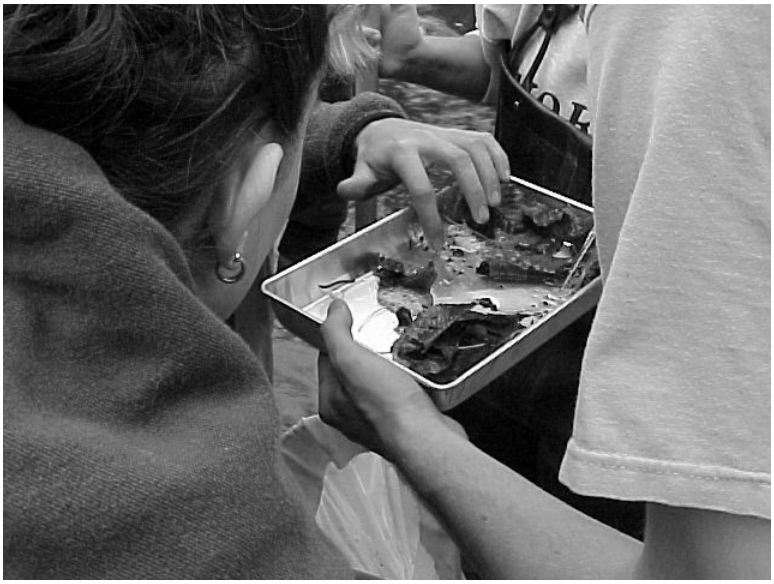
MI/DEQ/SWQ-02/101

VOLUNTEER MONITORING OF MICHIGAN'S RIVERS AND STREAMS

1998-2001 REPORT



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SECTION 1.0

INTRODUCTION

In January 1997, the Michigan Department of Environmental Quality (DEQ) completed a water quality monitoring report titled, "A Strategic Environmental Quality Monitoring Program for Michigan's Surface Waters" (Strategy). This Strategy, prepared by the Surface Water Quality Division (SWQD) and the Land and Water Management Division (LWMD), describes the necessary monitoring activities for a comprehensive assessment of water quality in Michigan's surface waters. It consists of nine interrelated elements: fish contaminants, water chemistry, sediment chemistry, biological integrity, wildlife contaminants, bathing beaches, inland lake quality and eutrophication, stream flow, and volunteer monitoring. The Strategy specifically identifies four monitoring goals:

- Assess the current status and condition of waters of the state and determine whether water quality standards are being met;
- Measure spatial and temporal water quality trends;
- Evaluate the effectiveness of water quality prevention and protection programs; and
- Identify new and emerging water quality problems.

In addition, the Strategy incorporates several key principles that are essential to effective monitoring. These include:

- Integrate and coordinate the use of scarce monitoring resources with other parties collecting water quality data;
- Maximize the use of local units of government and citizen volunteers to monitor water quality;
- Ensure that new and expanded monitoring activities are consistent with the DEQ's five-year watershed permitting process;
- Generate data that are scientifically defensible and relevant to the decision-making process;
- Manage and report data in a way that is meaningful to intended audiences.

Through its monitoring activities, the SWQD strives to assess water quality conditions at a minimum of 80 percent of stream and river miles over a five year period. One method identified to help to achieve this goal was the development of partnerships with citizen volunteer monitoring groups. Many states have successful programs to work with citizen volunteers in the collection, interpretation, and management of water quality data. Similarly, the LWMD has worked with volunteers since the 1970s to monitor inland lakes through the Self-Help Program. Based on these successful programs, the Strategy included a volunteer monitoring component that recommended working with groups to establish a statewide volunteer effort on wadable streams.

In 1998, the SWQD began working with selected local volunteer groups to monitor Michigan's wadable rivers and streams. Based on nine projects funded in 1998 and 1999, the SWQD produced a report that described accomplishments, the benefits of volunteer monitoring, and the use of volunteer data as a screening tool to assist the SWQD water quality monitoring efforts (MI/DEQ/SWQ-01/022). The report also identified some constraints or limitations of volunteer monitoring, as well as issues that require additional study.

In November 1998, the citizens of Michigan approved the Clean Michigan Initiative (CMI), a $675 million bond to clean up, protect, and enhance Michigan's environmental quality, natural resources, and infrastructure. Some of this money, specifically from the Clean Water Fund (CWF) portion of the CMI, was allocated for the implementation of the activities outlined in the Strategy. Since Fiscal Year 2000 (FY00), the SWQD has set aside approximately $50,000 per year from the CWF - CMI water quality monitoring funds for volunteer monitoring grant awards. These funds are intended to initiate or improve local volunteer monitoring programs, but not to serve as an ongoing funding source for individual groups.

Most of the monitoring conducted by volunteers in the state of Michigan has focused on aquatic benthic invertebrates and stream habitat. The volunteer monitoring data forms and sampling procedures are provided in Appendix A. The composition of the benthic community generally reflects physical and chemical conditions over time. Other advantages of monitoring benthic invertebrates and habitat include relatively little time commitment (each site monitored only twice per year, in the spring and fall), low cost, and simplicity of sample collection. Macroinvertebrates are collected from all available habitats and usually identified to Order, or in a few cases to Family, and the abundance of each taxon estimated as Rare or Common. The total stream quality score is calculated and used to rank the site as "Excellent", "Good", "Fair", or "Poor". Some volunteers also collect water samples for chemical analysis, although effective water sampling generally requires a more intense time commitment (several samples per year are preferred) and is more expensive than biological and habitat assessment because of analytical costs.

The SWQD releases an annual Grant Application Package (GAP) to solicit proposals from interested organizations. The Fiscal Year 2002 Volunteer Monitoring GAP is attached as Appendix B. Local units of government and nonprofit entities are eligible to receive grant funding. Eligible entities generally include county, city, township, and village agencies, watershed and environmental action councils, universities, regional planning agencies, and incorporated not-for-profit organizations. Each year, proposals are reviewed and the highest-rated ones are funded. The number of proposals funded with the available $50,000 varies each year depending on how much is requested by each of the top proposals. In FY00, five proposals were funded; nine proposals were funded in Fiscal Year 2001 (FY01).

The purpose of this report is to describe Michigan's volunteer monitoring activities and to summarize the efforts of the volunteer groups with which we have worked through the end of FY01. The following sections of this report discuss the technical assistance provided to volunteer organizations, data management, how volunteer data are used, the status of groups, and some of the monitoring results. Appendices are attached that include data forms, procedures, the FY01 GAP, a model Quality Assurance Project Plan (QAPP), and summary data tables.

SECTION 2.0

TECHNICAL ASSISTANCE

To ensure that volunteers collect high quality data, the SWQD provides technical assistance to groups that receive grants. When feasible, the SWQD also assists organizations that have other sources of funding but wish to use SWQD forms and procedures. The technical assistance includes training, site selection advice, quality assurance, database maintenance, and presentations at group meetings. The SWQD will only use data from groups that are trained and follow quality assurance procedures. These items are discussed below in more detail.

2.1 VOLUNTEER TRAINING

Prior to sampling, all volunteers are required to attend a one-day training session lead by a SWQD biologist or another SWQD-approved trainer. The morning portion of the training is a classroom session, during which volunteers learn about the data forms, sampling procedures, safety guidelines, the relationship of terrestrial and instream habitat to the macroinvertebrate community, and macroinvertebrate identification. The SWQD requires volunteers to identify most macroinvertebrates to Order, and a few to Family. The volunteers are provided with a taxonomic key and benthic invertebrate descriptions, and they practice macroinvertebrate identifications using preserved specimens.

The afternoon portion of the training involves a visit to a wadable stream or river site. This field session provides volunteers the opportunity to assess a site, collect and identify live macroinvertebrates, complete the data forms, and ask questions. Volunteers work in small groups to complete the data forms. After all groups have assessed the benthic invertebrate community and stream habitat, the findings are compared among groups and the results are discussed with the entire group.

Because it is impractical and too time-intensive for the SWQD to provide "refresher" training to all groups each year (as well as training new groups), groups are encouraged to conduct follow-up trainings on their own. These sessions allow new recruits to receive proper training and can improve the performance of the original volunteers. At a minimum, new volunteers that missed the SWQD training session must be paired up with experienced individuals to learn the sampling procedures before conducting an assessment on their own.

2.2 QUALITY ASSURANCE PROCEDURES

The SWQD requires all volunteer groups that receive CWF - CMI funds (those funded in the year 2000 and beyond) to develop and follow a QAPP. A model QAPP was developed to provide a framework for organizations to tailor to their individual needs (Appendix C). A QAPP is a written document that describes how data will be collected to achieve project objectives and the procedures that will be implemented to ensure the quality of the data. The QAPP is prepared by the grantee and approved by the SWQD prior to sample collection and analysis. The model QAPP can be modified to meet the goals and objectives of each organization. All groups funded in 2000 have completed QAPPs. Six of the nine groups funded in 2001 have finalized their QAPPs; the remaining three groups have prepared drafts which will soon be finalized.

One potential source of error with volunteer data is inaccurate identification of taxa. To ensure the accuracy of benthic invertebrate identifications, volunteers are required to submit a jar with one or a couple of preserved specimens of all different taxa found at each site. Volunteers are instructed to clearly label the jars so that they can easily be associated with the corresponding data sheet. A SWQD biologist then compares the contents of the jar with the appropriate data sheet to verify that volunteers are accurately identifying taxa. In most cases to date, volunteer identifications appear to be excellent. Once it becomes clear that an organization consistently identifies benthic invertebrates correctly, the SWQD will accept data without requiring the submittal of preserved specimens.

Another potential source of error with volunteer data is the failure to collect all taxa present at a site (or at least all common taxa). To determine whether this is a significant problem, the SWQD has performed "spot checks" of selected volunteer sites on the Pentwater and Flint River Watersheds. Volunteer and SWQD results then were compared to assess volunteer performance. In general, it appeared that the volunteers collected most of the common invertebrate taxa at the site. At all sites, SWQD biologists found more taxa than the volunteers, which was expected. However, the taxa collected by the biologists and not by the volunteers usually were found in very low numbers (only one or two individuals). Furthermore, in most cases, the overall stream rating did not change. These comparisons suggest that, for the most part, volunteers do a thorough job of collecting benthic invertebrates.

SECTION 3.0

DATA MANAGEMENT AND USE OF DATA

3.1 DATA MANAGEMENT

After each sampling event, volunteers provide copies of their data forms to SWQD, along with preserved macroinvertebrate specimens (as discussed in Section 2.2). In 2001, the SWQD created a Microsoft Access ® database to house the volunteer data. Most of the data received were transferred into this database. Some data have been received only recently and have yet to be entered into the database. The database contains a number of data fields, including organization information (year of funding, start date, number of sites assessed), site information (name, location, number of times sampled), and results for benthic invertebrates, habitat, and water chemistry. The data are provided to SWQD biologists to assist with biological surveys (see Section 3.2 below), and are available to the public upon request.

The SWQD recently developed a Water Quality Monitoring website to make monitoring information and data more accessible to the public. It can be accessed by going to www.michigan.gov/deq, clicking on "Water", then "Water Quality Monitoring", then "Assessment of Michigan Waters". This website has a volunteer monitoring component that contains the following:

1. A list and map of funded volunteer monitoring projects;
2. Maps of individual watersheds with volunteer monitoring, with sampling locations;
3. This volunteer monitoring report, and future ones as they are completed;
4. Previous volunteer monitoring reports;
5. The most recent Volunteer Monitoring GAP; and
6. Volunteer data forms, procedures, and benthic invertebrate identification keys.

In the future, the public will be able to access the volunteer monitoring database on this website to retrieve data summaries from any watershed monitored by volunteers.

3.2 USE OF VOLUNTEER DATA

A primary objective of the SWQD is to ensure that volunteers generate data of sufficient quality to serve as a "screening tool" for identifying sites that require additional assessment. To aid in the planning of the SWQD's 2001 and 2002 watershed biological surveys, volunteer information was provided to the biologists working in watersheds with trained volunteers. The information includes organization name, locations, parameters (benthic invertebrates, habitat, and/or water chemistry), a summary of findings, and volunteer contact information (see Appendix D for an example). These data are used by SWQD biologists to identify sites from which a diverse benthic macroinvertebrate assemblage was collected and therefore do not require follow-up visits. On the other hand, the volunteer data may indicate locations that do require further evaluation by a SWQD biologist because few benthic invertebrates were found or because poor habitat conditions were evident.

In addition, volunteers are encouraged to use their data to influence local decisions and activities. For example, one group of volunteers routinely monitors the Mill Creek (Lapeer and St. Clair Counties) in part to assist an Inter-County Drain Board in determining the best way to ensure adequate drainage while still protecting stream habitat and water quality. Other volunteers monitor certain sites every year to determine, in a qualitative sense, whether

conditions are improving or declining. Many organizations also use volunteer monitoring activities to educate citizens about water quality issues and raise awareness about how certain activities may impact water quality. Teachers frequently incorporate such information into their lesson plans to better educate students.

SECTION 4.0

STATUS OF PARTICIPATING VOLUNTEER ORGANIZATIONS

Between Fiscal Years 1998-2000, a total of 14 groups received grants totaling $123,019 from the State General Fund (1998-99) and the CMI - CWF (2000). In FY01, a total of $54,000 was awarded from the CMI - CWF to nine volunteer organizations (Table 1, Figure 1). Grants funds are primarily used to cover expenses such as equipment, salary and fringe for a local coordinator, and travel costs. Six of these groups are no longer providing data to the SWQD.

Between 1998 and 2000, volunteers assessed approximately 390 sites using a combination of benthic invertebrates, habitat, and water chemistry (Table 2). Groups funded in 2001 will monitor approximately 130 additional sites. The purpose of this section is to report on the status of these funded organizations, as well as a few groups that have not been funded, but for which the SWQD has provided technical assistance (Table 1, Figure 1). The most recent results for each group are also briefly summarized. Actual results can be found in Appendices E and F. An example output from the volunteer database is provided in Appendix G; similar outputs for each site visit are available upon request (contact information in Section 5.0).

4.1 ORGANIZATION INFORMATION

FUNDED IN FISCAL YEAR 1998

4.1.1 Clinton River Watershed Council

The Clinton River Watershed Council (CRWC) received a grant ($9,000) to train, in conjunction with representatives from Earth Force (formerly Project Green) and General Motors, middle and high schools teachers each year to collect chemical, habitat, and macroinvertebrate data from sites along the North Branch, Main Branch, and tributaries to the Clinton River. Currently, approximately two dozen schools are participating in this project. The CRWC also coordinates an Adopt-A-Steam program for local adult citizens and community groups to "adopt" one-mile sections of the Clinton River and its tributaries.

A total of 15 sites were assessed in the fall of 1999 (Appendix E). Based on the results of the fall monitoring, the macroinvertebrate community scored "Excellent" at 3 sites, "Good" at 6 sites, and "Fair" at 6 sites (Appendix E). Because of staff turnover at the CRWC, year 2000 data, although collected, were not sent to the SWQD. We are trying to get this information. The 2001 data have been sent to the SWQD, and will be entered into the volunteer database. We expect that data collected in future years will also be provided.

The basic infrastructure and quality assurance procedures remain in place for this group. Staff turnover at the CRWC and lack of communication between the SWQD and the CRWC, seem to be the main reasons why recent data have not been submitted to the SWQD. These problems appear to have been corrected.

4.1.2 Friends of the St. Joe River

The Friends of the St. Joe River (FSJR) received a grant ($9,000) to work with schools to monitor wadable sites in the St. Joseph River Watershed. In 1998, the SWQD trained a group of adult volunteers, who in turn trained teachers and assisted classes with monitoring to collect habitat and macroinvertebrate data. A number of schools have continued to monitor selected

sites, but the SWQD has not received data since 1999 (after the grant expired). The local coordinator recently moved out of the watershed, and a new coordinator is taking over the project. The teachers are trained by the local coordinator, who also usually accompanies the classes when they monitor a site.

The most recent stream habitat and macroinvertebrate community data provided to the SWQD from this group are from four sites monitored in May 1999. The benthic invertebrate community ranked "Fair" at two sites, "Good" at one site, and "Excellent" at one site (Appendix E). Based on recent telephone conversations, this group has committed to providing us with the data from 2000 and 2001.

The prospects for the continuation of this project appear to be high, despite staff turnover. A new local coordinator with some expertise in water quality monitoring is being hired, and already has worked with some schools. Many teachers continue to provide specimen jars to the SWQD to verify their benthic invertebrate identifications. Therefore, the quality assurance procedures are being followed for the most part. The main problem to date has been that data sheets have not been submitted to the SWQD. We expect that this problem will be resolved soon, based on recent conversations.

4.1.3 Northern Tittabawassee River Task Force

The Northern Tittabawassee River Task Force (Task Force) received a grant ($9,000) to work with teachers from schools in the Gladwin area to collect baseline data for instream habitat and macroinvertebrate community from the Cedar River, a tributary to the Tittabawassee River. The focus of this project was education, and the grant money was used to purchase sampling equipment and supplies for the participating schools. The SWQD provided teacher trainings in 1998. The SWQD received data from a few schools in 1998 and 1999, but only one teacher provided data in 2000 and 2001.

Data are from four stations located on the North and Main Branch of the Cedar River. The macroinvertebrate community ranked "Fair" at 1 site, "Good" at 1 site, and "Excellent" at 2 sites (Appendix E).

Except for the one teacher, the SWQD no longer receives data from this group. The main problem was that the local Task Force representative had a very difficult time contacting teachers, and when he did manage to contact them, most teachers did not provide the data in a complete and timely fashion.

4.1.4 Oceana County Conservation District

A group of adult volunteers was formed to collect stream habitat and benthic invertebrate community data from approximately 20 sites on the North and South Branch of the Pentwater River and associated tributaries, beginning in spring 1998. A grant ($9,000) was awarded to the Oceana County Conservation District to purchase equipment and support public outreach efforts. Volunteers were trained by the SWQD in 1998 and 2000.

