(P2 class'n change) Reviewed by LBub Date 2/2004

Region NER **County** Calumet **Report Date** 8/1975 **Classification** LAL/LFF

Water Body: Mud Creek

Discharger: Stockbridge WWTP

If stream is classified as Limited Forage Fish (LFF) or Limited Aquatic Life (LAL), check any of the following Use Attainability Analysis factors that are identified in the classification report:

_____ Naturally occurring pollutant concentrations prevent the attainment of use

_____ Natural, ephemeral, intermittent or low flow conditions or water levels prevent the attainment of the use, unless these conditions may be compensated for by the discharge of sufficient volume of effluent discharges without violating State water conservation requirements to enable uses to be met

_____ Human caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place

_____ Dams, diversions or other types of hydrologic modifications preclude the attainment of the use, and it is not feasible to restore the water body to its original condition or operate such modification in a way that would result in the attainment of the use

_____ Physical conditions related to the natural features of the water body, such as the lack of a proper substrate, cover, flow, depth, pools, riffles, and the like, unrelated to water quality, preclude attainment of aquatic life protection uses

_____ Controls more stringent than those required by sections 301(b) and 306 of the Act would result in substantial and widespread economic and social impact

Supporting Evidence in the report (include comments on how complete/thorough data is)

✓ Biological Data (fish/invert) good

✓ Chemical Data (temp, D.O., etc.) good

✓ Physical Data (flow, depth, etc.)

✓ Habitat Description good

✓ Site Description/Map

✓ Other: prior

Historical Reports in file:

8/29/75 - Dan Uhl / Dennis Weisensel

12/2000 - Michael Leif

Additional Comments/How to improve report:

- very little data (if any) available in P1 (1975) report

- P2 report very good

- need to figure out if we use P1 or P2 classns & report.

P2: Stockbridge Trib to Mud Creek — (LFF, July-March)
(FAL, April-June)

Mainstem Mud Creek — FAL

P1: wetlands = LAL

drainage area → Mud Creek = LAL (effl. ditch)

Mud Creek = LFF

Stream Reclassification

Stockbridge Tributary to Mud Creek and Mud Creek, Calumet County

Upper Fox River Basin
UFO2 Watershed
Township of Stockbridge

Submitted by Michael D. Reif
Wisconsin Department of Natural Resources
Oshkosh Service Center
December, 2000

phase 2

INTRODUCTION

Recent observations and data indicated that a reclassification was required for the Stockbridge Tributary to Mud Creek and Mud Creek in the Township of Stockbridge, Calumet County. An initial evaluation of the study area was evaluated in the fall of 1999 by Jeff Haack, NER Wastewater Engineer and Michael Reif, NER Wastewater Specialist. It was determined from that evaluation that a new stream classification study was needed (see November 18, 1999 memo to Rob McLennan by Jeff Haack in file). The original Stream Classification was conducted in August 1975 by District Biologist Dennis C. Weisensel and District Engineer Dan Uhl (see file). That evaluation classified the Stockbridge Tributary to Mud Creek as Effluent Ditch and the Main Stem of Mud Creek as Non-Continuous/Intermediate Fish and Aquatic Life. Data generated for this reclassification have indicated the classifications should be **Limited Forage Fishery** (LFF) for the Stockbridge Tributary to Mud Creek with a seasonal (April-June) classification of **Full Fish and Aquatic Life** (FFAL) to provide proper water quality protection for potential gamefish spawning such as northern pike, and **FFAL** for the Main Stem of Mud Creek (see Figure 2 topographic map copy). Analyses are made of the local Tributary and Mud Creek fishery and macroinvertebrate communities. Notes, suggestions and recommendations are made for the watershed as a whole.

METHODS

The Mud Creek Watershed is part of the Winnebago East Watershed UFO2 which is part of the Upper Fox River Basin (Figure 1). The Village of Stockbridge WWTP discharges to a triblutary to Mud Creek which is termed the Stockbridge Tributary to Mud Creek for this report.

