Physical, Chemical and Biological Study

of the West Branch of the Lackawaxen River, Wayne County, Pennsylvania

Introduction:

A physical, chemical, and biological assessment study of the West Branch of the Lackawaxen River was conducted on April 14, 2000, with subsequent lab work conducted in the following weeks. The purpose of this study was to determine the health of the river, based on the chemical and biological data collected. This data will also serve as a baseline for future monitoring activities.

Methods:

Physical characteristics, water temperature, dissolved oxygen (DO), pH, conductivity, total dissolved solids (TDS), alkalinity, and stream flow were measured in-stream at four sites along the river. This information was then recorded on data sheets taken from *EPA's Rapid Bioassessment Protocols (RBP) manual*. Water samples were collected and returned to the lab for analyses of nitrate-nitrogen, total phosphorus, sulfate, iron, manganese, copper, zinc, and aluminum. These values were then expressed in terms of mg/L (Table 1), which correlates to parts per million (ppm). A Habitat Assessment form, also taken from EPA's RBP manual, was also completed.

Macroinvertebrate samples were also collected at each site, from approximately a one m^2 area and returned to the lab for identification and counting purposes. Data generated from the macros collections at each site are given in Table 2.

1. a complete list of all the macros collected, identified primarily to genus and in some instances, species.
2. the number of total taxa and EPT taxa collected at each site (Note: taxa are the number of different organisms found at each site). EPT taxa are those organisms found within the Orders Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies). EPT organisms are pollution sensitive and their abundance is a reflection of the water quality and habitat conditions found at a site. A more diverse EPT community is an indication of good water quality and macroinvertebrate habitat conditions.
3. an indication of each organisms relative abundance, where Rare= 0-3 organisms found, Commom= 4-10 organisms, Abundant= 11-50 organisms, and Dominant= more than 50 organisms. These values were also taken from EPA's RBP manual.
4. each organisms Hilsenhoff Score (HS), a pollution tolerance value, ranging from 0-10, with 0 indicating an organism is extremely sensitive to pollution.
5. the adult fly imitation for the mayflies, stoneflies, and caddisflies.

Results:

Water Samples: Concentrations of all water quality parameters tested for are found in Table 1. The values measured at each site indicate that water quality conditions were not significantly impacted by any inputs of pollution from the watershed at the time of sampling. The conditions found most likely reflect the natural chemical and physical qualities of the river. Higher levels of zinc were found at Sites 3 and 4 than at the two sites upstream, however their concentrations were still low enough not to be of concern.

Macroinvertebrate samples:

Site 1 – downstream of Belmont Lake: Of the four sites sampled, the macroinvertebrate community at Site 1 had the lowest number of total (12) and EPT (3) taxa . The community was dominated by blackflies,

however, two mayflies and one caddisfy were also abundant. Though midge larvae and small aquatic worms were also prevalent, their presence most likely reflects the more favorable habitat for their development that was found at Site 1-slower flowing water with sediment deposits rich with organic material. Other organisms of note that were collected include two genera of dragonflies which were not found at any other site. Though the macroinvertebrate community had a low diversity of EPT's and large numbers of organisms with high HS scores, this doesn't indicate a pollution problem at Site 1. Stream conditions at this site are not favorable for the development of a diverse community, due to a lack of good riffles and a stream bottom rich with organic sediment.

Site 2 – downstream of Pleasant Mount PFBC fish hatchery: The macroinvertebrate community had the highest diversity at Site 2. Of the 24 taxa collected at this site, 14 of them were EPT's, indicating a healthy macros community, unaffected by inputs from the watershed. A rich community of stoneflies, all with HS scores of 3 or lower, and a good diversity of mayflies were collected from this site, reflecting the favorable conditions found at Site 2-faster, riffle dominated water with little sediment deposition. A number of non-EPT taxa were also collected that were not found at any of the other sites. The community found at Site 2 most likely reflects a macros community that has been able to develop unhindered by inputs from the watershed around it.

Site 3 – downstream of golf course and Rte. 107 bridge: A total of 19 taxa were collected at Site 3, with 15 of them belonging to the EPT group. Stoneflies and caddisflies were particularly diverse at this site, once again reflecting the fast moving, riffle dominated conditions at this site. Based on the macros community, this site also appears to be relatively unhindered in its development. Some pollution inputs from nearby fields, as well as runoff from the golf course and Rte. 107 may have a slight impact on the macros, however it appears to have no significant long-term impact.

Site 4 – Baird's Pool: A total of 21 taxa with 15 of them as EPT's were collected at Site 4. All but one of all the mayflies and one of all the stoneflies collected at all four sites, were found at Site 4. This indicates that water quality conditions and habitat for the development of a diverse macros community is also relatively unaffected at this site. A more diverse habitat including some slower, deeper water was found at this site and most likely accounted for the diversity of mayflies and stoneflies. As at Sites 2 and 3, the condition of the macros community at Site 4 indicate good water quality.