The SWQD received data from this group for the 1998-2000 spring and fall assessments. The volunteers have consistently provided specimen jars to verify benthic invertebrate identifications. Based on information from this group, some patterns in the data have been observed. The first, which is supported by data from other organizations, is that benthic invertebrate scores from a given site are almost always higher in the spring than in the fall. We also have found that at many

sites, during the first couple of years, benthic invertebrate scores improve from one year to the next.

In fall 2000, the macroinvertebrate community ranked "Fair" at 8 sites, "Good" at 11 sites, and "Excellent" at 1 site (Appendix E). The project continued in 2001 and spring 2002, but SWQD has not yet received the data. The Oceana County Conservation District will provide the data for 2001 and spring 2002.

This group also measures flow and temperature at selected sites in the Pentwater River. In 2001, the temperature data were used by the SWQD to help develop the Section 401 Water Quality Certification for the City of Hart's Hydroelectric Power Project.

This group continues to collect benthic invertebrate, habitat, temperature, and flow data at several locations in the Pentwater River Watershed. Quality assurance procedures are followed, as almost all of the volunteers have been trained, have participated in the project for several years, and continue to provide jars with benthic invertebrate specimens. There has been some staff turnover between 1998 and 2001, which is the primary reason for the delay in submitting the 2001 data to the SWQD. This group continues to be active and collects high quality information.

FUNDED IN FISCAL YEAR 1999

4.1.5 Friends of the Rouge River

The Friends of the Rouge (FOTR) volunteer group promotes citizen involvement in monitoring tributaries to the Rouge River to increase public awareness of water quality issues and to develop baseline data throughout the watershed. Volunteers consist of both adults and students. This organization received two grants, one in 1999 ($10,850) and one in 2001 ($5,013), to support and expand this project. A total of 18 sites were assessed during the fall and spring of 1999 and 2001. Only two sites were assessed in 2000, and the data from these sites are being submitted to the SWQD.

In fall 2001, 11 sites were assessed. The macroinvertebrate community ranked "Poor" at 4 sites, "Fair" at 6 sites, and "Good" at 1 site. Only one had an invertebrate community that ranked "Poor" in both the spring and fall (Tonquish Creek, Appendix E). During the summer of 2000, this location was visited by a SWQD biologist who confirmed that this stream rated "Poor" for macroinvertebrate and fish communities and therefore was not meeting Michigan Water Quality Standards. Tonquish Creek has since been scheduled for a Total Maximum Daily Load (TMDL) in 2007.

The FOTR continue to collect data for, and provide it to, the SWQD. All indications are that volunteers are following acceptable sample collection and quality assurance procedures, ensuring relatively high quality data that the SWQD can use for its intended screening purpose.

4.1.6 Father Marquette Middle School

The Father Marquette Middle School received a small grant ($540) to purchase equipment for volunteer monitoring. The purpose of this project was to evaluate stream habitat and benthic invertebrate community improvements in Compeau Creek due to the excavation of two sediment traps and an increase in stream habitat by adding gravel downstream of sediment traps. The volunteers consisted of teachers and 7th and 8th grade students, and the focus was

on education. The SWQD has not received any data and is trying to contact the school to obtain it. To our knowledge, they are no longer collecting data.

4.1.7 Michigan Lakes and Streams Association

The Michigan Lakes and Streams Association (MLSA) received a grant ($9,637) to monitor water quality in three branches of the Black River, in Allegan and Van Buren Counties. The adult volunteers were trained by a SWQD biologist, and were lead at the local level by a biologist with extensive experience in water quality monitoring and benthic invertebrates.

Benthic invertebrates and habitat were assessed at 15 sites in summer and fall 1999, and in spring 2000. In the spring of 2000, the macroinvertebrate community ranked "Poor" at 2 sites, "Fair" at 8 sites, and "Good" at 5 sites (Appendix E). A few sites had a macroinvertebrate community that ranked "Poor" on one sampling date and "Fair" to "Good" on another date. This may reflect the varying life history characteristics of some of the aquatic insects, or perhaps improvement in the collection techniques of the volunteers. No sites ranked "Poor" on two sampling dates.

Water samples were collected on five different dates and analyzed for turbidity, soluble reactive phosphorus, total phosphorus, and nitrate. Samples were analyzed at Central Michigan University. Water chemistry results are listed in Appendix F. No parameters were measured at any sampling location at levels that exceed Michigan Water Quality Standards. However, additional sampling above Great Bear Lake is recommended to help determine the sources of phosphorus.

The MLSA has not monitored the Black River Watershed since the spring 2000, when their grant expired.

4.1.8 Tip of the Mitt Watershed Council

The Tip of the Mitt Watershed Council received a grant ($8,650) primarily to survey volunteer organizations in Michigan about their interests and needs, and to identify ways that the SWQD can best meet these needs. They produced a report summarizing these findings, which is available upon request. In addition, they established the Friends of the Boyne River (FBR) to collect baseline water quality data on the Boyne River in Charlevoix County. The SWQD provided training to volunteers in 1999. One member of this group is knowledgeable about benthic invertebrates and verifies all identifications.

The FBR assessed the macroinvertebrate community and stream habitat at a total of five locations in fall 1999 and spring 2000 on the north, south, and main branches of the Boyne River (Appendix E). The macroinvertebrate community ranked "Fair" at 3 sites and "Good" at 2 sites (Appendix E). No sites were monitored in 2001, but the project continued in spring 2002. The FBR continues to collect data at a small number of sites, and to provide this information to the SWQD.

4.1.9 Flint River Watershed Council

The Flint River Watershed Council (FRWC) received a grant ($10,296) to monitor the benthic invertebrate community and stream habitat of the Flint River and its tributaries. This group consists primarily of adult volunteers and collects high quality information. The SWQD trained

the volunteers, who continue to use the SWQD data forms and follow recommended quality assurance procedures.

Macroinvertebrates have been collected at 29 different sites since 1999. In spring of 2001, 21 sites were assessed and the macroinvertebrate community ranked "Poor" at 6 sites, "Fair" at 5 sites, "Good" at 9 sites and "Excellent" at 1 site (Appendix E). Two sites that were monitored a minimum of 4 times, the North Branch Flint River and Gilkey Creek, ranked either "Poor" or "Fair" on all occasions. These two sites will be assessed by a SWQD biologist in 2003.

The FRWC has maintained a very effective monitoring project in the Flint River Watershed. They consistently monitor many sites and provide the data to the SWQD in a timely manner. This organization also has the benefit of a professor at the University of Michigan-Flint who is familiar with benthic invertebrates and can verify volunteer identifications.

FUNDED IN FISCAL YEAR 2000

4.1.10 Central Lake Superior Watershed Partnership

This Central Lake Superior Watershed Partnership received a grant ($4,715) to assess the benthic invertebrate community and stream habitat at seven locations on both the Salmon-Trout River and Chocolay River in Marquette County. Volunteers consist primarily of Northern Michigan University students under the direction of a biology professor who is familiar with benthic invertebrates.

Macroinvertebrates were collected in fall 2000 and spring 2001 at 14 sites, and the data were provided to the SWQD in a project report. In spring 2001, the benthic invertebrate community ranked "Fair" at 3 sites, "Good" at 10 sites, and "Excellent" at 1 site. These results indicate that the water quality in the Salmon Trout River and Chocolay River is sufficient to support trout and a diverse community of aquatic insects. This study revealed some possible threats to these rivers, including sediment input from roads, improper land-use practices, construction, and development.

This group continued to monitor these sites in fall 2001 and spring 2002, and is summarizing the data in a report which will be sent to the SWQD in the near future. They also expanded their project to include an additional 5 sites in the Salmon Trout River Watershed and sites in the Carp River Watershed, using funds from another grant (not a volunteer grant) received last year. The Central Lake Superior Watershed Partnership collects high quality data from a large number of sites, and consistently provides this information to the SWQD in a timely manner.

4.1.11 Grand Traverse Bay Watershed Initiative

The Grand Traverse Bay Watershed Initiative (GTBWI) received a grant ($13,781) to develop a volunteer monitoring program, conducting two evaluations per year of the benthic invertebrate community and stream habitat for three streams flowing to Grand Traverse Bay. Volunteers consist of teachers and students from the GTBWI Water Watch program. One of the goals of this group is to heighten public awareness about the importance of protecting these tributaries. This group provided the SWQD with data from four sites on three streams (Kids, Leo, and Northport Creeks) in Leelanau County, Michigan.

The sites were sampled in summer and fall 2001. The GTBWI found that the benthic invertebrate community ranked "Poor" on both sampling occasions at all four sites (Appendix E).

A SWQD biologist sampled one of these sites (Kids Creek at 11th Street) in 1998. The benthic invertebrate community rated as "Poor" using GLEAS Procedure 51, consistent with the results generated by the volunteers. The SWQD biologist noted that the stream bottom consisted almost entirely of shifting sand and silt, indicating a severe lack of substrate for invertebrate colonization. Kids Creek is scheduled for a TMDL in 2010. Follow-up sampling on Leo and Northport Creeks will be conducted by a SWQD biologist in 2003. The GTBWI continues to collect data and provide it to the SWQD.

4.1.12 Muskegon Conservation District

The Muskegon Conservation District received a grant ($10,000) to monitor the benthic invertebrate community, stream habitat, and water chemistry at 7 sites in Muskegon County. The sampling began in fall 2001. The invertebrate community ranked "Poor" at 2 sites, "Fair" at 4" sites, and "Good" at 1 site (Appendix E). Results of water chemistry analysis indicated elevated levels of total phosphorus and nitrate present in Ryerson Creek and Ruddiman Creek (Appendix F). The Muskegon River Watershed was assessed by the SWQD in 2001. The results of this assessment will be provided to the Muskegon Conservation District and additional follow-up site assessment will occur in future years. The Muskegon Conservation District continues to collect water quality data and provide it to the SWQD.

4.1.13 St. Clair County Drain Commissioner

The St. Clair County Drain Commissioner received a grant ($7,865) to monitor sites along Mill Creek in Lapeer County. The main objectives of this project are to: 1) assess the macroinvertebrate community and stream habitat at sites before and after dredging and/or implementation of river restoration techniques, and at sites that were unaltered; 2) to publish the results; and 3) to educate the public about the effects of dredging versus river restoration techniques to increase water conveyance in Mill Creek.

Volunteers assessed a total of 9 sites on Mill Creek beginning in spring of 1999 (Appendix E). In fall of 2001, the invertebrate community ranked "Fair" at 5 sites and "Excellent" at 4 sites (Appendix E). The sites scoring as "Excellent" were those receiving the river restoration techniques, while none of the dredged sites rated as "Excellent". The dredged sites consistently scored lower than did the river restoration sites. Some of these sites will receive follow up assessment in 2002 by a SWQD biologist.

This group also produced and distributed a report that summarizes their findings entitled, "Mill Creek Volunteer Monitoring Project: Second Annual Report, April 2002." This group is very motivated and reliable, and produces outstanding data. The benthic invertebrate identifications are always accurate. They continue to collect and submit data to the SWQD.

4.1.14 West Michigan Environmental Action Council

The West Michigan Environmental Action Council (WMEAC) received grants in 2000 ($11,385) and 2001 ($4,995) to collect baseline data, identify high quality streams, and promote stewardship. The WMEAC uses the data to identify areas of stream degradation and possible causes. Volunteers are primarily adults, although some school groups also participate.

They have assessed the macroinvertebrate community and stream habitat at 24 sites in the Grand River Watershed within Kent County. Based on data from 7 sites that were sampled in spring of 2000, the macroinvertebrate community ranked "Fair" at 2 sites, "Good" at 4 sites, and

"Excellent" at 1 site (Appendix E). A larger number of sites were assessed in spring and fall 2001, but the data sheets that were submitted to the SWQD lacked sufficient location detail. The additional location information has been added to the forms, and they will soon be provided to the SWQD. The WMEAC continues to collect and provide data to the SWQD.

FUNDED IN FISCAL YEAR 2001

4.1.15 Antrim Conservation District

The Antrim Conservation District received a grant ($11,998) to assess the benthic invertebrate community and stream habitat in eight streams within the Elk River Watershed. This group has received training by a SWQD biologist and has completed an approved QAPP. Sampling began in spring 2002.

4.1.16 Center for Science and Environmental Outreach

The Center for Science and Environmental Outreach received a grant ($7,384) to hold workshops for teachers from Upper Peninsula Schools in May and June 2002. These workshops provided training on SWQD's volunteer monitoring procedures to teachers who have integrated stream monitoring and watershed education into their curriculums. A QAPP is being prepared for teachers to follow. Sites will be located primarily in the Keweenaw Peninsula. Data collected by these teachers and students will be provided to the SWQD.

4.1.17 Crystal Lake Watershed Fund

The Crystal Lake Watershed Fund received a grant ($3,431) to evaluate the benthic invertebrate community and stream habitat of three tributaries flowing into Crystal Lake, Benzie County. This group received training from a SWQD biologist, and is finalizing their QAPP. Sample collection will begin when the QAPP is completed.

4.1.18 Friends of the Looking Glass River

The Friends of the Looking Glass River received a grant ($4,735) to assess the benthic invertebrate community and stream habitat at approximately 20 sites in the Looking Glass River Watershed. Data generated by this group will be used to help develop a watershed management plan. This group has been trained by a SWQD biologist and has completed an approved QAPP. Sampling began in spring 2002.

4.1.19 Mershon Chapter of Trout Unlimited

The Mershon Chapter of Trout Unlimited received a grant ($5,450) to examine the effects of erosion on stream quality by collecting macroinvertebrate community and stream habitat data from 20-40 road crossings along the Rifle River. This group has been trained by a SWQD biologist and has an approved QAPP. Sampling began in spring 2002.

4.1.20 St. Clair County MSU Extension 4-H

The St. Clair County MSU Extension 4-H received a grant ($7,123) to assess the benthic invertebrate community, stream habitat, and water chemistry at a minimum of 10 sites in the St. Clair River Watershed. Volunteers consist primarily of students and the focus of this group

is on public education and promotion of stewardship of Michigan's rivers and streams. A QAPP has been approved. Sampling began in spring 2002.

4.1.21 Timberland Resource Conservation District

The Timberland Resource Conservation District, in partnership with the Duck Lake/Duck Creek Watershed Advisory Committee, received a grant ($1,940) to collect data on the benthic invertebrate community, water chemistry, and temperature in Duck Creek (Muskegon River Watershed). This group has been trained by a SWQD biologist, and data collection will begin after a QAPP has been approved.

GROUPS WORKING WITH SWQD, BUT NOT FUNDED

4.1.22 Allegan Conservation District

The Allegan Conservation District was trained by a SWQD biologist in spring 2000. This group consists of teachers and middle school students. They submitted data for one location sampled in fall 2000 (Appendix E) and no longer provide data to the SWQD.

4.1.23 Friends of the Devils River

The Friends of the Devils River were trained by a SWQD biologist, and in fall 1999 began collecting data on the macroinvertebrate community, stream habitat, and water chemistry at four locations on the Devils River near Alpena, MI.

Water samples collected in September, October and December of 1999 were analyzed for dissolved oxygen, temperature, pH, total suspended solids, biochemical oxygen demand, and total phosphorus. Habitat and macroinvertebrate communities were examined in fall 1999 and spring 2000 at 6 sites (Appendix E). The invertebrate community ranked "Fair" at 3 sites, "Good" at 2 sites, and "Excellent" at 1 site (Appendix E). These data have been used by the SWQD in the planning of the 2002 biological surveys. The North Branch Devils River was identified as a location in which additional follow-up site assessment is needed, and will be included as one of the SWQD sampling locations in 2002.

The Friends of the Devils River are no longer providing data to the SWQD.

4.1.24 Little Manistee Watershed Council

The Little Manistee Watershed Council was trained by a SWQD biologist, and in fall 2000 began collecting data on the macroinvertebrate community and stream habitat at 11 locations within the Little Manistee River Watershed. The data have not yet been entered into the volunteer database, because there was not sufficient location detail on the data forms. After the additional location is received, the data will be entered.

The Little Manistee Watershed Council regularly provides their newsletter to the SWQD, which allows the SWQD biologist for this watershed to remain informed about various events, such as bank stabilization projects, sand trap maintenance, road crossing construction, and best management practices. This information will be used to plan the SWQD biological surveys in 2004. The Little Manistee Watershed Council continues to collect data and provide it to the SWQD.

4.1.25 River Raisin Watershed Council

The River Raisin Watershed Council was trained by a SWQD biologist, and in April 2001 began collecting data on the benthic invertebrate community and stream habitat at 8 locations within the River Raisin Watershed (Appendix E). The macroinvertebrate communities ranked "Fair" at 4 sites, "Good" at 3 sites and "Excellent" at 1 site (Appendix E). This group only monitors in the spring of each year, and therefore there are no data for fall 2001. The River Raisin Watershed Council collected data in spring 2002 and provided it to the SWQD.

4.1.26 Shiawassee River Task Force

The Shiawassee River Task Force was trained by a SWQD biologist, and in fall 2001 began to collect data on the macroinvertebrate community and stream habitat at 2 locations in the Shiawassee River Watershed (Appendix E). Sites ranked "Fair" and "Good". The Shiawassee River Task Force continues to collect data and provide it to the SWQD.

SECTION 5.0

CONCLUSIONS

The SWQD has been working with volunteers since 1998 to monitor wadable rivers and streams throughout the state. This effort has evolved as more groups participated and provided feedback on volunteer data forms, sampling procedures, trainings, and quality assurance requirements. Each year, the number of groups requesting technical and financial assistance is high, indicating public support for volunteer monitoring. For the most part, the SWQD has been successful in using volunteer data as a "screening tool" to identify high priority locations for follow-up assessment. This approach allows the SWQD to allocate limited staff and resources more efficiently, and therefore helps the SWQD reach its goal of assessing 80 percent of Michigan's river and stream miles over a five-year period.

As the number of volunteer groups has increased and the monitoring activities have developed, a number of observations and conclusions have become apparent. Many of these conclusions were discussed in a previous report (MI/DEQ/SWQ-01/022), and therefore are not discussed here. The observations mentioned below focus primarily on those not discussed in the previous report.