The Stockbridge Tributary to Mud Creek which originates to the east of the Village of Stockbridge and empties into Mud Creek about 2/3 mile below the Stockbridge WWTP was evaluated above and below the WWTP (Sites 1 and 2-see attached topographic map copy). Sites were chosen for this study to evaluate the Stockbridge Tributary relative to the WWTP as well as to provide a general understanding of the Watershed as a whole. The sites for this study are listed as follows (see Figure 2 for map locations of these sites):

Site	Description
1A	South Branch of the Stockbridge Tributary 10 feet below HWY E east of the Village of Stockbridge. This was a single point site which did not extend up or downstream.
1	Stockbridge Tributary starting 75 feet above the WWTP outfall and extending upstream 100 feet.
1-O	Village of Stockbridge WWTP outfall.
2	Stockbridge Tributary beginning at the mixed point below the WWTP and extanding Downstream 180 feet.
3	Mud Creek beginning 50 feet above Lakeshore Road and extending upstream 210 feet.
4	Mud Creek as it bends to the closest point to Mud Creek Road about 2/3 mile west of the intersection of Mud Creek and Lakeshore Roads. This site extends from there downstream 300 feet.
5	Mud Creek beginning about 100 feet upstream from HWY 55 along Hickory Hills Road and extending upstream 20 feet beyond where it goes under Hickory Hills Road.
6	Southern Branch of Mud Creek 10 feet above Hickory Hills Road (this was a single point site like 1A).

Sites were chosen to evaluate: 1) the background conditions of the Stockbridge Tributary (Site 1); 2) the impact of the Stockbridge WWTP (Site 2); 3) the condition of Mud Creek below the confluence with the Stockbridge Tributary (Site 3); 4) the quality of Mud Creek prior to its discharge into the backwaters of Lake Winnebago and 5) the upper reach of Mud Creek (Site 5). Additional sites were added: 1) to evaluate a South Branch to the Stockbridge Tributary that contains or is adjacent to 2 ponds that appear to be spring fed (Site 1A) and 2) a South Branch of Mud Creek in the upper reach which according to the Topographic map originates in 3 small ponds (Site 6).

Chemical Sampling – grab samples were collected on August 2 and 3, 2000 from sites 1A, 1, 1-O, 2, 3, 4 and 5. Parameters were selected to evaluate the organic and nutrient load in stream as well as metals to evaluate the soluble metals composition of the groundwater aquifer bedrock. This is especially important in the UFO2 watersheds since groundwater inputs from local dolomite characterize the streams and are important in their productivity. Samples were collected on dates where it was most likely that the samples evaluated only groundwater inputs so data could provide a basis for inference on the groundwater system of the watersheds (other than WWTP and point source inputs). All samples were preserved as required by State Lab of Hygiene protocol. Temperature, D.O. and pH were obtained in the field.

Dissolved oxygen and temperature – grab samples were collected of the 5 stations listed above on 3 different dates, May 19, 2000, June 7, 2000 and June 19, 2000. Samples were analyzed with a YSI 55 Dissolved Oxygen Meter.

Photo 1. Mud Creek Site 3 looking upstream from the downstream end of the site.