Summary:

Both water quality parameters and the macroinvertebrate community found at all sites indicate that the West Branch of the Lackawaxen River within its upper reaches, is essentially unaffected by man-induced activities within its watershed. Both the fish hatchery and the golf course appear to have little or no affect on conditions found in the river. All water quality parameters appeared normal and no indication of significant pollution loading was evident. The macros community also exhibited signs of a river unaffected by pollution over a long term period.

Further chemical and physical monitoring during periods of lower flow would indicate if any pollution loading problems exist. Any loading during such periods would be more evident, due to the lower amount of flow available for the dilution of a pollution problem. Additional macros sampling would most likely not reveal greater total or EPT taxa values than those found at the time of sampling, but would instead probably catch those macros that were emerging at the time of sampling, or are rare.

Table 1. Creamton Water Sample Data

	Site 1	Site 2	Site 3	Site 4
water temp (C)	5.9	5.7	7.1	9.5
dissolved oxygen (mg/L)	10.1	10.2	10.1	10.1

pH	7.7	8	7.8	7.6
conductivity (mS/cm)	0.045	0.05	0.056	0.072
alkalinity (mg/L)	26	28	32	28
total dissolved solids (mg/L)	26	30	32	35.9
nitrate-nitrogen (mg/L)	0.9	0.5	0.4	0.7
total phosphorus (mg/L)	0.05	0.03	0.03	0.10
sulfate (mg/L)	<1.0	1	3	9
iron (mg/L)	0.12	0.11	0.10	0.11
copper (mg/L)	0.01	0.02	0.01	0.01
manganese (mg/L)	0.1	0.1	0.1	0.1
zinc (mg/L)	0.01	0.04	0.26	0.22
aluminum	0.05	0.03	0.06	0.06

Table 2. Creamton Bug Data

List of macroinvertebrates collected at four sites on the West Branch of the Lackawaxen River on April 14, 2000. Information included in this list includes each organisms Family, genus (and some species), abundance at each site, Hilsenhoff score (HS) and fly tying info for the mayflies, stoneflies, and caddisflies. Note: R=rare (1or 2 organisms), C=common (3-10 organisms), A=abundant (11-50 organisms) and D=dominant (51+ organisms).

Family	Genus	Site 1	Site 2	Site 3	Site 4	HS	Fly tying info
Mayflies (Ephemeroptera)							
Baetidae	Baetis tricaudatus	-	A	-	-	6	Blue-winged Olive
Ephemerillidae	Ephemerella subvaria	-	D	D	A	2	Hendrickson
Ephemeridae	Ephemera guttulata	-	-	-	R	4	Green Drake
Heptageniidae	Epeorus pleuralis	-	D	D	D	3	Quill Gordon
	Stenonema vicarium	A	A	-	A	3	March Brown
Leptophlebiidae	Paraleptophlebia adoptia	-	A	A	C	4	Blue Quill
Oligoneuriidae	Isonychia bicolor	A	-	-	C	4	Isonychia
Stoneflies (Plecoptera)							
Perlidae	Acroneuria abnormis	-	A	C	C	3	Brown/yellow Stonefly
	Agnetina capitata	-	A	R	R	3	Brown/yellow Stonefly
	Paragnetina media	-	R	R	C	3	Brown/yellow Stonefly
Perlodidae	Isoperla	-	A	C	C	2	Little Yellow Stonefly
Chloroperlidae	Suwallia	-	-	R	-	0	Yellow Sally
Caddiesflies (Trichoptera)							
Hydropsychidae	Macrostemum	-	C	C	A	5	Spotted Sedge
Philopotamidae	Chimarra	-	-	-	D	3	Little Black Sedge

	Dolophilodes	-	-	R	-	3	Medium Evening Sedge
Polycentropodidae	Polycentropus	-	-	R	-	6	Brown Checkered Summer Sedge
Lepidostomatidae	Lepidostoma	-	-	R	-	1	Little Plain Brown Sedge
Limnephilidae	Goera	-	R	-	-	4	Grey Sedge
	Pycnopsyche	A	R	R	-	4	Great Brown Autumn Sedge
	Limnephilus	-	-	-	R	4	Summer Flyer Sedge
Odontoceridae	Marilia	-	R	R	R	0	Dark Blue Sedge
Rhyacophilidae	Rhyacophila	-	R	R	C	1	Green Sedge
Dragonflies (Anisoptera)							
Aeshnidae	Boyeria	R	-	-	-	3	
Corduliidae	Cordulegaster	R	-	-	-	3	
Damselflies (Zygoptera)							
Coenagrionidae	Enallagma	-	R	-	-	8	
Dobsonflies (Megaloptera)							
Corydalidae	Nigronia	R	R	C	R	3	
Aquatic beetles (Coleoptera)							
Elmidae (larvae)	Optioservus	R	A	C	C	5	
Psephenidae	Psephenus	-	R	-	C	4	
True flies (Diptera)							
Craneflies (Tipulidae)	Tipula	-	-	A	-	4	
Blackflies (Simuliidae)	Prosimulium	D	-	-	-	6	
Midges (Chironomidae)	various genera	A	A	A	A	6	
Athericidae (no common name)	Atherix	-	-	-	R	2	
Dance flies (Empididae)	Hemerodromia	-	C	-	-	6	
Sow bugs (Decapoda)							
Asellidae	Caecidotea	-	R	-	-	8	
Snails (Gastropoda)							
Physidae	Physella	-	R	-	-	8	
Planorbidae	Planorbella trivolvis	-	R	-	-	6	
Lymnaeidae	Stagnicola catascopium	C	-	-	-	8	
Fingernail clams (Bivalvia)							
Sphaeriidae	Pisidium	R	C	-	-	8	
Aquatic Worms (Oligochaeta)							
Lumbridulidae		-	-	-	C	9	
Naididae		C	-	-	-	9	
Total Taxa		12	24	19	21		