Based on data from groups that have monitored consistently, it appears that benthic invertebrate community scores improve the first few times a site is assessed by volunteers. This indicates that volunteers sample more thoroughly and effectively as they become more experienced. This is not surprising, of course, but it does have implications for concluding whether water quality at a site is improving or declining. This observation suggests that conclusions about site changes should not be based on a couple of site visits, but instead require many visits. This in turn, requires that groups make a long-term commitment to monitor consistently.

Seasonal differences in benthic invertebrate community scores frequently occur. It appears that scores in the spring generally are higher than fall scores. This observation likely is due to life history characteristics of aquatic insects. In spring, many larvae and nymphs are preparing to transform into adult insects. As a result, the larvae/nymphs are large and easily seen when collected. In the fall, many insects are still either in the egg stage, or recently hatched. They are very small and more difficult to collect and observe. Therefore, when a site is sampled for multiple years, spring scores should be compared to other spring scores, and fall scores to other fall scores, rather than trying to compare spring and fall scores.

Staff turnover within volunteer organizations is common, which can be a major challenge to long-term, consistent monitoring efforts. If an organization's monitoring coordinator leaves, monitoring activities often will falter until a replacement is found, which may take a great deal of time. The result may be a missed sampling season, or even a year. When a replacement is found, they need time to become familiar with the project. Therefore, we strongly recommend that organizations have at least two people who are familiar with the monitoring protocols and the volunteers, so that the project can continue without interruption if one person leaves.

We have observed that working with adult volunteers generally is preferable to working with schools. A number of reasons may contribute to this observation. Training logistics are more difficult with schools. All adult volunteers are trained, whereas only teachers are trained and not the students. Unless the teacher is very knowledgeable and dedicated to water quality monitoring, it is difficult to make sure that the students do a thorough job of collecting benthic

invertebrates. Overall, goals are different as well. Adults tend to be very interested in water quality issues and want to make something happen, whereas schools focus on education. Data quality may be secondary for schools. Many teachers that have been trained by a SWQD biologist have not submitted data forms or specimen jars. It is also difficult to contact teachers, especially during the summer. In contrast, most groups with primarily adult volunteers continue to collect samples and provide the data to the SWQD, although sometimes they have to be reminded to send in the data forms.

Finally, frequent communication between the SWQD and volunteer organizations is essential. While this may be obvious, it does have implications for how the projects are run. The SWQD cannot just fund and train volunteers, and expect the data collected by each group to be submitted twice per year. Some groups do not submit data and jars unless contacted by a SWQD biologist, unfortunately. In some cases, monitoring did not continue once the volunteer grant expired. These ongoing communication needs require additional staff time to make sure that volunteers are collecting and then providing the data. As more groups receive funding and participate in volunteer monitoring, the staff time required for this purpose will continue to increase.

For more information about volunteer monitoring of streams and rivers in Michigan, please contact Gary Kohlhepp at 517-335-1289 or e-mail at kohlhepg@michigan.gov.

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REFERENCES

Michigan Department of Environmental Quality (MDEQ) 1996. A strategic environmental quality monitoring program for Michigan's surface waters. Report MI/DEQ/SWQ-96/152.

Michigan Department of Environmental Quality (MDEQ) 2001. The use of Michigan volunteer monitoring data—benefits and constraints. Report MI/DEQ/SWQ-01/022.

TABLE 1. INVENTORY OF VOLUNTEER ORGANIZATIONS AND FUNDING STATUS

Organization Name	County	Status	Funding Year	Grant Amount	Start Date
Allegan Conservation District	Allegan	Not Active	Not Funded		11/8/2000
Antrim County Conservation District	Antrim	Active	FY01	$11,998	4/30/2002
Center for Science and Environmental Outreach	Houghton	Active	FY01	$7,384	4/30/2002
Central Lake Superior Watershed Partnership	Marquette	Active	FY00	$4,715	5/19/2000
Clinton River Watershed Council	Macomb	Active	FY98	$9,000	5/28/1999
Crystal Lake Watershed Fund, Inc.	Benzie	Active	FY01	$3,431	4/30/2002
Friends of the Devils River	Alpena	Not Active	Not Funded		10/14/1999
Friends of the Looking Glass River	Clinton	Active	FY01	$4,735	4/30/2002
Friends of the Rouge River	Wayne	Active	FY99 and FY01	$10,850 and $5,013	5/13/1999
Friends of the St. Joe River	Hillsdale	Not Active	FY98	$9,000	5/11/1999
Grand Traverse Bay Watershed Initiative	Leelanau	Active	FY00	$13,781	6/29/2001
Little Manistee Watershed Council	Lake	Active	Not Funded		4/30/2002
Marquette Middle School	Marquette	Not Active	FY99	$540	5/15/1999
Mershon Chapter of Trout Unlimited	Ogemaw	Active	FY01	$5,450	4/30/2002
Michigan Lakes and Streams Association	Allegan	Not Active	FY99	$9,637	5/10/1999
Muskegon Conservation District	Muskegon	Active	FY00	$10,000	1/9/2001
Northern Tittabawassee River Task Force	Gladwin	Not Active	FY98	$9,000	10/28/1998
Oceana County Conservation District	Oceana	Active	FY98	$9,000	6/3/1998
River Raisin Watershed Council	Lenawee	Active	Not Funded		4/28/2001
Shiawassee River Task Force	Oakland	Active	Not Funded		11/17/2001
St. Clair County 4-H MSU Extension	St. Clair	Active	FY01	$7,123	4/30/2002
St. Clair County Drain Commissioner	St. Clair	Active	FY00	$7,865	4/30/2002
Timberland Resource Conservation District	Muskegon	Active	FY01	$1,940	4/30/2002
Tip of the Mitt Watershed Council	Charlevoix	Active	FY99	$8,650	10/10/1999
University of Michigan - Flint River Watershed Council	Lapeer	Active	FY99	$10,296	5/12/1999
West Michigan Environmental Action Council	Kent	Active	FY00 and FY01	$11,385 and $4,995	5/6/2000

TABLE 2. INVENTORY OF WATERBODIES AND PARAMETERS MONITORED BY VOLUNTEER ORGANIZATIONS, 1998-2001

Organization Name	Waterbody Name	Habitat	Macroinvertebrates	Water Chemistry
Allegan Conservation District	Miller Creek	☑	☑	☐
Antrim County Conservation District	Pine River	☑	☑	☐
Center for Science and Environmental Outreach	To be announced	☑	☑	☐
Central Lake Superior Watershed Partnership	Big Creek	☑	☑	☐
Central Lake Superior Watershed Partnership	Cedar Creek	☑	☑	☐
Central Lake Superior Watershed Partnership	Chocolay River	☑	☑	☐
Central Lake Superior Watershed Partnership	East Branch Chocolay River	☑	☑	☐
Central Lake Superior Watershed Partnership	East Branch Salmon Trout River	☑	☑	☐
Central Lake Superior Watershed Partnership	Main Branch Salmon Trout River	☑	☑	☐
Central Lake Superior Watershed Partnership	Salmon Trout River	☑	☑	☐
Central Lake Superior Watershed Partnership	Silver Creek	☑	☑	☐
Central Lake Superior Watershed Partnership	Silver Lead Creek	☑	☑	☐
Central Lake Superior Watershed Partnership	Snake Creek	☑	☑	☐
Central Lake Superior Watershed Partnership	West Branch Chocolay River	☑	☑	☐
Clinton River Watershed Council	Clinton River	☑	☑	☐
Clinton River Watershed Council	Galloway Creek	☑	☐	☐
Clinton River Watershed Council	Gibson Drain	☑	☐	☐
Clinton River Watershed Council	Main Branch Clinton River	☑	☑	☐
Clinton River Watershed Council	Main Branch Clinton River	☑	☐	☐
Clinton River Watershed Council	Middle Branch Clinton River	☑	☑	☐
Clinton River Watershed Council	North Branch Clinton River	☑	☑	☑
Clinton River Watershed Council	North Branch Clinton River	☑	☑	☐
Clinton River Watershed Council	Paint Creek	☑	☑	☐
Clinton River Watershed Council	Red Run Drain	☑	☑	☐
Clinton River Watershed Council	Stony Creek	☑	☑	☐

TABLE 2. INVENTORY OF WATERBODIES AND PARAMETERS MONITORED BY VOLUNTEER ORGANIZATIONS, 1998-2001

Organization Name	Waterbody Name	Habitat	Macroinvertebrates	Water Chemistry
Clinton River Watershed Council	Stony Creek	☑	☐	☐
Crystal Lake Watershed Fund, Inc.	Unnamed Tributary to Crystal Lake	☑	☑	☐
Friends of the Devils River	Mainstem of the Devils River	☑	☑	☐
Friends of the Devils River	North Branch Devils River	☑	☑	☐
Friends of the Devils River	South Branch Devils River	☑	☑	☐
Friends of the Looking Glass River	Looking Glass River	☑	☑	☐
Friends of the Rouge River	Bishop Creek	☑	☑	☐
Friends of the Rouge River	Fellows Creek	☑	☑	☐
Friends of the Rouge River	Fowler Creek	☑	☑	☐
Friends of the Rouge River	Franklin Creek	☑	☑	☐
Friends of the Rouge River	Johnson Creek	☑	☑	☐
Friends of the Rouge River	Lower Rouge River	☑	☑	☐
Friends of the Rouge River	Main Branch Rouge River	☑	☑	☐
Friends of the Rouge River	Middle Branch Rouge River	☑	☑	☐
Friends of the Rouge River	Pebble Creek	☑	☑	☐
Friends of the Rouge River	Rouge River	☑	☑	☐
Friends of the Rouge River	Tonquish Creek	☑	☑	☐
Friends of the Rouge River	Upper Rouge River	☑	☑	☐
Friends of the St. Joe River	Dowagiac Creek	☑	☑	☐
Friends of the St. Joe River	McCoy Creek	☑	☑	☐
Friends of the St. Joe River	St. Joe River	☑	☑	☐
Friends of the St. Joe River	Swan Creek	☑	☑	☐
Grand Traverse Bay Watershed Initiative	Kids Creek	☑	☑	☐
Grand Traverse Bay Watershed Initiative	Leo Creek	☑	☑	☐
Grand Traverse Bay Watershed Initiative	Northport Creek	☑	☑	☐

TABLE 2. INVENTORY OF WATERBODIES AND PARAMETERS MONITORED BY VOLUNTEER ORGANIZATIONS, 1998-2001

Organization Name	Waterbody Name	Habitat	Macroinvertebrates	Water Chemistry
Grand Traverse Bay Watershed Initiative	Suttons Bay Creek	☑	☑	☐
Lenawee Conservation District	Evans Creek	☑	☑	☐
Lenawee Conservation District	Goose Creek	☑	☑	☐
Lenawee Conservation District	Little Raisin River	☑	☑	☐
Lenawee Conservation District	River Raisin	☑	☑	☐
Lenawee Conservation District	Saline River	☑	☑	☐
Lenawee Conservation District	South Branch Macon Creek	☑	☑	☐
Lenawee Conservation District	South Branch Raisin River	☑	☑	☐
Lenawee Conservation District	South Branch Saline River	☑	☑	☐
Little Manistee Watershed Council	Little Manistee	☑	☑	☑
Marquette Middle School	Compeau Creek	☑	☑	☐
Mershon Chapter of Trout Unlimited	Rifle River	☑	☑	☐
Michigan Lakes and Streams Association	Barber Creek	☑	☑	☑
Michigan Lakes and Streams Association	Barber Creek	☑	☑	☐
Michigan Lakes and Streams Association	Barber Creek	☐	☐	☑
Michigan Lakes and Streams Association	Black River	☑	☑	☐
Michigan Lakes and Streams Association	Black River Extension Drain South Branch Blac	☑	☑	☑
Michigan Lakes and Streams Association	Black River Extension Drain South Branch Blac	☑	☑	☐
Michigan Lakes and Streams Association	Black River Extension Drain South Branch Blac	☐	☐	☑
Michigan Lakes and Streams Association	Cedar Creek	☑	☑	☑
Michigan Lakes and Streams Association	Cedar Creek	☑	☑	☐
Michigan Lakes and Streams Association	Cedar Creek	☐	☐	☑
Michigan Lakes and Streams Association	Great Bear Lake Drain South Branch Black Riv	☑	☑	☑
Michigan Lakes and Streams Association	Great Bear Lake Drain South Branch Black Riv	☑	☑	☐
Michigan Lakes and Streams Association	Great Bear Lake Drain South Branch Black Riv	☐	☐	☑

TABLE 2. INVENTORY OF WATERBODIES AND PARAMETERS MONITORED BY VOLUNTEER ORGANIZATIONS, 1998-2001

Organization Name	Waterbody Name	Habitat	Macroinvertebrates	Water Chemistry
Michigan Lakes and Streams Association	Haven and Max Lake Drain	☑	☑	☑
Michigan Lakes and Streams Association	Haven and Max Lake Drain	☑	☑	☐
Michigan Lakes and Streams Association	Haven and Max Lake Drain	☐	☐	☑
Michigan Lakes and Streams Association	Main Branch Black River	☑	☑	☑
Michigan Lakes and Streams Association	Main Branch Black River	☑	☑	☐
Michigan Lakes and Streams Association	Main Branch Black River	☐	☐	☑
Michigan Lakes and Streams Association	North Branch Black River	☑	☑	☑
Michigan Lakes and Streams Association	North Branch Black River	☑	☑	☐
Michigan Lakes and Streams Association	North Branch Black River	☐	☐	☑
Michigan Lakes and Streams Association	Scott Creek	☑	☑	☑
Michigan Lakes and Streams Association	Scott Creek	☐	☐	☑
Michigan Lakes and Streams Association	South Branch Black River	☑	☑	☑
Michigan Lakes and Streams Association	South Branch Black River	☑	☑	☐
Michigan Lakes and Streams Association	South Branch Black River	☐	☐	☑
Michigan Lakes and Streams Association	Spice Bush Creek	☑	☑	☑
Michigan Lakes and Streams Association	Spice Bush Creek	☑	☑	☐
Michigan Lakes and Streams Association	Spice Bush Creek	☐	☐	☑
Mill Creek Monitoring Project	Mill Creek	☑	☑	☐
Mill Creek Monitoring Project	North Branch Mill Creek	☑	☑	☐
Mill Creek Monitoring Project	South Branch Mill Creek	☑	☑	☐
Muskegon Conservation District	Bear Creek	☐	☐	☑
Muskegon Conservation District	Duck Creek	☑	☑	☐
Muskegon Conservation District	Duck Creek	☐	☐	☑
Muskegon Conservation District	Ruddiman Creek	☑	☑	☐
Muskegon Conservation District	Ruddiman Creek	☐	☐	☑

TABLE 2. INVENTORY OF WATERBODIES AND PARAMETERS MONITORED BY VOLUNTEER ORGANIZATIONS, 1998-2001

Organization Name	Waterbody Name	Habitat	Macroinvertebrates	Water Chemistry
Muskegon Conservation District	Ryerson Creek	☑	☑	☐
Muskegon Conservation District	Ryerson Creek	☐	☐	☑
Muskegon Conservation District	Silver Creek	☑	☑	☐
Northern Tittabawassee River Task Force	Cedar River	☑	☑	☐
Northern Tittabawassee River Task Force	North Branch Cedar River	☑	☑	☐
Oceana County Conservation District	Cedar Creek	☑	☑	☐
Oceana County Conservation District	Crystal Creek	☑	☑	☐
Oceana County Conservation District	Donaldson Creek	☑	☑	☐
Oceana County Conservation District	Hart Dam	☑	☑	☐
Oceana County Conservation District	Huftile Creek	☑	☑	☐
Oceana County Conservation District	Norht Branch Pentwater River	☑	☑	☐
Oceana County Conservation District	North Branch Pentwater River	☑	☑	☐
Oceana County Conservation District	North Branch Pentwater River	☑	☐	☐
Oceana County Conservation District	Russel Creek	☑	☑	☐
Oceana County Conservation District	South Branch Pentwater River	☑	☑	☐
River Raisin Watershed Council	Evans Creek	☑	☑	☐
River Raisin Watershed Council	Goose Creek	☑	☐	☐
River Raisin Watershed Council	River Raisin	☑	☑	☐
River Raisin Watershed Council	River Raisin	☑	☐	☐
River Raisin Watershed Council	Saline River	☑	☑	☐
River Raisin Watershed Council	South Branch Macon Creek	☑	☐	☐
River Raisin Watershed Council	South Branch River Raisin	☑	☑	☐
River Raisin Watershed Council	South Little River Raisin	☑	☐	☐
Shiawassee River Task Force	Patterson Drain	☑	☑	☐
Shiawassee River Task Force	Unnamed Tributary to Shiawassee River	☑	☑	☐

TABLE 2. INVENTORY OF WATERBODIES AND PARAMETERS MONITORED BY VOLUNTEER ORGANIZATIONS, 1998-2001

Organization Name	Waterbody Name	Habitat	Macroinvertebrates	Water Chemistry
St. Clair County 4-H MSU Extension	Pine River	☑	☑	☐
St. Clair County Drain Commissioner	Mill Creek	☑	☑	☐
Timberland Resource Conservation District	Duck Creek	☐	☐	☑
Tip of the Mitt Watershed Council	Main Branch Boyne River	☑	☑	☐
Tip of the Mitt Watershed Council	North Branch Boyne River	☑	☑	☐
Tip of the Mitt Watershed Council	South Branch Boyne River	☑	☑	☐
University of Michigan - Flint River Watershed C	Brent Run	☑	☑	☐
University of Michigan - Flint River Watershed C	Butternut Creek	☑	☑	☐
University of Michigan - Flint River Watershed C	Evergreen Creek	☑	☑	☐
University of Michigan - Flint River Watershed C	Farmers Creek	☑	☑	☐
University of Michigan - Flint River Watershed C	Flint River	☑	☑	☐
University of Michigan - Flint River Watershed C	Gilkey Creek	☑	☑	☐
University of Michigan - Flint River Watershed C	Hasler Creek	☑	☑	☐
University of Michigan - Flint River Watershed C	Indian Creek	☑	☑	☐
University of Michigan - Flint River Watershed C	Kearsley Creek	☑	☑	☐
University of Michigan - Flint River Watershed C	Misteguay Creek	☑	☑	☐
University of Michigan - Flint River Watershed C	North Branch Flint River	☑	☑	☐
University of Michigan - Flint River Watershed C	North Branch Flint River	☑	☐	☐
University of Michigan - Flint River Watershed C	Pine Run	☑	☑	☐
University of Michigan - Flint River Watershed C	Plum Creek	☑	☑	☐
University of Michigan - Flint River Watershed C	Silver Creek	☑	☑	☐
University of Michigan - Flint River Watershed C	South Branch Flint River	☑	☑	☐
University of Michigan - Flint River Watershed C	Springbank Creek	☑	☑	☐
University of Michigan - Flint River Watershed C	Squaw Creek	☑	☑	☐
University of Michigan - Flint River Watershed C	Swartz Creek	☑	☑	☐