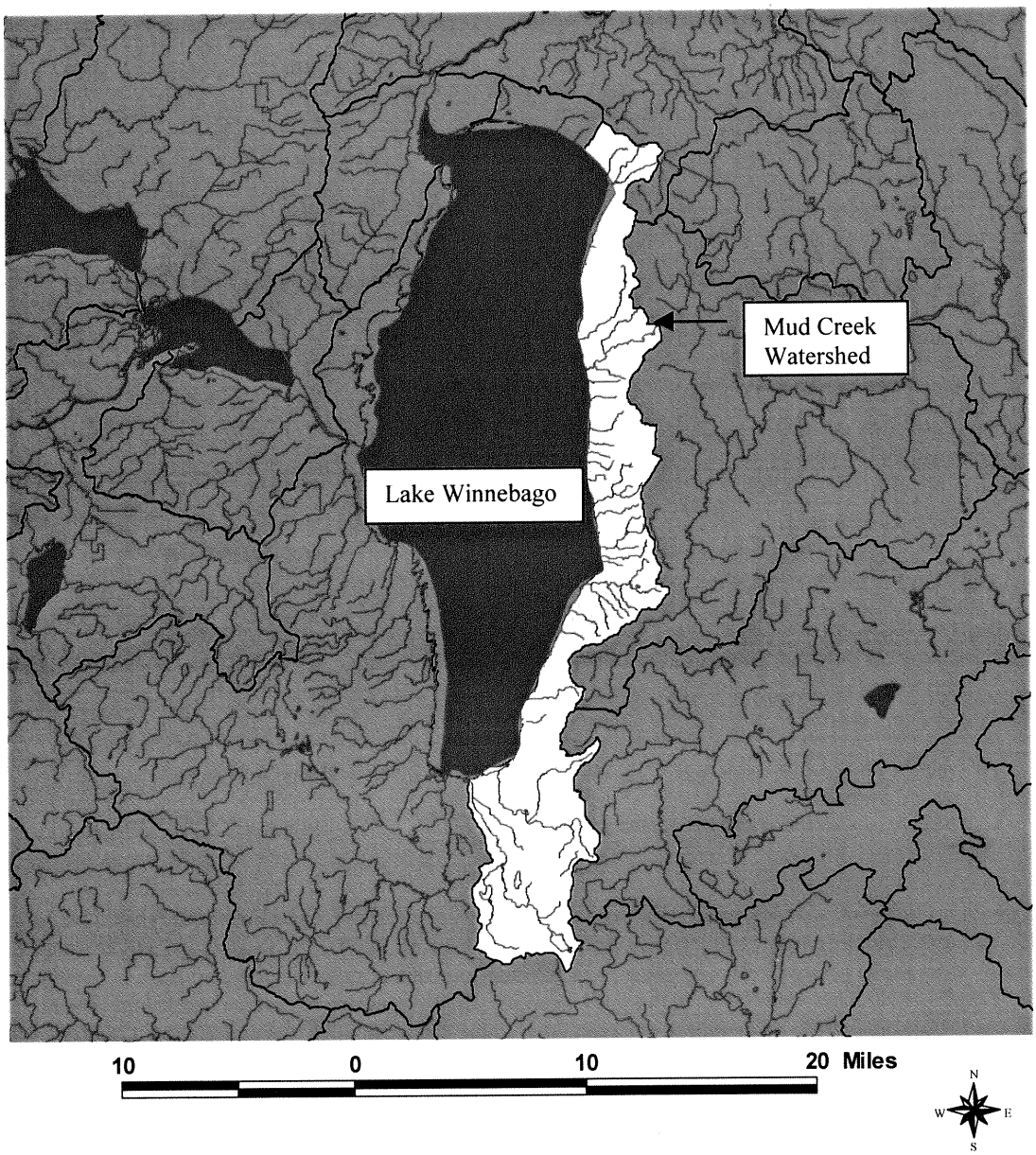
Fish communities – a backpack stream shocker was used to collect fish from the five study sites on June 7, 2000. The fish sampling was conducted by Bob Olynyk, Oshkosh DNR Fish Technician and Michael Reif. Attempts were made to follow the sampling recommendations of Simonson, lyons and Kanehl (1994) and Lyons (1992). Fish easily identified in the field were recorded (gamefish were measured) and returned to the stream. Samples of the other fish were taken back to the Oshkosh DNR Service Center Lab for identification. Attempts were made to sample all available fish and all available habitat. Initial fish identification has been done using the keys in Becker (1983).

Macroinvertebrate communities – Macroinvertebrate communities were sampled at the same five sites sampled for the fish communities sampling. A D-frame net was used to collect macroinvertebrates. Initial field picking was done and attempts were made to collect 100 macroinvertebrates at each site. All macroinvertebrates samples were preserved in the field with isopropyl alcohol and taken back to the Oshkosh DNR Service Center Lab for identification. A second picking and enumeration was done at the Oshkosh lab. Initial macroinvertebrate identification was done with the keys in Hilsenoff (1995).

Aquatic plants – general observations were made of the aquatic plants available at all sites during sampling.