EPT Taxa		3	14	15	15		

Habitat Assessment Field Data Sheets Riffle/Run Prevalence

Habitat Parameter	Site 1	Site 2	Site 3	Site 4	Optimal 20 to 16	Suboptimal 15 to 11	Marginal 10 to 6	Poor 5 to 0
Instream Cover (fish)	18	20	19	20	Greater than 50% mix of boulder, cobble, submerged logs, undercut banks, or other stable habitat	30-50% mix of boulder, cobble, or other stable habitat; adequate habitat	10-30% mix of boulder, cobble, or other stable habitat; habitat availability less than desirable	Less than 10% mix of boulder, cobble, or other stable habitat; lack of habitat obvious
Epifaunal Substrate	19	19	19	18	Well-developed riffle and run; riffle is as wide as stream and length extends two times the width of stream; abundance of cobble	Riffle is as wide as stream but length is less than 2 times width; abundance of cobble; boulders and gravel common	Run area may be lacking; riffle not as wide as stream and its length is less than 2 times the stream width; gravel or large boulders and bedrock prevalent; some cobble present	Riffles or run virtually nonexistent; large boulders and bedrock prevalent; cobble lacking
Embeddedness	3	18	19	18	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment
Velocity/Depth Regimes	7	10	14	14	All four velocity/depth regimes present (slow-deep; slow-shallow; fast-deep; fast-shallow)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes)	Only 2 of the 4 regimes present (if fast-shallow or slow-shallow are missing, score lower)	Dominated by 1 velocity/depth regime (usually slow-deep)
Channel Alteration	20	20	17	19	No channelization or dredging present	Some channelization present, usually in areas of bridge abutments;	New embankments present on both banks; and 40-80% of stream	Banks shored with gabion or cement; over 80% of the stream reach channelized

						evidence of past channelization, i.e. dredging (greater than 20 yr) may be present, but recent channelization is not present)	reach channelized and disrupted	and disrupted
Sediment Deposition	5	18	19	18	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition	Some new increase in bar formation, mostly from coarse gravel; 5-30% of the bottom affected; slight deposition in pools	Moderate deposition of new gravel, coarse sand on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; Moderate deposition of pools prevalent	Heavy deposits of the material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition
Frequency of Riffles	12	20	19	16	Occurrence of riffles relatively frequent; distance between riffles divided by the width of the stream equals 5 to 7; variety of habitat	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream equals 7 to 15	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream equals 15 to 25	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is > 25
Channel Flow Status	18	19	19	20	Water reaches base of both lower banks and minimal amount of channel substrate is exposed	Water fills > 75% of the available channel; or < 25% of channel substrate is exposed	Water fills 25 - 75% of the available channel and/or riffle substrates are mostly exposed	Very little water in channel and mostly present as standing pools
Condition of Banks	17	19	20	15	Banks stable; no evidence of erosion or bank failure	Moderately stable; infrequent, small areas of erosion mostly	Moderately unstable; up to 60% of banks in reach have	Unstable; many eroded areas; "raw" areas frequent along straight

						healed over	areas of erosion	sections and bends; on side slopes, 60 - 100% of bank has erosional scars
Bank Vegetative Protection	20	20	17	17	More than 90% of the streambank surfaces covered by vegetation	70 - 90% of the streambank surfaces covered by vegetation	50 - 70% of the streambank surfaces covered by vegetation	Less than 50% of the streambank surfaces covered by vegetation
Grazing or Other Disruptive Pressure	20	20	8 (off east bank)	20	Vegetative disruption through grazing or mowing is minimal or not evident; almost all plants allowed to grow naturally	Disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining	Disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining	Disruption of streambank vegetation is very high; vegetation has been removed to 2 inches or less in average stubble height
Riparian Vegetative Zone Width	20	20	7	20	Width of riparian zone >18 meters; human activities (i.e. parking lots, roadbeds, clearcuts, lawns or crops) have not impacted zone	Width of riparian zone 12 - 18 meters; human activities have impacted zone only minimally	Width of riparian zone 6 - 12 meters; human activities have impacted zone a great deal	Width of riparian zone <6 meters; little or no riparian vegetation due to human activities
Score	179	223	197	213				