TABLE 2. INVENTORY OF WATERBODIES AND PARAMETERS MONITORED BY VOLUNTEER ORGANIZATIONS, 1998-2001

Organization Name	Waterbody Name	Habitat	Macroinvertebrates	Water Chemistry
University of Michigan - Flint River Watershed C	Thread Creek	☑	☑	☐
West Michigan Environmental Action Council	Black Creek	☑	☑	☐
West Michigan Environmental Action Council	Duck Creek	☑	☑	☐
West Michigan Environmental Action Council	Emmons Creek	☑	☑	☐
West Michigan Environmental Action Council	Honey Creek	☑	☑	☐
West Michigan Environmental Action Council	Indian Mill Creek	☑	☑	☐
West Michigan Environmental Action Council	McCord Creek	☑	☑	☐
West Michigan Environmental Action Council	Mill Creek	☑	☑	☐

APPENDIX A

VOLUNTEER MONITORING DATA FORMS AND PROCEDURES

Single Site Watershed Survey Data Sheet

Date: | Time:
Waterbody Name: | County: | Station #:
Location: | Township: | Sec T R ¼ ¼
Investigator: | Lat: | Long:

Coordinate Determination Method (check the one that applies):
___ GPS ___ GPS w/ DBR ___ Digital mapping software ___ Topographic map ___ Other (describe _____)
Map Scale (if known _____)

Upstream Side/Downstream Side

PHYSICAL HABITAT

BACKGROUND INFORMATION - pg. 18

Event Conditions noted at site	None	Light	Moderate	Heavy	
Days since Rain	≤ 1	2	3	Unknown	
Water Temp./D.O./pH *					
Water Color	Clear	Gray	Brown	Black	Green
Waterbody Type-u/s	Stream	Lake	Impound	Wetland	
Waterbody Type-d/s	Stream	Lake	Impound	Wetland	
Stream Width (ft.)	<10	10-25	25-50	>50	
Avg. Stream Depth (ft.)	<1	1-3	>3	Unknown	
Water Velocity (ft./sec) *					
Stream Flow Type	Dry	Stagnant	L	M	H

PHYSICAL APPEARANCE - pg. 20
(Check all that apply)

Aquatic Plants	Present	Abundant
Floating Algae	Present	Abundant
Filamentous Algae	Present	Abundant
Bacterial Sheen/Slimes	Present	Abundant
Turbidity	Present	Abundant
Oil Sheen	Present	Abundant
Foam	Present	Abundant
Trash	Present	Abundant

SUBSTRATE (%) – pg. 22
(add to 100%)

Boulder – 10 in. diam.	
Cobble/Gravel –10 to .08 in. diam.	
Sand – coarse grain	
Silt/Detritus/Muck - fine grain/organic matter	
Hardpan/Bedrock – solid clay/rock surface	
Artificial – manmade	
Unknown	

INSTREAM COVER – pg. 23
(check all that apply)

Undercut Banks	
Overhanging Vegetation	
Deep Pools	
Boulders	
Aquatic Plants	
Logs or Woody Debris	

RIVER MORPHOLOGY – pg. 23

Riffle	Present		Abundant
Pool	Present		Abundant
Channel	Natural	Recovering	Maintained
Designated Drain	?	Y	N

Highest Water Mark (ft.)	?	<1	1-3	3-5	5-10	>10

STREAM CORRIDOR – pg. 26

Riparian Veg. Width ft.(L)	<10	10-30	30-100	>100
Riparian Veg. Width ft.(R)	<10	10-30	30-100	>100
Bank Erosion	0	L	M	H
Streamside Land Cover	Bare	Grass	Shr	Trees
Stream Canopy %	<25	25-50		>50

Stream Cross Section

Adjacent Land Uses

Wetlands	L	R
Shrub or Old Field	L	R
Forest	L	R
Pasture	L	R
Crop Residue	L	R
Rowcrop	L	R
Residential Lawns, Parks	L	R
Impervious Surfaces	L	R
Disturbed Ground	L	R
No Vegetation	L	R

* Optional Data Item

Data Sheet Version 4/27/00

Single Site Watershed Survey Data Sheet (page 2)

Date: **Station #:**

Upstream Side/Downstream Side

POTENTIAL SOURCES (Severity: S – slight; M – moderate; H – high) – pg. 28							
Crop Related Sources	S	M	H	Land Disposal	S	M	H
Grazing Related Sources	S	M	H	On-site Wastewater Systems	S	M	H
Intensive Animal Feeding Operations	S	M	H	Silviculture (Forestry NPS)	S	M	H
Highway/Road/Bridge Maintenance and Runoff (Transportation NPS)	S	M	H	Resource Extraction (Mining NPS)	S	M	H
Channelization	S	M	H	Recreational/Tourism Activities (general)	S	M	H
Dredging	S	M	H	• Golf Courses	S	M	H
Removal of Riparian Vegetation	S	M	H	• Marinas/Recr. Boating (water releases)	S	M	H
Bank and Shoreline Erosion/ Modification/Destruction	S	M	H	• Marinas/Recr. Boating (bank or shoreline erosion)	S	M	H
Flow Regulation/ Modification (Hydrology)	S	M	H	Debris in Water	S	M	H
Upstream Impoundment	S	M	H	Industrial Point Source	S	M	H
Construction:Highway/Road /Bridge/Culvert	S	M	H	Municipal Point Source	S	M	H
Construction: Land Development	S	M	H	Natural Sources	S	M	H
Urban Runoff (Residential/ Urban NPS)	S	M	H	Source(s) Unknown	S	M	H

SITE SUMMARY INFORMATION – pg. 33			
SURVEY DIRECTION	N/A	U/S	D/S
SITE SIMILARITY	?	Y	N
OVERALL SITE RANKING	L	M	H
SITE FOLLOW-UP RANK	L	M	H

COMMENTS:

Instream Survey Data Sheet

Average Water Depth (ft.):
Is the substrate covered with excessive silt? ( ) Yes ( ) No
Substrate Embeddedness: ( ) 0-25% ( ) 25-50% ( ) > 50%

Benthic Macroinvertebrates

Describe the types of habitats and substrates from which invertebrates were collected:

Use letter codes (R = 1-10, C = 11 or more) to record the approximate numbers of organisms in each taxa found in the stream reach.

Group 1 Sensitive	Group 2 Somewhat-Sensitive	Group 3 Tolerant
_____Beetle adults (Coleoptera)	_____Beetle larvae (Coleoptera)	_____Aquatic worms (Oligochaeta)
_____Caddisfly larvae (Trichoptera)	_____Clams (Pelecypoda)	_____Leeches (Hirudina)
_____Hellgrammites (Megaloptera)	_____Cranefly larvae (Diptera)	_____Midge larvae (Diptera)
_____Mayfly nymphs (Ephemeroptera)	_____Crayfish(Decapoda)	_____ Pouch snails (Gastropoda)
_____Gilled Snails (Gastropoda)	_____Damselfly nymphs (Odonata)	_____Sowbugs (Isopoda)
_____Stonefly nymphs (Plecoptera)	_____Dragonfly nymphs (Odonata)	_____True Bugs (Hemiptera)
_____Water penny (Coleoptera)	_____Scuds (Amphipoda)	_____Other Diptera
_____Blackfly larvae (Diptera)	_____Alderfly larvae (Megaloptera)	

Group 1	Group 2	Group 3
____# of R's * 5.0 =____	____# of R's * 3.0 =____	____# of R's * 1.1 = ____
____# of C's * 5.3 =____	____# of C's * 3.2 =____	____# of C's * 1.0 = ____
Group 1 Total =____	Group 2 Total =____	Group 3 Total = ____

Total Stream Quality Score (sum of totals for Groups 1-3) = _____

____Excellent (>48) ____Good (34-48) ____Fair (19-33) ____Poor (<19)

During the sampling and evaluation, did you observe any fish or wildlife? ( ) Yes ( ) No

If yes, please describe (if possible):

(Data Sheet Version 4/27/00)

STREAM CROSSING WATERSHED SURVEY PROCEDURE

April 27, 2000

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Surface Water Quality Division
Michigan Department of Environmental Quality

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STREAM CROSSING WATERSHED SURVEY PROCEDURE

A. OBJECTIVES

This set of watershed and stream survey forms is intended to be used as a quick screening tool to increase the amount of information available on the water quality of Michigan's rivers, and the sources of pollutants to the rivers. The survey procedure was designed to provide standardized assessment and data recording procedures that can be used by a variety of Surface Water Quality Division (SWQD) staff and trained volunteers. It does not take the place of the Surface Water Quality Division's more comprehensive Procedure 51 surveys ("Qualitative Biological and Habitat Survey Protocols for Wadable Streams and Rivers") that are conducted by SWQD aquatic biologists to assess current water quality status.

This watershed survey assessment procedure is designed to address several general objectives:

- Increase the information available on the water quality of Michigan rivers and the sources of pollutants, for use by Division staff and local watershed groups.

- Provide for consistent data collection and management statewide.

- Serve as a quick screening tool to identify issues and the need for more in depth investigations (the visual assessment portion of the survey should take an experienced surveyor no more than 5-10 minutes per site to complete).

- Provide information for use in the Division's Procedure 51 stream assessments to help determine the following: (1) where monitoring stations should be established; (2) how far upstream a station is representative; and (3) what pollutant sources are present (identified in federal clean water act Section 305[b] reporting categories) for incorporation into the Procedure 51 assessment reports.

This survey procedure is one of several assessment procedures that will be used to meet the Division's long-term goal to "Improve the identification of nonpoint pollution sources and impacts in Michigan watersheds to effectively target resources by 2011." A short-term goal has been established for this survey procedure, which states that the Division will "Conduct NPS physical assessments in 80% of Michigan's watersheds (10,000-20,000 acres in size) by FY2006."

B. GENERAL CONCEPTS

The survey forms are to be completed at locations where a road crosses a stream. There are two types of survey effort incorporated by the forms.

The first form is a two-page visual assessment of stream conditions and watershed characteristics observed by an investigator from the road stream crossing. The surveyor should include any appropriate observations that can be seen along the entire length of the stream visible from the road crossing. Only observations that are actually seen are to be recorded. No "educated guesses" are to be made about what should be there or is probably there. If something cannot be seen, it should not be recorded. The one exception is if a significant source or stream impact is known to be upstream of a particular site, a comment about its presence can be made in the comment section of the form.

The second one-page form is an optional form to be used at select stations where additional instream assessment work—primarily the characterization of benthic macroinvertebrate communities—is desired. The level of training needed to complete the instream form is greater than that needed for the visual form.

It is important to keep in mind the intent and limitations of this type of survey. The watershed survey data sheet portion of the survey was designed to be completed using visual assessments; therefore, the data are inherently subjective. Additionally, in order to increase the amount of data that can be collected, this survey process was designed to be conducted by a variety of personnel with different knowledge levels of water quality, aquatic biology, and nonpoint source pollution issues. Consequently, the survey procedure is useful as a qualitative screening tool to identify issues and the potential need for more in-depth studies. It is not intended to be used as a scientifically rigorous quantification of water quality or watershed conditions.

The limitations of this survey procedure were taken into account in establishing the objectives, the content and design of the form, and the methods for conducting the assessments. There are a variety of quality assurance and quality control (QA/QC) items (described at the end of this document) implemented specifically to minimize subjective variation and account for different knowledge levels among the people conducting the survey. These QA/QC activities should facilitate the accurate collection of quality data on a statewide basis. Nevertheless, when the survey data are interpreted, the analysis needs to take into account the numerous sources of data variability present as a result of the assessment methodology, particularly when drawing conclusions or making watershed management recommendations.

C. SURVEY DESIGN

1. Selecting Watersheds to Survey

One of the watershed survey objectives is to provide information that can be used to help determine where sampling locations should be established for the Division's Procedure 51 stream assessments. In order for the watershed survey information to be available for this SWQD use, streams scheduled for Procedure 51 assessments should be surveyed the prior year with this stream crossing survey (Figure 1). Watersheds may be surveyed earlier than their scheduled year if necessary because of workload demands, but the surveys should be done as close in time to the scheduled year as possible. Using this schedule, watersheds would be re-surveyed approximately every five years.

If watershed survey information is to be collected for other reasons, such as for a local watershed planning or assessment effort, select watersheds or subwatersheds as appropriate based on the objectives of that project. For example, if agricultural sources are known or suspected sources of a pollutant of concern in a particular major watershed, the survey may want to focus on the subwatersheds with the most agricultural land use.

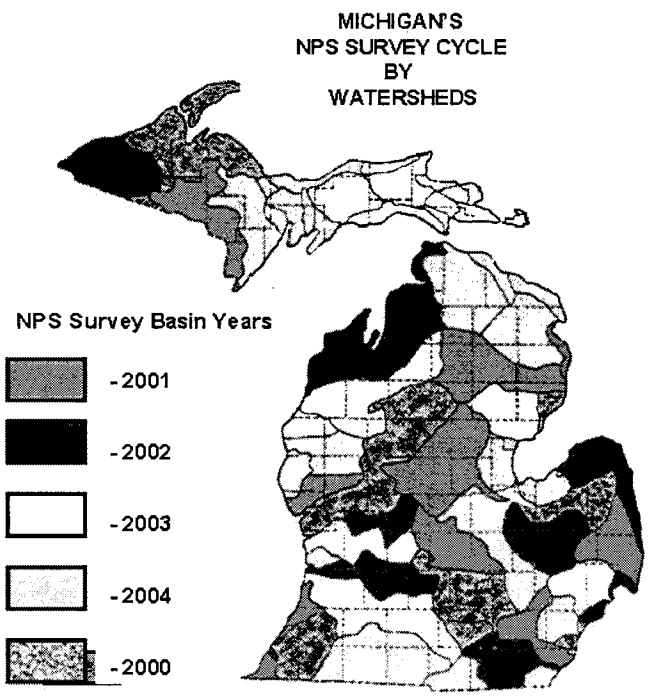


Figure 1. Schedule for stream crossing watershed surveys.

2. Watershed Survey Scope

The approach used to survey a particular watershed, and the scope of that assessment, should be determined prior to beginning the fieldwork. This initial survey planning effort should cover: which stations will be assessed, the general order in which they will be assessed, assigning station numbers, determining what information will be collected at each site (some of the data are optional), and what time of year the survey will be done.

3. Selecting Survey Stations

One of the basic questions that needs to be answered in planning the assessment is: how many stream crossing sites should be surveyed within a watershed to adequately characterize it, and where should they be located? That depends on a variety of factors including the heterogeneity of land use, soils, topography, hydrology, and other characteristics within the watershed. Consequently, this question can only be answered on a watershed-by-watershed basis.

A general guideline is to try to survey a minimum of 30% of the stream crossing sites within a watershed, with the sites distributed such that each subwatershed (and in turn their subwatersheds) are assessed to provide a representative depiction of conditions found throughout the watershed. At least one site should be surveyed in each tributary, with the location of this site being near the mouth of the tributary. The distribution of sampling stations within the watershed should also achieve adequate geographic coverage. Consider establishing stations upstream and downstream of suspected pollutant source areas, or major changes in land use, topography, soil types, water quality, and stream hydrology (flow volume, velocity or sinuosity).

The previous paragraphs lay out the minimum quantity of data needed to meet the statewide SWQD objective. However, this procedure identifies several other objectives that apply to individual watersheds. If the intent of a particular watershed survey is to meet some of these watershed specific objectives, then additional data are needed. A general guideline in this case is that most stream crossing sites within a watershed need to be assessed to fully meet the procedure objectives.

4. Watershed Map

Make a single map for the watershed on which to delineate sub-basins and stations. One way this can be done is by copying the appropriate pages of maps, such as those in the *Michigan Atlas & Gazetteer*, and then cutting, pasting, and copying until there is a single sheet that includes the entire survey area.

5. Sub-basins

In many cases, but not all, it is desirable to divide the watershed into appropriately sized sub-basins that facilitate data collection and analysis. There are no limits on how many stations can be in a single watershed or sub-basin; however, think about the smallest area for which a distinct summary analysis of the data may be needed, and delineate the watershed appropriately.

6. Station IDs

A station ID is comprised of both: (1) a 2-4 letter abbreviation for the name of the sub-basin or river segment being surveyed, and (2) a number that is derived sequentially in an upstream direction starting with 01 at the downstream end of the sub-basin or river segment. The letters and numbers should be separated by a hyphen. For example, the third station upstream of the Pine River mouth could be coded as "PR-03".

In order to make the best decisions on assigning appropriate station IDs to facilitate data entry and analyses, it is important to consider that the computer database for this assessment survey includes four columns for river names in addition to the station ID column. Computer sorts and data summaries can be made for any "name" in any of the five columns. The first column—or organizational tier—corresponds roughly to the USGS major river basins for Michigan, such as the Manistee River. The second column corresponds to the larger tributaries to major rivers, such as the Pine River tributary to the Manistee River. The third column corresponds roughly to sub-basin names, such as the Pine River East Branch. The fourth column uses the waterbody name entered on the watershed survey data sheet, which may be a segment of river already named in one of the preceding levels, or a headwater tributary such as Edgett Creek, a tributary to the Pine River East Branch. The fifth column is the station ID name.

