.	7		2	1	1	1	1
Larsia sp.	6	1	2	4			

TAXON	TOLERANCE*	STATION					
		SED-13	SED-14	SED-15	SED-16	SED-17	SED-18
OTHER DIPTERA							
Ceratopogonidae							
Bezzia/Palpomyia sp.	6	1		1			
Dasyhelea sp.	6			1	6	2	7
Tipulidae	4				1		
TOTAL		100	100	100	100	100	100

* - Tolerance scale ranges from 0-10, with 0=highly intolerant and 10=highly tolerant.