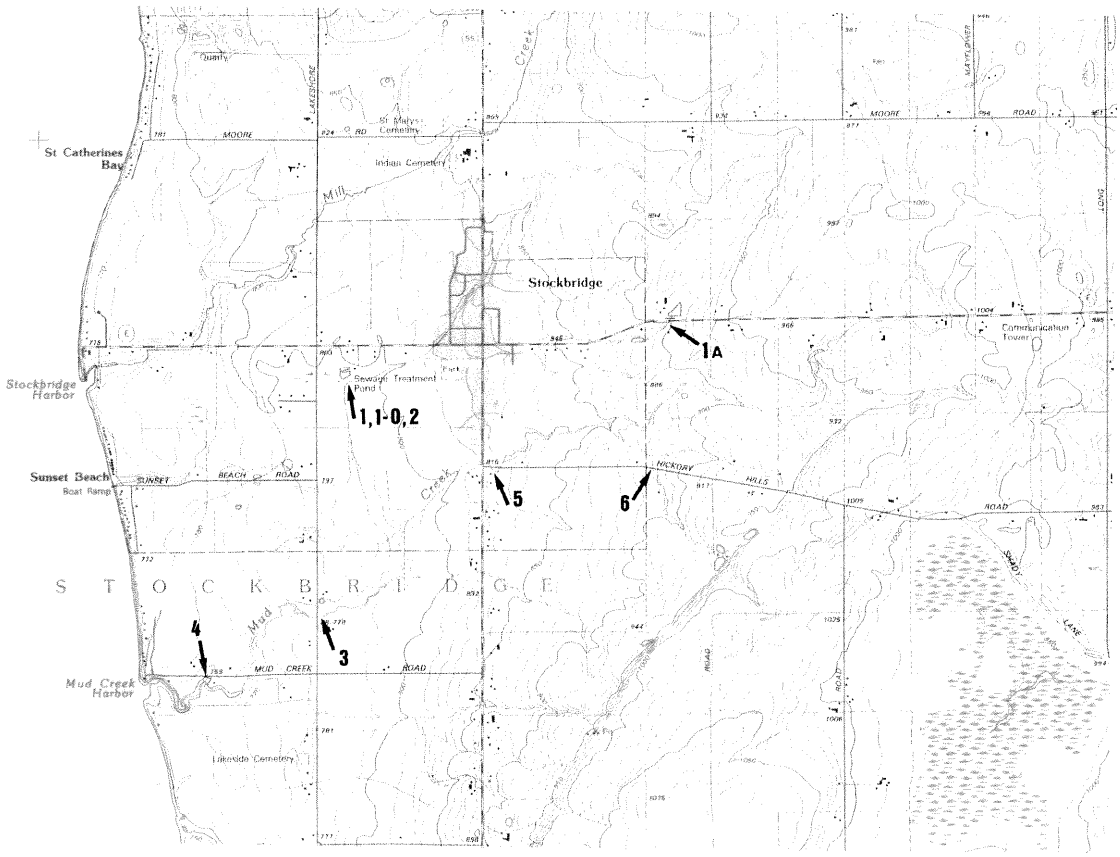
Habitat assessment – a general instream, bank and cultural use assessment was made at all sites during the samplings.

Figure 1. **UFO2**



Stream flow – stream flow sampling was done using a Swoffer Model 2100 Current Velocity Meter with Swoffer Model 13 Wand. Other general estimates were made relative to these readings.

Figure 2. Location of sampling sites on Mud Cr. and the Stockbridge Tributary.