It makes sense to "name" stations (the letter portion of the station ID) to either facilitate data summaries that cannot be obtained by sorting on any of the first four columns, or to use a name that groups the stations by one of the four river names in order to help organize the data. For example, it might be useful for data analysis purposes to divide the Pine River into upstream and downstream sub-basins. Whereas one could identify all these stations as PR-???, if the Pine River upstream stations are coded as PRU or PU, data could be summarized for those two areas separately by sorting the data on the station ID field. Sorting on any of the four river name fields would not group the data to accomplish the same analyses.

<u>Station IDs Part 1: Letter Abbreviation Designations</u>

Assign each watershed or sub-basin a unique 2-4 capital letter designation for ID purposes. This letter designation will be part of the surveyor-defined station identification number and should be descriptive of the primary river in that watershed or

sub-basin. Note that a separate *unique station identifier* (USI) will also be automatically assigned in the database (and stored in a separate column) for each station when the data are entered. The USI is different from the letter-number station ID designation created by the surveyor and it will distinguish among any similarly coded station designations anywhere in the state. However, to minimize potential data analysis difficulties, try not to repeat any letter codes within the geographic area where you are conducting assessments.

Station IDs Part 2: Station Numbers

Assign numbers to all stations that will be surveyed in each watershed, except in certain cases when the surveyor intends to select some stations in the field based on observed stream or watershed characteristics. Start at the downstream end of the watershed and number upstream. If more than 40-60 stations are identified within a sub-basin, one should consider dividing that sub-basin into smaller sub-basins to facilitate easier data analysis. Station numbers for each sub-basin should begin with "01". When a tributary confluence is reached, that entire tributary should be numbered before continuing upstream with numbering on the mainstream (Figure 2). If additional stations need to be added later—which sometimes happens in the field when a road crossing is encountered that is not on a map—use a decimal system for additions. For instance, if two stations are added between stations 16 and 17, the station numbers would be 16.1 and 16.2, with 16.1 being the one closest to station 16.

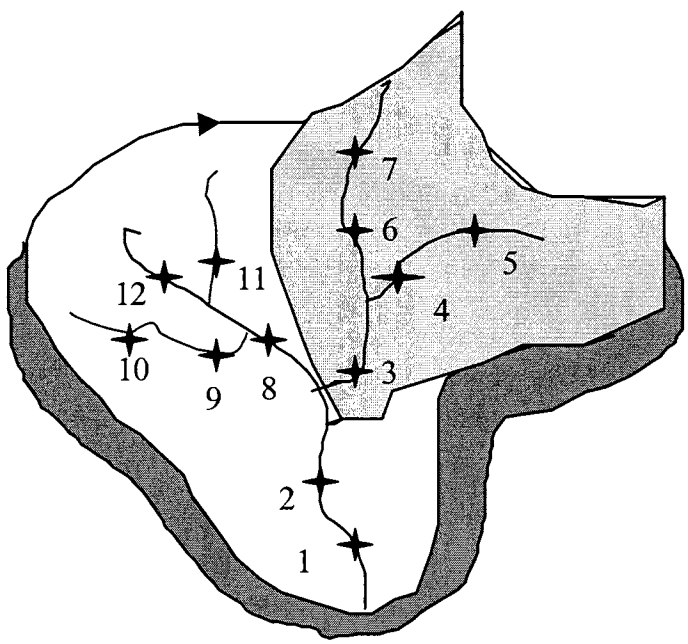


Figure 2. Numbering sequence for survey stations.

7. Station Survey Order

Determine in which order the stations will be surveyed. It does not matter if the investigator works from downstream stations to upstream stations, or the reverse. Many people prefer to work from upstream to downstream so they know what conditions existed upstream of the site they are currently surveying. Others prefer to work from downstream to upstream so they can look for specific types of pollutants/sources based on stream impacts they have noted. Some people determine survey order based on travel logistics.

Regardless of which direction is preferred by a surveyor, within a given sub-basin, the survey should be conducted in a single direction to facilitate properly answering and interpreting the watershed survey form question (on the second page) asking whether the station is similar to the previously assessed station. For the same reason, if more than one investigator (or team) is conducting a survey in a watershed, it is important that all stations within a single sub-basin are surveyed by the same investigator, if possible. Working in a single direction also helps to confirm which photographs (taken at each station) go with each station.

8. Time of Year

The time of year in which a survey is conducted is important. Surveys should not be conducted when there is snow on the ground or ice on the water because sources and impacts may be hidden from view. The best time for getting an unobstructed view of the landscape is in the early spring before leaf-out, followed next by late fall after leaf drop. However, if potential nutrient enrichment of the watershed to be surveyed is a major consideration, then summer is often the best time to conduct the survey because there may be more aquatic plant or algae growth visible as a potential manifestation of nutrient enrichment. Surveys conducted during or shortly after storm runoff events may help to identify sources of pollutants, but increased stream turbidity during that time may make assessment of instream conditions difficult. Furthermore, all stations within a single watershed should be surveyed as closely together in time as possible to facilitate relative data comparisons among stations surveyed under similar stream flow and seasonal conditions.

D. DATA SHEETS

Watershed Survey Data Sheet

Date: | Time:
Waterbody Name: | County: | Station #:
Location: | Township: | Sec T R ¼ ¼
Investigator: | Lat: | Long:

Coordinate Determination Method (check the one that applies):
___ GPS ___ GPS w/ DBR ___ Digital mapping software ___ Topographic map ___ Other (describe _____)
Map Scale (if known _____)

PHYSICAL HABITAT

BACKGROUND INFORMATION - pg. 18

Event Conditions noted at site	None	Light	Moderate	Heavy	
Days since Rain	≤ 1	2	3	Unknown	
Water Temp./D.O./pH *					
Water Color	Clear	Gray	Brown	Black	Green
Waterbody Type-u/s	Stream	Lake	Impound	Wetland	
Waterbody Type-d/s	Stream	Lake	Impound	Wetland	
Stream Width (ft.)	<10	10-25	25-50	>50	
Avg. Stream Depth (ft.)	<1	1-3	>3	Unknown	
Water Velocity (ft./sec) *					
Stream Flow Type	Dry	Stagnant	L	M	H

PHYSICAL APPEARANCE - pg. 20

	U/S (Check all that apply)		D/S (Check all that apply)	
Aquatic Plants	Present	Abundant	Present	Abundant
Floating Algae	Present	Abundant	Present	Abundant
Filamentous Algae	Present	Abundant	Present	Abundant
Bacterial Sheen/Slimes	Present	Abundant	Present	Abundant
Turbidity	Present	Abundant	Present	Abundant
Oil Sheen	Present	Abundant	Present	Abundant
Foam	Present	Abundant	Present	Abundant
Trash	Present	Abundant	Present	Abundant

SUBSTRATE (add to 100%) – pg. 22

	U/S (%)	D/S (%)
Boulder – 10 in. diam.		
Cobble/Gravel –10 to .08 in. diam.		
Sand – coarse grain		
Silt/Detritus/Muck - fine grain/organic matter		
Hardpan/Bedrock – solid clay/rock surface		
Artificial – manmade		
Unknown		

INSTREAM COVER – pg. 23

	U/S (X)	D/S (X)
Undercut Banks		
Overhanging Vegetation		
Deep Pools		
Boulders		
Aquatic Plants		
Logs or Woody Debris		

RIVER MORPHOLOGY – pg. 23

	U/S			D/S		
Riffle	Present		Abundant	Present		Abundant
Pool	Present		Abundant	Present		Abundant
Channel	Natr	Recov	Maintnd	Natr	Recov	Maintnd
Designated Drain	?	Y	N	?	Y	N
Highest Water Mark (ft.)	?	<1	1-3	3-5	5-10	>10

STREAM CORRIDOR – pg. 26

	U/S				D/S			
Riparian Veg. Width ft.(L)	< 10	10-30	30-100	>100	<10	10-30	30-100	>100
Riparian Veg. Width ft.(R)	< 10	10-30	30-100	>100	<10	10-30	30-100	>100
Bank Erosion	0	L	M	H	0	L	M	H
Streamside Land Cover	B	Gr	Sh	Trees	B	Gr	Sh	Trees
Stream Canopy %	<25		25-50	> 50	<25		25-50	> 50

Adjacent Land Uses

Wetlands	L	R	L	R
Shrub or Old Field	L	R	L	R
Forest	L	R	L	R
Pasture	L	R	L	R
Crop Residue	L	R	L	R
Rowcrop	L	R	L	R
Residential Lawns, Parks	L	R	L	R
Impervious Surfaces	L	R	L	R
Disturbed Ground	L	R	L	R
No Vegetation	L	R	L	R

Stream Cross Section

* Optional Data Item

Data Sheet Version 4/27/00

Date: **Watershed Survey Data Sheet** (page 2) Station #:

POTENTIAL SOURCES (Severity: S – slight; M – moderate; H – high) – pg. 28													
	U/S			D/S				U/S			D/S		
Crop Related Sources	S	M	H	S	M	H	Land Disposal	S	M	H	S	M	H
Grazing Related Sources	S	M	H	S	M	H	On-site Wastewater Systems	S	M	H	S	M	H
Intensive Animal Feeding Operations	S	M	H	S	M	H	Silviculture (Forestry NPS)	S	M	H	S	M	H
Highway/Road/Bridge Maintenance and Runoff (Transportation NPS)	S	M	H	S	M	H	Resource Extraction (Mining NPS)	S	M	H	S	M	H
Channelization	S	M	H	S	M	H	Recreational/Tourism Activities (general)	S	M	H	S	M	H
Dredging	S	M	H	S	M	H	• Golf Courses	S	M	H	S	M	H
Removal of Riparian Vegetation	S	M	H	S	M	H	• Marinas/Recr. Boating (water releases)	S	M	H	S	M	H
Bank and Shoreline Erosion/ Modification/Destruction	S	M	H	S	M	H	• Marinas/Recr. Boating (bank or shoreline erosion)	S	M	H	S	M	H
Flow Regulation/ Modification (Hydrology)	S	M	H	S	M	H	Debris in Water	S	M	H	S	M	H
Upstream Impoundment	S	M	H	S	M	H	Industrial Point Source	S	M	H	S	M	H
Construction:Highway/Road /Bridge/Culvert	S	M	H	S	M	H	Municipal Point Source	S	M	H	S	M	H
Construction: Land Development	S	M	H	S	M	H	Natural Sources	S	M	H	S	M	H
Urban Runoff (Residential /Urban NPS)	S	M	H	S	M	H	Source(s) Unknown	S	M	H	S	M	H

SITE SUMMARY INFORMATION – pg. 33			
SURVEY DIRECTION	N/A	U/S	D/S
SITE SIMILARITY	?	Y	N
OVERALL SITE RANKING	L	M	H
SITE FOLLOW-UP RANK	L	M	H

COMMENTS:

Single Site Watershed Survey Data Sheet

Date: | Time:
Waterbody Name: | County: | Station #:
Location: | Township: | Sec T R ¼ ¼
Investigator: | Lat: | Long:

Coordinate Determination Method (check the one that applies):
___ GPS ___ GPS w/ DBR ___ Digital mapping software ___ Topographic map ___ Other (describe _____)
Map Scale (if known _____)

Upstream Side/Downstream Side

PHYSICAL HABITAT

BACKGROUND INFORMATION - pg. 18

Event Conditions noted at site	None	Light	Moderate	Heavy	
Days since Rain	≤ 1	2	3	Unknown	
Water Temp./D.O./pH *					
Water Color	Clear	Gray	Brown	Black	Green
Waterbody Type-u/s	Stream	Lake	Impound	Wetland	
Waterbody Type-d/s	Stream	Lake	Impound	Wetland	
Stream Width (ft.)	<10	10-25	25-50	>50	
Avg. Stream Depth (ft.)	<1	1-3	>3	Unknown	
Water Velocity (ft./sec) *					
Stream Flow Type	Dry	Stagnant	L	M	H

PHYSICAL APPEARANCE - pg. 20
(Check all that apply)

Aquatic Plants	Present	Abundant
Floating Algae	Present	Abundant
Filamentous Algae	Present	Abundant
Bacterial Sheen/Slimes	Present	Abundant
Turbidity	Present	Abundant
Oil Sheen	Present	Abundant
Foam	Present	Abundant
Trash	Present	Abundant

SUBSTRATE (%) – pg. 22
(add to 100%)

Boulder – 10 in. diam.	
Cobble/Gravel –10 to .08 in. diam.	
Sand – coarse grain	
Silt/Detritus/Muck - fine grain/organic matter	
Hardpan/Bedrock – solid clay/rock surface	
Artificial – manmade	
Unknown	

INSTREAM COVER – pg. 23
(check all that apply)

Undercut Banks	
Overhanging Vegetation	
Deep Pools	
Boulders	
Aquatic Plants	
Logs or Woody Debris	

RIVER MORPHOLOGY – pg. 23

Riffle	Present	Abundant	
Pool	Present	Abundant	
Channel	Natural	Recovering	Maintained
Designated Drain	?	Y	N

Highest Water Mark (ft.)	?	<1	1-3	3-5	5-10	>10

STREAM CORRIDOR – pg. 26

Riparian Veg. Width ft.(L)	<10	10-30	30-100	>100
Riparian Veg. Width ft.(R)	<10	10-30	30-100	>100
Bank Erosion	0	L	M	H
Streamside Land Cover	Bare	Grass	Shr	Trees
Stream Canopy %	<25	25-50		>50

Adjacent Land Uses

Wetlands	L	R
Shrub or Old Field	L	R
Forest	L	R
Pasture	L	R
Crop Residue	L	R
Rowcrop	L	R
Residential Lawns, Parks	L	R
Impervious Surfaces	L	R
Disturbed Ground	L	R
No Vegetation	L	R

Stream Cross Section

* Optional Data Item

Data Sheet Version 4/27/00

Single Site Watershed Survey Data Sheet (page 2)

Date: **Station #:**

Upstream Side/Downstream Side

POTENTIAL SOURCES (Severity: S – slight; M – moderate; H – high) – pg. 28							
Crop Related Sources	S	M	H	Land Disposal	S	M	H
Grazing Related Sources	S	M	H	On-site Wastewater Systems	S	M	H
Intensive Animal Feeding Operations	S	M	H	Silviculture (Forestry NPS)	S	M	H
Highway/Road/Bridge Maintenance and Runoff (Transportation NPS)	S	M	H	Resource Extraction (Mining NPS)	S	M	H
Channelization	S	M	H	Recreational/Tourism Activities (general)	S	M	H
Dredging	S	M	H	• Golf Courses	S	M	H
Removal of Riparian Vegetation	S	M	H	• Marinas/Recr. Boating (water releases)	S	M	H
Bank and Shoreline Erosion/ Modification/Destruction	S	M	H	• Marinas/Recr. Boating (bank or shoreline erosion)	S	M	H
Flow Regulation/ Modification (Hydrology)	S	M	H	Debris in Water	S	M	H
Upstream Impoundment	S	M	H	Industrial Point Source	S	M	H
Construction:Highway/Road /Bridge/Culvert	S	M	H	Municipal Point Source	S	M	H
Construction: Land Development	S	M	H	Natural Sources	S	M	H
Urban Runoff (Residential/ Urban NPS)	S	M	H	Source(s) Unknown	S	M	H

SITE SUMMARY INFORMATION – pg. 33			
SURVEY DIRECTION	N/A	U/S	D/S
SITE SIMILARITY	?	Y	N
OVERALL SITE RANKING	L	M	H
SITE FOLLOW-UP RANK	L	M	H

COMMENTS:

Instream Survey Data Sheet

Average Water Depth (ft.):
Is the substrate covered with excessive silt? ( ) Yes ( ) No
Substrate Embeddedness: ( ) 0-25% ( ) 25-50% ( ) > 50%

Benthic Macroinvertebrates

Describe the types of habitats and substrates from which invertebrates were collected:

Use letter codes (R = 1-10, C = 11 or more) to record the approximate numbers of organisms in each taxa found in the stream reach.

Group 1 Sensitive	Group 2 Somewhat-Sensitive	Group 3 Tolerant
_____Beetle adults (Coleoptera)	_____Beetle larvae (Coleoptera)	_____Aquatic worms (Oligochaeta)
_____Caddisfly larvae (Trichoptera)	_____Clams (Pelecypoda)	_____Leeches (Hirudina)
_____Hellgrammites (Megaloptera)	_____Cranefly larvae (Diptera)	_____Midge larvae (Diptera)
_____Mayfly nymphs (Ephemeroptera)	_____Crayfish(Decapoda)	_____ Pouch snails (Gastropoda)
_____Gilled Snails (Gastropoda)	_____Damselfly nymphs (Odonata)	_____Sowbugs (Isopoda)
_____Stonefly nymphs (Plecoptera)	_____Dragonfly nymphs (Odonata)	_____True Bugs (Hemiptera)
_____Water penny (Coleoptera)	_____Scuds (Amphipoda)	_____Other Diptera
_____Blackfly larvae (Diptera)	_____Alderfly larvae (Megaloptera)	

Group 1	Group 2	Group 3
____# of R's * 5.0 =____	____# of R's * 3.0 =____	____# of R's * 1.1 = ____
____# of C's * 5.3 =____	____# of C's * 3.2 =____	____# of C's * 1.0 = ____
Group 1 Total =____	Group 2 Total =____	Group 3 Total = ____

Total Stream Quality Score (sum of totals for Groups 1-3) = _____

____Excellent (>48) ____Good (34-48) ____Fair (19-33) ____Poor (<19)

During the sampling and evaluation, did you observe any fish or wildlife? ( ) Yes ( ) No

If yes, please describe (if possible):

(Data Sheet Version 4/27/00)

E. INSTRUCTIONS FOR COMPLETING DATA SHEETS

1. Watershed Survey Data Sheets

a. Site Identification Information

Photographs:

Taking Pictures

Take one photo looking upstream from the road crossing and one photo looking downstream. The photos should be composed (framed) to best represent site conditions. Take the photos in the same sequence at each station to help in later assigning the photos to the proper upstream/downstream designation at the sites. The photos should include at least some of the riparian corridor—how much depends on which areas are significant to include in the photo. Additional photos may be taken to highlight a particular item of concern in the river or upland landscape. Photos may also be taken between stations to record a specific river concern or source area, but these photos should be assigned to the pertinent upstream or downstream station to keep them organized.

Camera Type

Photos may be taken with a traditional 35 millimeter film camera or with a digital camera, whichever the surveyor prefers.

Photo Storage

Regardless whether the original photo was taken with film or digitally, two copies of each photo will be maintained. A copy of each photo will be entered into a computer database that will store all the survey information: digital shots can be transferred directly and traditional developed photos can be scanned in. The original photo will be filed with the paper data forms—digital copies can be kept on their original storage media and conventional photo prints can be clipped to the appropriate station forms. Be sure to label the photos (on the back of individual print photos or on the storage media of digital photos) as soon as possible to minimize the possibility of not being able to determine which photos are for which stations.

Date: Record the month, day and year.

Time: Use 24-hr time (e.g. 1:00 PM should be recorded as 1300).

Waterbody Name: The waterbody name should be the name of the river or river branch, as given on the U.S. Geological Survey topographic map for the area corresponding to the ***station location***. For tributary streams to major rivers, record the tributary stream name here, ***not*** the major river name. For instance, if the stream being

surveyed is the North Branch of the Chippewa River, but the station is on Hogg Creek, record Hogg Creek as the waterbody name. If the tributary is an unnamed tributary, record as "Unnamed Tributary to" followed by the name of the next named stream downstream. In the above example, a station on an unnamed tributary of Hogg Creek would be recorded as "Unnamed Tributary to Hogg Creek".

County: Record county name.

Station #: Record station number. Station numbers should use both: (1) a 2-4 letter abbreviation for the name of the sub-basin or river segment being surveyed [see previous discussion on Survey Design], and (2) a number that is derived sequentially in an upstream direction, starting with 01 at the downstream end of the sub-basin or river segment. The letters and numbers should be separated by a hyphen. For example, the third station upstream of the Pine River mouth would be coded as "PR-03".

Location: Record the name of the road crossing the stream. If the same road crosses a single stream two or more times in the same sub-basin, it is sometimes desirable to record the road name relative to the nearest crossroads (e.g. "Green Road between Brown Road and Hill Road"). If the same road crosses a single stream two or more times *in the same township section*, record the road name relative to the distance from the nearest crossroad (e.g. "Green Road 1/8 mile east of Brown Road").

Township: Record the township name.

Sec: Record the township section number, town number, range number, and section ¼ ¼ designations (e.g. SW ¼ of the NW ¼).

Investigator: Record the name of the person conducting the survey (doing the assessment and filling out the form) at this particular site. A last name is generally sufficient.

Lat: Record the latitude coordinates of the road crossing location.

Long: Record the longitude coordinates of the road crossing location.

Coordinate Determination Method: Check the method used to calculate the latitude/longitude location coordinates.

Map Scale: If a map is used to determine latitude/longitude coordinates, record the scale of measurement (e.g. 1:25,000) if known.

Upstream Side/Downstream Side: This category is on the Single Site Watershed Survey Data Sheet only. The "single site" sheet is designed primarily for use by those groups participating in the Division's volunteer monitoring program and it includes only enough response categories for assessing one side of a stream crossing. If using this

data sheet, circle either Upstream Side or Downstream Side, as appropriate, to designate which side of the stream crossing is being assessed.

b. Background Information

Event Conditions Noted at Site: A stream "event" occurs when water runoff from a significant weather event, such as a major rainstorm or fast snowmelt, causes an increase in river flow. Note that high water flow conditions can exist (particularly in the spring) that are not related to storm events. Also, rainstorms can occur that result in no increase in stream flow and therefore there is no stream event.

Circle the appropriate description of event conditions exhibited ***in the stream***. Event conditions are increased river flow above what would be considered typical or normal for the stream for the time of year. The surveyor needs to determine this based on the following:

- Their knowledge of recent weather conditions (e.g. how much it has rained recently).
- Visual stream observations (look for event related conditions such as a rising or recently elevated water level, water running off the land into the stream, fast stream water velocity, increased water turbidity, an increase in the amount of debris being carried by the stream, etc.).
- The surveyor's knowledge (or best guess) of what is typical flow for that (or a similar) stream, in that geographic area, for that season of the year.

None	-	No event conditions are evident. Stream flow conditions exist that are typical for the season of the year. Note that it is possible to have "high" flow conditions that are not due to a recent storm event.
Light	-	Stream exhibits increased turbidity from normal and/or the water level of the stream (stage height) is somewhat elevated above what would be considered typical for the season of the year.
Moderate	-	Stream stage height is elevated substantially above typical flow conditions for the stream, for that time of year.
Heavy	-	Bank full or flooding conditions exist.

Days Since Rain: Circle the appropriate number of days that have passed since the last significant rain ended. This information is based on what you know about recent weather in the vicinity of the site. If you do not know, circle "unknown".

Water Temp: This is an optional data item. The person coordinating a particular watershed survey will determine if temperature measurements will be made. If measured, record the water temperature to the nearest degree fahrenheit or centigrade, making sure to include the scale units.

Water D.O.: This is an optional data item. The person coordinating a particular watershed survey will determine if dissolved oxygen (DO) measurements will be made. If measured, record the DO level in the river. If DO is measured, it is important that the water temperature be measured also.

Water pH: This is an optional data item. The person coordinating a particular watershed survey will determine if pH measurements will be made. If measured, record the pH of the stream to the nearest tenth.

Water Color: Circle the choice that best represents the color of the water.

Waterbody Type-u/s: Characterize the waterbody upstream of the road crossing and circle the appropriate category. Impd=impoundment.

Waterbody Type-d/s: Characterize the waterbody downstream of the road crossing and circle the appropriate category. Impd=impoundment.

*****

Continue with the next four stream criteria if a stream is present upstream OR downstream of the road crossing.

*****

Stream Width (ft): Circle the range that represents the average stream width in feet. Make this observation using best professional judgement of the distance. This can be done by pacing off the distance (counting the number of steps taken) on the road crossing from one edge of the stream to the other. There is no need to measure the distance with a tape measure or similar device, however, it is best to have previously paced off distances of 10, 25 and 50 feet so that the number of strides is known to these category endpoints.

Avg. Stream Depth (ft): Circle the appropriate depth range in feet. If the water is turbid and the depth cannot be determined, circle "Unknown". This observation is for the average depth of the stream that is consistently observed. In other words, if the stream is mostly shallow, but is 5ft deep in the channel, the >3ft category should be circled. However, if the stream is generally shallow (<1ft), but has a pool that is 3ft deep, circle the <1ft category since a pool is not representative of the average depth of <1ft observed over most of the stream. Remember that water often looks shallower than it is. The primary purpose of this data observation is to identify sites that would be suitable for wading for potential future instream assessments.

Water Velocity (ft/sec): This is an optional data item. The person coordinating a particular watershed survey will determine if water velocity measurements will be made. If measured, record the approximate surface water velocity in feet per second, observed at the surface in the area of fastest river flow that is not impacted by the road crossing. The preferred method is to observe how far downstream surface bubbles, foam, leaves,

or other floating objects, travel in one second (or observe for 10 seconds and divide the distance by 10). Another method is to step off the width of the road, time how long it takes a particular object (e.g. leaf, stick, grass blade) to float from the upstream side of the bridge to the downstream side, and divide the number of seconds into the distance to get feet per second. In some cases, the water velocity measured at the road crossing will not accurately represent actual stream velocity. This may occur at road crossings where the river width is abnormally restricted by the size of passage beneath the road (such is often the case with culverts), which can cause faster flow through the culvert than is observed in the stream. In such a case, it is better to measure water velocity further upstream or downstream (by looking further upstream or downstream from the bridge, not by going to a different location), if possible.

Stream Flow Type: Circle the category that best represents general flow volume in the stream. Note that in this case, "average" flow refers to the annual average flow. If a river flow is reduced in the summer, due to dry and hot conditions, circle "L" because it is below average, even though low flow may be typical for that stream in the summer.

Dry	=	No standing or flowing water, sediments may be wet.
Stagnant	=	Water present but not flowing, can be shallow or deep.
L (low)	=	Flowing water present, but flow volume would be considered to be below average for the stream.
M (medium)	=	Water flow is in average range for the stream.
H (high)	=	Water flow is above average for the stream.

c. Physical Appearance

Starting with this section of the form and continuing to the end, the person conducting the survey should evaluate each category twice—once for the upstream (U/S) side of the road crossing, and a second time for the downstream (D/S) side. ***The exception to this is that people participating in the Division's volunteer monitoring program may want to use the alternative Single Site Watershed Survey Data Sheet, which only includes assessment categories for one side of the stream crossing.*** From this point on, the surveyor is assessing two distinct sites. The conditions observed at one site should not bias the surveyor's assessment of conditions at the other. Usually it is easiest to complete the rest of the form for either the upstream or downstream site first, and then move to the other side of the road crossing and complete the remainder of the form for the remaining site. Most people do the upstream site first since it is listed on the form first.

Check the stream upstream and downstream, for as far as can be seen from the road stream crossing, for the presence of any of the following characteristics. If a category type (e.g. aquatic plants) is not present in the stream, do not record anything. If a category type can be seen, in any amount, circle "present". If a category type is present in a large portion of the stream, circle "abundant".

Aquatic Plants: This category refers to aquatic macrophytes only, not terrestrial species. By definition, macrophytes are any plant species that can be readily seen without the use of optical magnification. However, the usage here is directed primarily toward aquatic vascular plants—plants with a vascular system that typically includes roots, stems and/or leaves. This includes duckweed, as it is a floating vascular plant. Certain large algae species that superficially look like vascular plants, such as Chara, can be recorded here as well. If the person conducting the survey is knowledgeable about aquatic plants, the particular type or species of plant(s) can be noted in the comment section at the end of the form. Floating, suspended, or filamentous algae species should be recorded in one of the algae categories and not here.

Floating Algae: The presence of suspended algae (single celled organisms that may or may not form colonies) or floating algae mats/bundles should be recorded here. This includes bluegreen algae mats/bundles, whether floating on the surface, suspended in the water column, or present at the bottom.

Filamentous Algae: Algae that appear in stringy or ropy strands, such as Cladophora. The strands may or may not be attached to other objects in the waterbody.

Bacterial Sheen/Slimes:
-Bacterial sheens occur as oily appearing sheens on the water surface, often with a silverish cast to them. The sheens are produced from bacterial decomposition activity, and occur most often in still water areas of lake edges and coves, as well as wetland areas. The sheen can be distinguished from petroleum products by breaking into distinct platelets when poked with a stick or otherwise physically disturbed, whereas petroleum products remain viscous.
-Bacterial slimes are bacterial growths that are visible as a slimy-appearing coating of stream or lake substrates. They can be various colors, including black and orange.

Turbidity: Water appears cloudy—it is not transparent. Turbidity is caused by suspended particulates such as silt, sand, algae, or fine organic matter. Turbid water is opaque to varying degrees, preventing the observer from seeing very far into it. Note that water can have a color to it that is not turbidity, such as the brown transparent water often associated with swampy areas. If the water is slightly turbid, circle "present". If it is moderately turbid to very turbid, circle "abundant".

Oil Sheen: An oily appearing sheen on the water surface caused by petroleum products. A thin sheen will often have a rainbow of hues visible. The sheen can be distinguished from bacterial sheens by remaining viscous when poked with a stick or otherwise physically disturbed, whereas bacterial sheens break into distinct platelets.

Foam: Naturally occurring foam often looks like soap suds on the water surface and can be white, grayish or brownish. Foam is produced when water with dissolved organic material is aerated and can range in extent from individual bubbles to mats several feet high. Foam is typically produced in streams when water flows through rapids or past surface obstructions such as logs, sticks and rocks. Simple wave action

can produce foam in lakes. This naturally occurring foam is quite common. Natural foam can be distinguished from soap suds by rubbing it between ones fingers. If the suds disintegrate and leave only wet fingers or a gritty residue, the foam is natural. If the suds feel slippery and soapy, it is not natural foam.

Trash: Use this category to record the presence of general litter, such as paper, bottles, cans, etc., either in the waterbody or along the riparian banks. Use some reasonable discretion when completing this category. A single piece of gum wrapper on one bank would not be sufficient cause for checking "present".

d. Substrate

Substrate is the material that makes up the bottom of the stream or lake. In general, good quality substrates (from an aquatic habitat perspective) contain a large amount of course aggregate material—such as gravels and cobbles—with a minimal amount of fine particles surrounding or covering the interstitial pore spaces. These stable materials provide the solid surfaces necessary for the colonization of attached algae and the development of diverse macroinvertebrate communities.

Using the particle size and composition guidance provided below, identify the percent areal extent of each substrate type present. Round off to the nearest 10% increment. For example, do not record 25%, use either 20% or 30%. The composition estimate should include the entire area of the stream bottom that is visible from the road stream crossing, including substrates near or under the bridge. Sometimes it is not possible to determine the substrate type all the way across a river because it is too deep or the water is turbid. In these cases, assign the appropriate percentage amount to the "unknown" category.

Substrate Type		Composition and Size
Boulder	-	Rocks 10 inches in diameter or larger.
Gravel-Cobble	-	Rocks 1/12 inch to 10 inches in diameter.
Sand	-	Rocks 0.06 to 2 millimeters in diameter.
Silt-Muck-Detritus	-	Silt is usually clay, very fine sands, or organic soils, 0.004 to 0.06 millimeters in diameter. Muck is decomposing organic material of very fine diameter. Detritus is small particles of organic material such as pieces of leaves, sticks, and plants.
Hardpan-Bedrock	-	Solid surface. Hardpan is usually packed clay, <0.004 millimeters in diameter. Bedrock is a solid rock surface (the tops of buried boulders are not bedrock).

Artificial	-	Human made, such as concrete piers, sheet piling or rock riprap (that portion of shoreline erosion protection structures that extends below the water surface is considered substrate).
Unknown	-	The portion of the stream bottom for which a substrate type determination can not be made because the bottom can not be seen due to water depth or turbidity.

e. Instream Cover

Instream cover generally refers to habitat cover that is available to fish to: (1) protect them from predators, or (2) avoid certain stream conditions such as fast flow velocities or direct sunlight. Check all the instream cover types on the data form that are present in the stream reach for as far as can be seen—except, only check those cover types that are in areas of sufficient water depth (usually greater than 6 inches). Types of cover include the following:

Undercut Banks	-	Stream banks that overhang the stream because water has eroded some of the material beneath them.
Overhanging Veg	-	Terrestrial vegetation that extends out from shore over the surface of the stream within a foot or two of the water surface (includes trees, shrubs, grasses, etc.). This category also includes sweeping vegetation, which is terrestrial shoreline vegetation that extends into the water itself (such as low hanging branches on shrubs) and is therefore often "swept" in a downstream direction by the current .
Deep Pools	-	A depression or "hole" in the bottom of the stream where the water is substantially deeper than the average water depth of the stream.
Boulders	-	Rocks 10 inches in diameter or larger.
Aquatic Plants	-	Aquatic macrophytes.
Logs/woody Debris	-	Logs, branches and roots.

f. River Morphology

<u>Riffle</u>

Riffles are areas of naturally occurring, short, relatively shallow, zones of fast moving water followed by a pool. The water surface is visibly broken (often by small standing waves) and the river bottom is normally made up of gravel, rubble and/or boulders. Riffles are not normally visible at high water and may be difficult to identify in large

rivers. The size of, and distance between, riffles is related to stream size. In large mainstream reaches, such as the Manistee or Muskegon rivers, riffles may be present in the form of rapids.

Present	-	A riffle can be positively identified.
Abundant	-	A series of riffles and pools are visible.

Pool

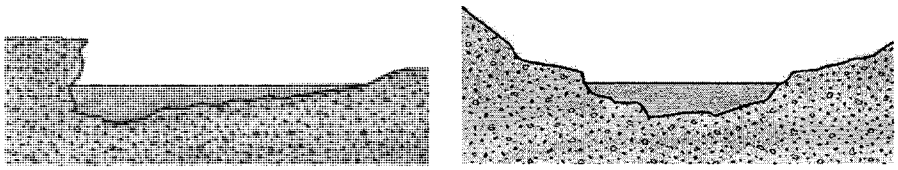
Pools are areas of relatively deep, slow moving water. The key word here is "relatively". Water depth sufficient to classify an area as a pool can vary from around 8 inches in small streams, to several feet in wadable streams, to tens of feet in large rivers. Pools are often located on the outside bend of a river channel and downstream of a riffle zone or obstruction. The water surface of a pool is relatively flat and unbroken. The presence of pools in large rivers may be difficult to identify because of an increase in relative scale, and an often limited ability to see to the bottom of deep or turbid stream reaches.

Present	-	At least one pool can be identified.
Abundant	-	A series of pools in a riffle pool sequence are visible.

Channel

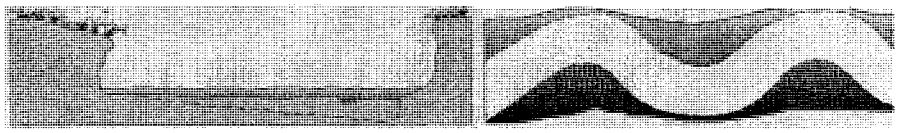
The channel condition, for the purposes of this assessment, is classified as Natural, Recovering, or Maintained.

Natural Stream - A natural stream has not been altered from its defined pattern, dimension and profile by artificial means, which includes straightening and widening. It is not necessarily stable, however. The stream has a non-uniform cross section with distinct pool and riffle sequences, although in large rivers the pool/riffle sequences may be difficult to identify. Mild to extreme meanders are often visible. The banks are vegetated and there are no signs of spoil piles or dikes along sides. The stream is not channelized or artificially controlled.

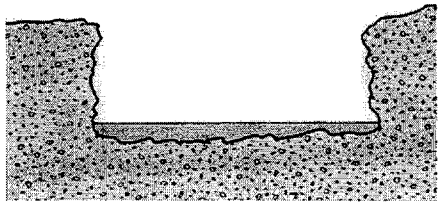


Recovering - A recovering stream is one that has been straightened or otherwise controlled, and is evolving back to a stable pattern, dimension and profile. The stream channel is relatively straight, or is overly wide with a channel

within the wider channel. Meanders may be beginning to form as evidenced by bank erosion and pool formation. Pools and riffles should be forming but may be sparse. Point bars may be forming. Vegetation may be sparse or very young. Defined dikes or spoil piles along the stream bank can be identified.