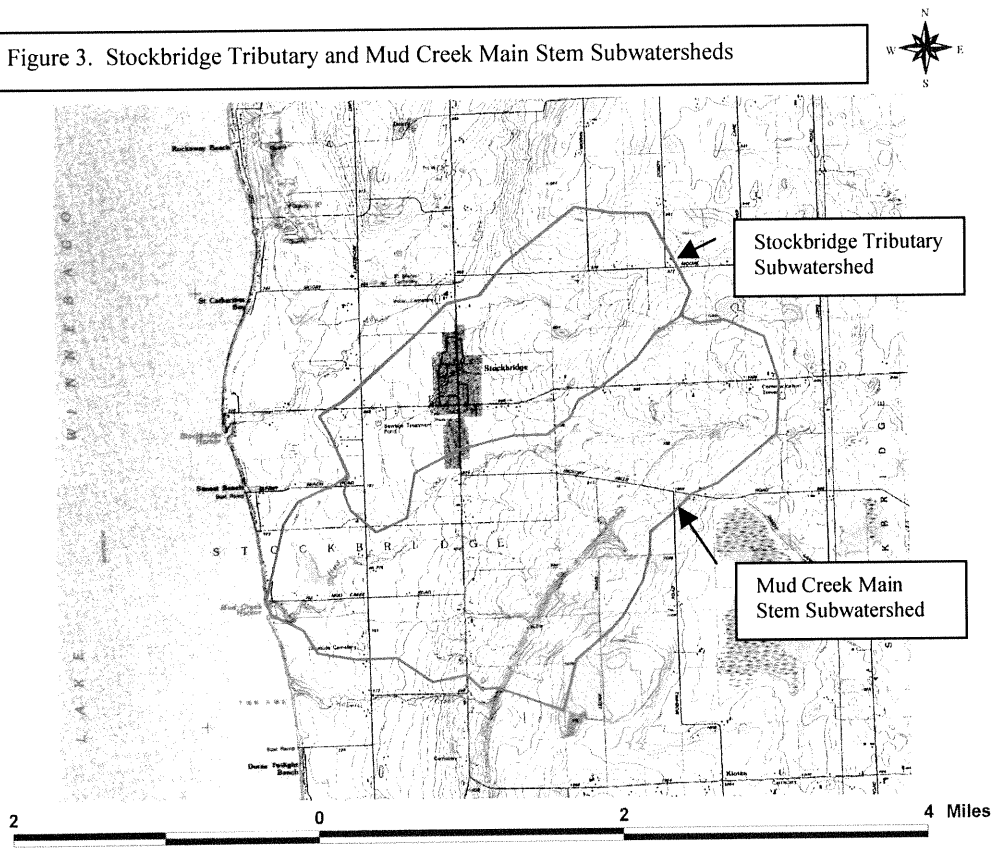


RESULTS AND DISCUSSION

A stream is classified based on the watershed's natural physical and chemical characteristics, cultural influences of the stream system, and its potential biological use. These factors affect the ability of the surface water to support certain uses. I evaluated the stream's existing biological use and determined what its potential use could be in the absence of controllable impacts.

For the purposes of this study the Mud Creek watershed was separated into two subwatersheds: the Stockbridge Tributary Subwatershed and the Mud Creek Main Stem Subwatershed which were determined by Arcview to have drainage areas of 1,498 acreas and 2732 acres respectively (see Figure 3). The total drainage acreage for the entire Mud Creek Watershed was determined to be 4230 acres.

Figure 3. Stockbridge Tributary and Mud Creek Main Stem Subwatersheds



The in-stream nutrient (N and TP), sodium and chloride levels were highest at Sites 2, 3 and 4 (Table 1A). These higher concentrations were likely mainly due to the higher concentrations in the WWTP effluent. The NO2+NO3-N level was fairly high (8.06) at site 1A. The source of the higher N at that point is unknown and can only be speculated on. All D.O. levels at all site and times were at least greater than 6.0 mg/l indicating that at least during the times of sampling D.O. is not a problem for the aquatic life of the Watershed. BOD5 levels were also all lower than 2.0 indicating that oxygen consumption by the water in the stream is not a concern.

The alkalinity, hardness and metals concentrations at all sites indicate the entire watershed to have very hard water and to have significant groundwater inputs. Also groundwater inputs seem to be fairly variable and are higher in the upper parts of the watershed. The hardness and metals concentrations at site 1A and 5 indicate the most significant groundwater inputs at these points of the sites sampled. Of all sites the hardness at 460 mg/l was highest at site 1A. This along with the cool temperature of the water at 1A (14.8 Deg. C) indicate significant groundwater inputs near that site and indicate good potential for a cold water aquatic community there. The field pH of 7.3 I found was also indicative of higher than normal amounts of CO2 which also indicates significant groundwater inputs. Surface water this hard should have an equilibrium pH near 8.3. The lower pH is indicating that the Tributary at the time of collection was not at equilibrium with atmospheric CO2. I discussed this site with the owner of the property adjacent to 1A. He said the stream starts about ¼ mile above that point in springs that come from the side of the escarpment. He said the local farmer that owned the land the springs are on used to put their milk in the spring water to keep it cool. He showed me that the stream comes from the escarpment and flows around the farm pond across the HWY from site 1A (rather that originating from the farm pond that the Topo Map shows (see Figure 2)). He said the farm pond itself has its own springs that feed it. The Tributary then flows down the HWY E roadside ditch and goes under HWY E directly across from the farm pond. It appeared to me though that there is a small bottom draw from the farm pond (it's unknown to me if it was constructed that way or if it occurred later) and some of what I sampled at 1A could have been from the farm pond. He also

told me that when they have very heavy rains or during heavy snowmelt periods that the flow can go over HWY E (the culvert appears to be too small to handle the higher flows that occur at times). He said the stream from there goes to the area of the second pond downstream from his house (see the second pond below site 1A) and from there goes underground. I was not able to verify this but I was not able to find a channel below that point and the Topo map shows the stream dissipating into the field as it goes back under HWY E. He said it comes back out of the ground at a location in the east side of the Village (see photo 24 at the end of this report). I was not able to verify this and do not know how the groundwater system works between those two points but it does appear that the groundwater regime and bedrock construction has a significant input into the function of the watershed.

Site number 5 had the third highest hardness and the highest aluminum and iron concentration of all sites indicating likely significant groundwater inputs near there. Site 5 had the second lowest water temperature of all sites sampled possibly giving more evidence for significant groundwater inputs. However it must be noted that Site 5 was one of the two most shaded sites (Site 3 was the other). Also notable was the concentration ratio of magnesium to calcium. At Site 5 it was greater than 1 but was less than 1 at all other sites. This likely indicates that the bedrock at that location has a greater concentration of magnesium than calcium and that groundwater input is significant at that point. Magnesium is significantly less soluble in water than calcium (Garrels and Christ, 1965) so it would take higher magnesium levels in the groundwater discharge bedrock aquifer near that site to result in that ratio. These data also indicate that earth metals as well as other fairly soluble metals like aluminum and iron are very important in studies of the watersheds that come from the escarpment in the UFO2 Watershed.

On three different occasions I conducted D.O. surveys. The data from these surveys are in Tables 1B to 3B. On all dates the highest temperature and was at Site 1 above the WWTP. The lowest temperature (other than below the farm pond at Site 1A described above) was at Site 5 indicating that there is significant groundwater inflow at or near Site 5. The initial dissolved oxygen survey was conducted shortly (within 24 hours) after a large rainfall. The Stockbridge Tributary and Mud Creek were both very turbid light brown where I could not see my D.O. probe an inch below the surface. Flows in Mud Creek were much higher than at other times illustrating the flashiness that this stream has responding to heavy rainfall. It was also an illustration of the amount of sediment that goes into the Stockbridge Tributary and Mud Creek from nonpoint sources which are very evident when one drives around the subwatershed. The dissolved oxygen levels at all sites and all sampling times were sufficiently high to sustain high quality biological populations.

Data from the macroinvertebrate samples are in Tables 1E-4E. The Hilsenhoff Biotic Index (HBI) values (Hilsenhoff 1987) from these samples are as follows:

Site	HBI
1	4.6
2	10
3	7.0
4	5.3

The Hilsenhoff biotic index ranges from 0 being excellent water quality to 10 being very poor water quality. Values indicate a drop from good water quality at Site 1 above the WWTP to very poor water quality at Site 2 below the WWTP. Site 3's HBI of 7.0 indicated fairly poor water quality while Site 4's HBI of 5.3 indicated good water quality. These values in themselves describe well the water quality of the Tributary and Mud Creek but community compositions illustrate even further.

In the site above the WWTP (Site 1) Gammarus sp dominated the sample. Gammarus sp has an HBI of 4 indicating very good water quality. Below the WWTP outfall the sample from Site 2 was dominated by bloodworms (Chironomus plumosus) which have an HBI of 10 indicating very poor water quality. Therefore the WWTP discharge is having a significant detrimental impact on the water quality of the Stockbridge Tributary. Also significant is Site 2's lack of Gammarus, riffle beetles, or damselflies (as compared to site 1) which would have likely been there without any negative impacts.