Maintained - A maintained stream channel is one that is actively controlled through dredging, widening, straightening, or the formation of dikes along the stream channel. The stream channel is straight, wide and shallow at low flow, and has a uniform cross section. Bank vegetation is typically sparse or very young. Pools and Riffles are not existent or very sparse.



Designated Drain

If the surveyor knows whether or not the stream segment being assessed is a legally designated drain under the Michigan Drain Code, circle "Y" (yes) or "N" (no). If the surveyor does not know, circle the "?".

Highest Water Mark

The highest water mark is the maximum height to which the stream water level rises at the site, as determined by the visible evidence present. This level is typically reached during floods or high flow conditions. The highest water mark is determined as the distance in feet **above the present water level** at the site. If the surveyor cannot visibly determine how far the stream rises at the site, circle the "?" on the form.

The highest water mark may be visible as discoloration on bridge pilings or abutments, stream debris (trash, leaves, weeds) left along the stream banks or in tree/shrub branches, ice scour marks on trees or streambanks, or muddy residues left in floodplains or on streamside vegetation.

Stream Cross Section

Draw a rough cross section of the stream profile. This should be just a general approximation. Do not spend more than a few seconds on this.

g. Stream Corridor

The questions in this section are used to characterize terrestrial land cover and land use in the vicinity of the stream, often referred to as the stream corridor.

Riparian Vegetative Width

The riparian vegetative width is the width of the streamside natural vegetation zone along the stream banks. The width is measured from the edge of the stream to the end of the contiguous block of natural vegetation. Natural vegetation is defined as including trees, shrubs, old fields, wetlands, or planted vegetative buffer strips (often used in agricultural areas and stormwater runoff control). Agricultural crop land and lawns are **not** considered natural vegetation for the purposes of this question. Circle the appropriate distance (in feet) that represents the **average, or most representative** (>50% of the lineal bank distance) width of the vegetation zone for each side of the river. Left and right banks are determined from the perspective of facing downstream.

Bank Erosion

Bank erosion may occur as a result of natural flow conditions, or may be caused by human activities. Determine the severity of erosion that has taken place and circle the appropriate category. Record the most severe magnitude of erosion observed on either bank.

0 - The banks appear stable and there is no evidence of erosion. These banks have stable toes and sidewalls, are most likely well vegetated or structurally stabilized, and have no evidence of exposed tree roots or leaning trees due to eroded soil. They are not being altered by water flows, livestock access, or recreational access.

L - Low evidence of erosion. Streambanks are stable but are being lightly altered. Less than 10% of the streambank is receiving any kind of stress. Stress that is noted is very light. Less than 10% of the bank is sloughing, broken down, or actively eroding.

M - Moderate evidence of erosion. At least 75% of the streambank is in stable condition. Between 10% and 25% of the streambank is sloughing, broken down, or actively eroding.

H - High evidence of erosion. Less than 75% of the streambank is in stable condition. Over 25% of the streambank is sloughing, broken down, or actively eroding. Streambank sidewalls may have been scraped by machinery or scouring flows, banks may be slumped, bank toe may be severely undercut. Tree roots may be exposed or fallen/leaning trees may be present.

Streamside Land Cover

Circle the letter of the dominant type of cover that exists at the streambank "edge" (within the first 20 feet or so of the stream edge) along the reach of river that can be seen from the road stream crossing.

B - Bare ground. No, or almost no, streamside vegetation.
G - Grasses, wildflowers, ferns, sedges (non-woody vegetation).
S - Shrubs and small trees. Woody vegetation less than 15 feet high.
T - Trees (15 feet tall or higher).

Stream Canopy

The stream canopy is the amount of leafy vegetation that extends out over a stream (at any height) and shades the water from direct sunlight. The amount of stream canopy should be recorded as the amount of water shading that would be present if the sun were directly over the stream.

0 - None. No shading of stream when sun is directly overhead.
L - Low. Less than 25% of the stream would be shaded.
M - Moderate. 25-50% of the stream is shaded.
H - High. Over 50% of the stream is shaded.

Adjacent Land Uses

Circle the appropriate left or right streambank designation for all of the following land uses that are adjacent to the stream. Land use along the entire length of stream that can be seen from the road stream crossing should be evaluated. This might include land that is beyond the riparian corridor. "Adjacent" requires the use of some judgement on the part of the surveyor, but generally refers to any land that can be seen from the crossing and is reasonably close to the stream such that pollutants could run off it into the stream. For example, if a 20-acre corn field is near a stream but separated from it by a 10' grass/shrub buffer strip, the "Rowcrop" category should be circled. If the same field were 100' from the stream and the intervening distance was wooded, the "Forest" category should be circled.

Wetlands	-	Wetland vegetation is present. May or may not include standing water. Could include shrubs and trees.
Shrub or Old Field	-	Meadow or field that has not been recently cultivated or grazed. Often represented by tall grasses and shrubs.
Forest	-	Trees present in forested setting (includes small woodlots). Trees may be cultivated or natural.
Pasture	-	Field showing signs of being recently or actively grazed by livestock (vegetation is cropped close to the ground).
Crop Residue	-	An agricultural crop residue remains, after harvest and/or tillage, which covers 30% or more of the field surface.
Rowcrop	-	Agricultural cropland planted in rows and cultivated.
Res. Lawns, Parks	-	An expanse of maintained grass, often found in residential lawns and parks.
Impervious	-	Impervious surfaces (water can not penetrate them) are present near the water. Includes paved surfaces and roofs.
Disturbed Ground	-	Soil has been disturbed (plowed, cleared, bulldozed, excavated) for construction or agriculture. Vegetation is not present on disturbed ground but may be present in adjacent areas.
No Vegetation	-	Bare ground. No vegetation is present on the soil, but it is not disturbed ground.

h. Potential Sources

The intent of this section is to evaluate the relative importance of potential sources in terms of pollutant contribution to the waterbody at a given site in the watershed. The evaluation assesses the potential for pollutant inputs at the site, **NOT pollutant impacts**, or the potential for pollutant impacts. Pollutant impacts, as indicated by visual manifestations, were evaluated previously on the first page of the data sheet.

Evaluating potential sources of pollutants to a waterbody is a three step process: identification of potential sources, evaluation of pathways for pollutants to get to the waterbody, and finally evaluation of the severity (magnitude) of this pollutant input or loading. The three steps of this process will result in scoring identified sources on the survey sheet as Slight, Moderate, or High Priority in terms of the severity or amount of their pollutant contribution to the waterbody at the site being surveyed.

(1) Source Identification

Visually evaluate the various land use/land change activities at the site for potential sources of pollution. Note all potential sources for the area that can be seen (choosing from among the list of sources on page two of the survey data sheet). For example, is there evidence of soil disturbance at the site, or land uses such as residential lawns, agricultural fields, parking lots, urban areas, etc., near the waterbody. Use the source definitions provided to help identify what potential sources may exist. If it is known that a significant source exists upstream between the road crossing and the next road crossing, such as a wastewater treatment plant, it may be important to note the presence of that source, but it should be recorded in the comments section since it was not visible at the site.

(2) Pollutant Pathway

Next, for each potential source that has been identified, evaluate how pollutants could get from the source to the water. An evaluation of likely pathways for pollutants to enter the waterbody provides information regarding the potential for the identified sources to contribute pollutants. The following provides a quick outline of some visual observations to consider in evaluating pollutant pathways. Pay particular attention to likely water runoff patterns at the site that may occur during rainfall or snowmelt events.

- Gully/rill erosion provides a direct pathway for pollutants to enter the stream in a concentrated flow when the land slopes toward the stream. Pollutants associated with eroding soils will vary depending on the type of land use activity.
- Tile/pipe discharges are potential direct pathways for pollutants.
- Bare soils near the edge of a waterbody provide a likely pathway for sediment to get to the waterbody.
- Maintained lawns to the edge of a waterbody provide a likely pathway for nutrients and pesticides to the waterbody.
- Land disturbance/use activities to the edge of a waterbody provide a likely pathway for various pollutants to the waterbody.
- Open areas of disturbed soils and/or bare soils devoid of vegetation provide a potential pathway for pollutants via wind erosion.
- Steep streambanks (steeper than a 2:1 slope) devoid of vegetation are likely pathways for sediment.
- No canopy over the waterbody is a pathway for dramatic thermal increase in water temperature during the day.
- Impervious surfaces (parking lots, roads, roof tops, etc.) provide a likely pathway for various pollutants, and may increase flows in the watershed causing flashiness.
- Culverts/bridges may not be aligned with the stream, or may be undersized, and could provide a likely pathway for flow to create streambank erosion both upstream and downstream of the culvert or bridge.

(3) Severity Ranking

Finally, for each source for which a pathway has been identified, evaluate how severe the pollutant loading is. Rank each source identified as Slight, Moderate or High severity for the contribution of pollutants, based on the magnitude or quantity of pollutants likely to be delivered to the stream. At present, the surveyor must use their judgement on assigning a slight, moderate or high rating. Eventually, it is expected that there will be a reference photo collection that will provide an example for each rating level in each of the subject categories.

The severity ranking is based only on *pollutant inputs* from the specific source *at the site*, not on visible stream impacts or impacts the pollutant may cause downstream. The pollutant loads from the identified source(s) may or may not have an impact at the site. Assessment of the impact on the waterbody at this site should have been evaluated on the first page of the survey form.

Evaluation of the source, location and pathways can provide a reasonable assessment of the severity of the pollutant loading. The following provides a quick outline of some visual observations to consider in evaluating the severity of pollutant loading.

- Proximity to waterbody – generally the closer the use, or land disturbance activity, is to the waterbody, the greater the likelihood for pollutant delivery.
- Slope to waterbody – generally the steeper the slope/topography to the waterbody, the greater the likelihood of overland pollutant delivery.
- Conveyance to waterbody (ditch, pipe, etc.) – generally a conveyance from the use, or land disturbance activity, increases the likelihood of pollutant delivery.
- Imperviousness – impermeable surfaces reduce the amount of land area available for water infiltration and increase the potential for overland runoff. Additionally, if a watershed is greater than 10% impervious, it will start to show some systemic problems due to impacts from flow. If a watershed is greater than 25% impervious, the natural hydrology is generally heavily impaired.
- Intensity and type of use, or land disturbance activity – generally the more intensive the activity the greater the likelihood for the generation of pollutants. Certain activities may have specific types of pollutants associated with them.
- Size of erosion area – generally the larger the erosion area the greater the likelihood for sediment delivery.
- Soil type – clay is less permeable than sand, and therefore would create a greater potential for overland runoff of pollutants.
- Presence and type of vegetation – the greater the vegetative buffer around a waterbody, the better the filtration of pollutants from nearby land disturbance and use activities. Certain types of vegetative buffers work better than others and should be evaluated on a case-by-case basis.

Note: It is usually most time efficient to go through this three-step process individually for each source as it is identified, and then go on to the next source identified (if more than one exists), rather than to evaluate all sources at the same time.

Potential Source Category Definitions.

Source Category	Use this Source Category if ...
Crop Related Sources (1050)*	... there is a reasonably clear pathway for pollutants to enter the waterbody from the farmed area. Possible pathways: farming to the edge of the drain, gully/rill erosion off field, tile discharge, wind erosion off field.
Grazing Related Sources (1350)	... there is clear evidence that grazing of animals near or in the waterbody has resulted in the degradation of streambanks or stream beds, sedimentation, nutrient enrichment, and/or potential bacterial contamination.
Intensive Animal Feeding Operations (1600)	... there is a reasonably clear pathway for pollutants to enter the waterbody from either runoff from the operation or land application of animal manure. Possible pathways: overland flow, tile discharge.
Highway/Road/Bridge Maintenance and Runoff (Transportation NPS) (8300)	... there is clear evidence that transportation infrastructure is creating increased flow, runoff of pollutants, or erosion areas in or adjacent to the waterbody.
Channelization (7100)	... there is clear evidence that the natural river channel has been straightened to facilitate drainage.
Dredging (7200)	... there is clear evidence that a waterbody has been recently dredged. Evidence might include: spoil piles on side of waterbody, disturbed bottom, disturbed banks.
Removal of Riparian Vegetation (7600)	... there is clear evidence that vegetation along the waterbody has been recently removed (within the last few years).
Bank and Shoreline Erosion/ Modification/Destruction (7700)	... there is clear evidence that the banks or shoreline of a waterbody have been modified through either through human activities or natural erosion processes.
Flow Regulation/ Modification (Hydrology) (7400)	... there is reasonably clear evidence that flow modifications in the watershed have created unstable flows resulting in streambank erosion.
Upstream Impoundment (7350)	... there is reasonably clear evidence that an upstream impoundment has contributed to impacts on downstream sites. Impacts may be: nuisance algae, increased temperatures, streambank erosion from unstable flows.
Construction:Highway/Road /Bridge/Culvert (3100)	... there is clear evidence that on going or recent construction of transportation infrastructure is contributing pollutants to the waterbody.
Construction: Land Development (3200)	... there is clear evidence that on going or recent land development is contributing pollutants to the waterbody.
Urban Runoff (Residential/ Urban NPS) (4000)	... there is a reasonably clear pathway for pollutants to enter the waterbody from an urban/residential area. Possible pathways: gully/rill erosion, pipe/storm sewer discharge, wind erosion, runoff from lawns or impervious surfaces.
Land Disposal (6000)	... there is a reasonably clear pathway for pollutants to enter the waterbody from an area where waste materials (trash, septage, hazardous waste, etc.) have been either land applied or dumped. Possible pathways: gully/rill erosion, pipe discharge, wind erosion, or direct runoff.
On-site Wastewater Systems (e.g. septic systems-6500)	... there is reasonably clear evidence of nutrient enrichment and/or sewage odor is present, and there is reason to believe the area is unsewered.

Source Category	Use this Source Category if ...
Silviculture (Forestry NPS) (2000)	... there is a reasonably clear pathway for pollutants to enter the waterbody from the forest management area. Possible pathways: logging to the edge of the waterbody, gully/rill erosion off site, pumped drainage, erosion from logging roads, wind erosion off site.
Resource Extraction (Mining NPS) (5000)	... there is a reasonably clear pathway for pollutants to enter the waterbody from the mined area. Possible pathways: gully/rill erosion off site, pumped drainage, runoff from mine tailings, wind erosion off site.
Recreational/Tourism Activities (general) (8700)	... you are unable to clearly identify the recreational source as related to a golf course, or recreational boating activity. Foot traffic causing erosion would fall into this category.
Golf Courses (8710)	... there is a reasonably clear pathway for pollutants to enter the waterbody from the golf course area. Possible pathways: overland runoff, gully/rill erosion off course, tile discharge, wind erosion off course.
Marinas/Recr. Boating (water releases) (7910)	... if you can reasonably determine that releases of pollutants to a waterbody such as septage or oil/gasoline are due to recreational boating activities.
Marinas/Recr. Boating (streambank erosion)	... you can reasonably determine that streambank erosion is due to wake from recreational boating activities.
Debris in Water (8520)	... debris in the water either is discharging a potential pollutant, or is causing in stream impacts due to modifications of flow. Possible examples: Leaking barrel, Refrigerator, Tires, etc. This does not include general litter (e.g. paper products).
Industrial Pt. Source (0110)	... there is reasonably clear evidence that an upstream industrial point source has contributed pollutants.
Municipal Pt. Source (0200)	... there is reasonably clear evidence that an upstream municipal point source has contributed pollutants.
Natural Sources (8600)	... there is reasonably clear evidence that natural sources are contributing pollutants. Possible examples: streambank erosion, pollen, foam, etc.
Source(s) Unknown (9000)	... if you see an impact but are unable to clearly identify any likely sources.

* The numbers in parentheses under Source Category are not relevant to conducting the survey and can be ignored by the surveyor. The numbers refer to U.S. Environmental Protection Agency reporting categories under Section 305(b) of the federal Clean Water Act and are included here to facilitate source reporting in SWQD Procedure 51 reports.

i. Site Summary Information

Survey Direction

Watershed surveys will normally be conducted in either an upstream (U/S) or downstream (D/S) direction from one site to the next, in order to provide continuity in interpreting changes in the watershed. Circle the survey direction used. If the survey is being conducted to evaluate singular sites, and not for characterization of a watershed (i.e. multiple sites in the same watershed), then circle "Not Applicable" (N/A) for the survey direction.

Site Similarity

This is a shorthand way to allow quick evaluation of whether **physical habitat** at sites upstream or downstream of the current site are similar to the physical habitat of the site being evaluated. If the physical habitat is **nearly identical** to the previous site, circle "Y" for Site Similarity. If there are differences between sites, even small ones, circle "N". In most circumstances, sites will probably **not** be similar since there are often a few physical habitat conditions that differ among adjacent sites. If there is uncertainty as to whether the site is similar to the previous site, or N/A is circled under survey direction, then circle "?" for Site Similarity.

Overall Site Ranking

This is a shorthand way to allow quick evaluation of how important a site is for **remediation activities** regarding **sources** of pollution. If the majority of pollution sources are rated as slight in severity, circle "L", low priority for remedial actions. If the majority of pollution sources are rated moderate in severity, circle "M", medium priority for remedial actions. If the majority of pollution sources are rated high in severity, circle "H", high priority for remedial actions.

Site Follow-Up Ranking

This is a shorthand way to allow quick evaluation of how important a site is for **timely follow-up activities** regarding **sources** of pollution. Follow up activity ranking should be based on the following criteria:

- Identified short-term need, such as for construction sites.
- Ability to rapidly address the issue, such as with a phone call, site visit, or enforcement.
- Unknown issues that should be investigated further, such as a pipe discharge of unknown origin.

Comments

Any observations about the site that were not covered elsewhere on the survey form should be recorded in this section. If certain survey responses require clarification or elaboration, those should be described here as well. The comment section can also be used to add detail to the site characterization, such as listing the types of aquatic plants or algae present, if known.