Sites 3 and 4 in Mud Creek below the confluence with the Stockbridge Tributary contained a large number of mayflies (Stenacron interpunctatum at Site 3 and Leptophlebia sp at Site 4). Site 3 also contained a large number of Hydropsyche betteni. These data along with the greater macroinvertebrate diversity at Sites 3 and 4 indicate an increase in water quality from Site 2. Site 5 was evaluated with a D-frame net though a sample was not picked. However, observations of the macroinvertebrate community was sufficient to indicate that it was similar to Site 5 without the mayflies and included a larger number of blackflies. Site 5 was found to contain Hydropsychidae. On June 19, 2000 while conducting flow measurements at Site 1A immediately below HWY E I observed some stick case making caddisflies attached to a stick in the stream. This is the stream that discharges from the farm pond created by an earthen dam in the upper reaches of the Stockbridge Tributary. I took a few of these caddisflies back to the lab. They keyed to the genus Anabolia sp of the Tricoptera family Limnephilidae. According to Flint (1960) and Wiggins (1973) larvae of Anabolia sp inhabit marshes, slow-flowing streams, and temporary pools. I also observed several Gammarus sp. The discharge from the farm pond (0.1 cfs Table 1F) which appeared to be an under draw from the pond, had a temperature of 15.3 Deg. C (Table 3C), which was 2 degrees C cooler than the second coolest site (Site 5) on that date. The HBI numbers for the family Limnephilidae indicate water quality ranging from excellent to fair water quality (Hillsenhoff, 1987). This is a significant improvement in water quality relative to the downstream Sites 1 and 2. I looked hard for a connection of this Tributary to the main stem of the Stockbridge Tributary. I could not find a connection. It appeared to either go underground or seep away before going under Co. Tr. E toward the Stockbridge Tributary. This Tributary also flows through another man made pond about 1000 feet below Site 1A.

It is curious to note that I was not able to collected any caddisflies at site 4 even though they were a dominant part of the Site 3 community. I expected them to be there. It will be important to evaluate these same sites in the future to evaluate potential changes in the macroinvertebrate communities. The current at Site 4 was similar to Site 3 and it had a good rubble bottom which should have allowed for caddisfly attachment.

I conducted a flow measurement survey on June 19, 2000. All flows at all measured sites were 0.33 cfs or less (Table 1F). The streamflow conditions (by observation) were near the flow levels I observed in April during the macroinvertebrate survey. I expect these flow conditions to be near normal for this time of the year. It is obvious that during some dry years parts of the study area may go dry leaving only local pools. It is notable that the streamflow at Site 3 (0.33 cfs) below where the Mud Creek Main Stem and Stockbridge Tributary converge was only 0.05 cfs greater than the flow at Site 1 on the Stockbridge Tributary above the WWTP. Obviously there is significant error in stream gauging with a flowmeter but these data are sufficient to indicate that though the Stockbridge Tributary Subwatershed is about half the size of the Mud Creek Main Stem Subwatershed it makes up a majority of the flow at Site 3. It is also notable that the flow at Site 1A was approximately equal to the flow at Site 5 indicating again that significant flow comes from the Stockbridge Tributary Subwatershed.

A fish survey was conducted for this study on June 7, 2000. There were heavy rains on Sunday (June 4). The streams were high with very turbid water on Monday (June 5) but were down to near normal by Wednesday (June 7) when we conducted the fish survey. The Stream was also clear by Wednesday. This all illustrates a quick recovery from the high flows which were apparently mostly surface runoff. Site 1 had the following fish community composition: one 3 5/8 inch yellow perch, 6 fathead minnows, 2 creek chubs and 5 brook stickleback. Except for the yellow perch all species were low D.O. tolerant or moderately low D.O. tolerant species and indicative of a Limited Forage Fishery classification if dominant in the community (Ball, 2000). Site 2 below the WWTP had a very large number of brook stickleback and no game species. We also noticed a large number of crayfish at site 2 (something I did not notice during the macroinvertebrate survey). Site 3 contained two 7 inch white suckers, several dace and other minnows. Site 4 contained one 6 ½ inch pumpkinseed, 1 logperch, several dace, emerald shiners and other minnows. We found only four fish at site 5 but one was a Mottled Sculpin indicating cooler water conditions (Becker, 1983). Site 5 had also the coolest water of all sites except for site 1A mentioned above. At least 2 of the others at Site 5 were dace. We did not sample the fish community of Sites 1A or 6.