Sometimes while traveling to or from a site, significant factors that could potentially affect water quality (e.g. land use, habitat, and pollutant sources) are observed. If these conditions were observed between this site and the next upstream site, they should be recorded here, with a notation that the conditions cannot be seen from the site. These "between site" observations are often important for characterizing conditions in a watershed and should be recorded whenever possible.

2. Instream Survey Data Sheet

a. General Considerations

The instream survey data sheet (primarily covering benthic macroinvertebrate collections) is an optional form that will usually only be completed at a small number of selected sites relative to the number of sites visually surveyed. Many watersheds may not have any instream data collected from them. The form is primarily intended for those groups participating in the Division's volunteer stream monitoring program. However, others may use the form should they desire some benthic macroinvertebrate data from some of their sites.

The criteria used to select sites for instream assessment work include those criteria discussed earlier in the "Survey Design" section on selecting survey stations. Additionally, when evaluating the potential impacts from a suspected pollutant source area, stations should be located upstream and downstream of the source area. In all cases, the site should be representative of the area of stream surveyed, it should contain a diverse range of instream cover, and it should contain some gravel/cobble bottom substrates.

This instream assessment work should only be conducted by properly trained personnel. Conducting the instream survey and completing the instream data sheet requires more intensive training than that needed for completing the watershed survey data sheet. Training should be given only by Gary Kohlhepp, Great Lakes and Environmental Assessment Section (GLEAS), SWQD (517-335-1289); Nicole Vidales, GLEAS, SWQD (517-241-9534); or other aquatic biologists designated by them.

b. Assessment Procedures

Average Water Depth

To measure average water depth (ft), three measurements should be made at random points along the representative reach length being surveyed (preferably in stable sand areas), and these values averaged for a mean depth. If the stream is too deep for measurements, an estimate will suffice.

Siltation

Some siltation along stream margins is normal. However, silt that settles on gravel, cobble, and woody debris in the main stream channel can have a negative impact on the benthic invertebrates that colonize these substrates and also can affect fish reproduction. Note on the data form whether there is obvious siltation on the dominant substrate types in the main stream channel.

Embeddedness

Embeddedness refers to the extent to which gravel, cobble, or boulders are surrounded or covered by fine material (such as silt or sand). The more the substrate is embedded, the less its surface area is exposed to the water and available for colonization by invertebrates. Record the appropriate level of embeddedness observed in the stream reach. This is measured as the percentage of an **individual** substrate piece, such as a rock, that is covered on average.

Benthic Macroinvertebrates

The sampling effort expended to collect benthic macroinvertebrates at each site should be sufficient to ensure that all types of benthic invertebrate habitats are sampled in the stream reach. This generally will be about 30 minutes of total sampling time per station.

Sample collection should begin at the downstream end of the stream reach and work upstream.

Macroinvertebrate samples should be collected from all available habitats within the stream reach using a dip net with a one millimeter (mm) mesh, a kick screen made from doweling and window screening, or by hand picking. Habitat types can include gravel, cobble, silt, sand, submerged wood, leaf packs, algal mats, and aquatic plants. Habitat and substrate types from which macroinvertebrates were collected (or collections were attempted) should be recorded on the form.

All organisms collected should be placed into a jar or bucket to form one composite sample. The composite sample should be rinsed and all large pieces of debris removed. The remaining sample contents should be emptied into an enamel pan with a light-colored bottom.

The organisms in the pan should be identified to order using the taxonomic keys provided, and the abundance of each taxon in the stream segment should be estimated and recorded on the survey form (R=Rare [1-10 organisms], C=Common [11 or more organisms]).

The total stream quality score should be calculated as indicated on the survey form. This score is then used to rank the site as excellent, good, fair, or poor.

During the macroinvertebrate survey, volunteers should take note of any fish or wildlife (frogs, turtles, ducks, etc.) that may be visible in/on the stream and document any observations on the survey form.

F. DATABASE

This section has not been drafted yet, because the database has not been developed. Once the database is developed, instructions will be issued on how to use the database, input data, and conduct data analyses. These instructions will cover the following items at a minimum.

1. Format
2. Entering Data
3. Maintenance
4. Data Analysis
5. Standard Reports

G. QUALITY ASSURANCE/QUALITY CONTROL

1. Concept

Quality assurance is an integrated system of management practices used to verify that the quality control system is operating within acceptable limits and to evaluate the quality of the data. Quality control is a system of technical procedures implemented to produce measurements of needed quality. Some of the basic quality assurance and quality control (QA/QC) components of this stream crossing watershed survey procedure include: assignment of staff roles and responsibilities, personnel training, determining the confidence level required for the data, field data collection audits, replicate surveys, database entry audits, database management, data analysis, report preparation, and periodic procedure evaluations.

2. Data Principles

This section describes the type, quantity and quality of data needed to meet the procedure objectives and support decisions based on the survey results.

a. Data Type

The types of data to be collected were carefully considered in the development of the survey forms and have been determined to be appropriate for the goals of this procedure. Most of the data collected for the watershed survey data sheet are obtained by simple visual observation. The observations are recorded by mostly choosing among preselected possible responses. Additionally, some water quality and biological data may be collected at selected locations by appropriate personnel.

b. Data Quantity

The minimum quantity of data needed is that which will meet the SWQD goal of assessing 80% of Michigan's watersheds. The question of how many stream crossing sites should be surveyed within a watershed to adequately characterize it was discussed in detail earlier in this document in the Survey Design section. The basic concept is that the number and distribution of stations within a watershed is determined on a watershed-by-watershed basis. The general guideline is to try to survey a minimum of 30% of the stream crossing sites within a watershed, with the sites distributed such that each subwatershed (and their subwatersheds) is assessed to provide a representative depiction of conditions found throughout the watershed. At least one site should be surveyed in each tributary and adequate geographic coverage of the watershed should be obtained.

The previous paragraph lays out the minimum quantity of data needed to meet a statewide SWQD objective. However, this procedure identifies several other objectives that apply to individual watersheds. If the intent of a particular watershed survey is to meet some of these watershed-specific objectives, then additional data are needed. The general guideline in this case is that most stream crossing sites within a watershed need to be assessed to fully meet the procedure objectives.

c. Data Quality

The quality of data needed is that which will meet the procedure objectives and support water quality management decisions based on the data. As stated earlier in this document, the watershed survey data sheet portion of the survey was designed to be completed using visual assessments; therefore, the data are inherently subjective. Additionally, in order to increase the amount of data that can be collected, this survey process was designed to be conducted by a variety of personnel with different knowledge levels of water quality, aquatic biology, and nonpoint source pollution issues. Furthermore, land use and water quality conditions vary considerably throughout the state such that a condition that might be considered a major problem in more pristine

areas, potentially may not be judged as being so bad in another part of the state. Some conditions in streams also vary seasonally, such as stream flow, aquatic plant growth, and the amount of leafy material present in the stream. Consequently, there are a variety of QA/QC items implemented specifically to minimize variation from both subjective observations and environmental conditions in order to facilitate the accurate collection of quality data on a statewide basis.

3. Initial Field Tests

Initial field tests need to be done to confirm the accuracy (bias), precision (reproducibility), and comparability of the data. Field tests will involve having several trained people independently assess conditions at a set of selected sites. By having a variety of people assess the same site, the results can be checked to see how well the various survey results match each other to check precision. The sites chosen should also exhibit a large range of water quality and land use conditions to check accuracy and comparability. These field tests should be done at the startup of the survey effort as a pretest of the data forms and instructions.

4. Tiers of Data Quality

As discussed previously, this survey process was designed to be conducted by a variety of personnel with different knowledge levels of water quality, aquatic biology, and nonpoint source pollution issues, in order to increase the amount of data that can be collected. To facilitate accuracy and comparability of data results, all data will be classified into one of three data quality tiers.

Tier 1. It is expected that the best quality data—with respect to accuracy, precision and comparability—will be collected by personnel with the most water quality training, and experience working with nonpoint source pollution issues. Consequently, Tier 1 data will be that collected by SWQD staff and other water quality professionals.

Tier 2. Tier 2 data is the next level down, and is that data collected by volunteers that have gone through a training program specific to conducting the stream crossing watershed surveys.

Tier 3. Tier 3 data is considered to be of variable quality, and is that data collected by schools, 4H groups, and other similar organizations. Although Tier 3 data may be of less rigorous quality than Tier 1 and Tier 2 data, the information is useful for identifying potential problem sites, for later follow-up investigation by others, that might not have otherwise been surveyed. Additional benefits accrue from the educational aspects of the students/volunteers learning about the issues and conducting the surveys.

5. Spot Field Checks

Spot field checks should be done periodically. This will involve having a second investigator go out to a site that was recently surveyed by another person and conduct an independent assessment of the site. The results can be compared to evaluate the accuracy of site depiction and the reproducibility of the results between surveyors.

6. Reference Photos

Soon after project implementation, a reference photo collection should be assembled with photos that show examples of each response category for each potential source on the watershed survey data sheet. Using "Bank and Shoreline Erosion" as an example, reference photos showing slight, moderate, and high erosion sites, would help maintain a consistent frame of reference for surveyors throughout the state, and would be an educational aid when training new surveyors.

7. Database

This section has not been drafted yet because the database itself has not been completely developed, but it will cover the following items.

Database Development
Database Structure (organization)
Data Entry (templates, "out of range" checks, spot data entry checks)
Database Maintenance/Management
Data Analysis
Standard Reports

8. Post-Implementation Evaluation

Post-implementation evaluation should be most intensive immediately after project startup to verify the following: the data sheets are appropriate for the information that is requested; that surveyors are interpreting the data sheets correctly; that the instructions are clear; that surveyors are accurately identifying and recording conditions at the sites; and that results are reproducible and comparable.

9. Training

Personnel conducting stream crossing watershed surveys should be trained prior to conducting the survey.

Training on completing the Watershed Survey Data Sheet, or the Single Site Watershed Survey Sheet, can be given by any SWQD staff who have been trained on the survey procedure and have experience using it to evaluate sites. Any questions that arise that cannot be answered by the trainer should be directed to Charlie Bauer, Saginaw Bay District Office, SWQD (517-686-8025).

The training for conducting the instream survey and completing the Instream Survey Data Sheet is more intensive than that needed for completing the watershed or single site data sheets. Training should be given only by Gary Kohlhepp, Great Lakes and Environmental Assessment Section (GLEAS), SWQD (517-335-1289); Nicole Vidales, GLEAS, SWQD (517-241-9534); or other aquatic biologists designated by them.

APPENDIX B

VOLUNTEER GRANT APPLICATION PACKAGE

Michigan Department of Environmental Quality
http:\\www.deq.state.mi.us

Surface Water Quality Division
Clean Water Fund
Clean Michigan Initiative

Volunteer Monitoring
Grant Application Package
Fiscal Year 2002

John Engler, Governor
Russell J. Harding, Director

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Information for the Volunteer Monitoring Grant Application Package

Funding Source and Authority

This Grant Application Package (GAP) is for Clean Water Fund (CWF) Volunteer Monitoring Grants offered under the Clean Michigan Initiative (CMI). Information contained in this GAP is based on existing Surface Water Quality Division (SWQD) guidance as well as administrative rules promulgated for the CMI CWF Grants, being Part 8808 of PA 451. Approximately $50,000 will be available for grants in Fiscal Year 2002. These funds are intended to initiate or improve local volunteer monitoring programs, but not to serve as an ongoing funding source.

General Information for Grant Application Package

- There is no maximum dollar amount (per grant) limit. The dollar amount requested should be based upon what is needed to carry out the tasks identified in the project proposal.
- Disbursement of grant funds is done on a cost-reimbursement basis.
- This grant requires a minimum 25% local match of funds (can include in-kind services).
- Project contracts cannot exceed two years.
- Applicants may include the cost of equipment and supplies, sample analysis, and staff needed to implement the volunteer monitoring activities.
- Applicants may be contacted for clarification and for the purpose of negotiating changes in proposed project activities, timetable and grant amounts. The Department of Environmental Quality (DEQ) can award grants for amounts other than those requested and/or request changes to or clarification of the proposed work plan.
- Information provided in grant application will **not** be kept confidential.
- Successful applicants will be required to enter into a project contract with the Department. A project contract consists of standard "boilerplate" language (some of which has been simplified and included in Appendix B; see SWQD Grants: Terms & Conditions of Grant Awards), the applicant's work plan, timetable and budget information, and a compensation clause. Copies of the boilerplate can be obtained by contacting the SWQD Administrative Unit at (517) 373-8070. Failure of a successful applicant to accept these obligations may result in cancellation of the grant award.

Submittal Deadline

Applications must be received no later than **February 19, 2002**.
Late applications will not be considered for funding. See Grant Application Delivery Instructions for further information.

Contact Person

Nicole Vidales; telephone (517) 241-9534; email vidalesn@michigan.gov

Description of Volunteer Monitoring Grants

The CMI CWF Volunteer Monitoring Grant is meant to fund water quality monitoring activities in wadable streams and rivers. The monitoring primarily includes an evaluation of benthic invertebrate communities and stream habitat twice per year (spring and fall), and also can include the collection of water samples. The DEQ will provide training to the grantees, and intends to use the resultant data as a screening tool to identify sites requiring a more detailed assessment. In selecting projects for grant award, the SWQD will consider all of the following:

- The goals and objectives of the monitoring project;
- The applicant's ability to successfully carry out the project;
- The applicant's commitment to gather data following SWQD-recommended data forms, collection procedures, and quality assurance procedures;
- The applicant's willingness to attend an 8-hour training session provided by SWQD;
- The length of time the applicant will commit to continue water quality monitoring after the grant expires; and
- The location of the river/stream.

Eligibility

Local units of government and non-profit entities are eligible to receive grant funding. Non-profit entities are those exempt from taxation under section 501(c)(3) of the internal revenue code. Eligible entities generally include county, city, township, and village agencies, watershed and environmental action councils, universities, regional planning agencies, and incorporated not-for-profit organizations.

To be eligible, volunteer groups must meet all of the following:

- Must have undergone a successful financial audit within the 24-month period immediately preceding the application.
- Must submit a Quality Assurance Project Plan within 60 days of grant award.
- Must be committed to continuing the monitoring project after the grant expires.
- Must not have had a grant revoked or terminated or demonstrated an inability to manage a grant or meet the obligations in a project contract with the Department within the 24-month period immediately preceding the application.
- Must submit an application by the deadline of **February 19, 2002**.

Ineligible Entities and Activities

- Ineligible entities: Individuals and for-profit organizations are not eligible to receive this funding directly. Federal and state agencies are also not eligible.

- Volunteer activities such as river clean-ups, lake monitoring, restoration efforts, and strictly education activities will not be funded.

List of Information Required for the Volunteer Monitoring Grant Application Package

The application must include all of the following:

1. One-page SWQD Application Cover Sheet.
2. Maximum four-page Project Description .
3. Maximum three-page Work Plan with the mandatory elements (see page 8).
4. One- or two-page Timetable.
5. SWQD Grant Application Budget Sheet.

Attachments:

1. One-page audit letter
2. Letters of commitment

All other information provided by the applicant--including binders, extraneous reports, and general letters of support--will not be considered, reviewed or returned. We highly recommend that you contact Nicole Vidales of the DEQ/SWQD before submitting your proposals if you have any questions.

Grant Application Package Delivery Instructions

Applications must be either sent by FAX, electronically sent (email), or US postmark dated no later than **February 19, 2002**.

FAX applications to:	(517) 373-9958 Attention: Nicole Vidales
Email applications to:	vidalesn@michigan.gov
Mail applications to:	Michigan Department of Environmental Quality Surface Water Quality Division Grants Attn: Nicole Vidales PO Box 30273 Lansing, Michigan 48909-7773

Instructions for Volunteer Monitoring Grant Application Package

Directions for Preparing Cover Sheet

The Cover Sheet is the first page of the entire package and is to be filled out by all applicants. See Appendix for blank copy of Cover Sheet.

- The *Project Name* is the name of the proposed project submitted for funding.
- *Project Location* is the primary county in which the project will be conducted. This is to help us distinguish similarly named projects. Fill in only one county.
- *Watershed Impacted by Project* is the watershed in which the project will be conducted or the watershed that may be affected by project.
- The *Organization Name* is the group, agency or local unit of government applying for funding. Please include the organization's fax and telephone number.
- The *Contact Person* is the person in that organization that can be contacted by DEQ staff for any needed additional information. On the line provided, include the name and title of the contact person.
- Fill in the *Contact Person's E-Mail* address, if available.
- Under *Organization Address*, be sure to include the street name and number on the first line and the city and zip code on the second line.
- *Project Duration.* Indicate the approximate amount of time needed to implement the project, in years and months. Note that the maximum duration of projects for this GAP is 2 years.
- *Preferred Start Date.* Indicate the month and year you would like to start your project. While project start dates are contingent upon funding availability, there is usually some flexibility in start dates.
- *Grant Amount Requested* is the amount of funding being sought. *Local Match* is the amount of local funding committed to the project. The local match can include in-kind services. The *Project Total* should equal the Grant Amount Requested + the Local Match.
- The *Person with Grant Acceptance Authority and Their Title.* The person with grant acceptance authority is the person who will be accepting responsibility for the terms and conditions of the contract. This may be the contact person, or it may be somebody else in the organization (or perhaps a board member). The contact person also needs to sign the Cover Sheet, as indicated. Include title by name. An original signature is not required for submission of a proposal, however the final contract agreement requires an original signature.

Directions for Preparing Project Description

In no more than four pages, please provide the following information in the order listed, using the topic headings. Consider each bulleted statement as it applies to your project. Use 11 or 12-point font on 8 ½" x 11" paper. Number the pages and attach to Page 1, the Grant Application Cover Sheet.

Statement of Volunteer Monitoring Water Quality Concerns/Issues.

- Indicate how citizens and/or local governments will use the data to promote improved water quality in the river/stream of interest.

Project Goals and Objectives.

- Describe project goals (what you hope to achieve) and objectives (measurable, if possible).
- Describe how goals and objectives will be accomplished.
- If possible, please include the following information for each river/stream:
    1. Waterbody name
    2. Location (county, longitude and latitude)
    3. Number of proposed sampling sites per waterbody
    4. Indicate past monitoring efforts and results, if any
    5. Describe surrounding environment (wetland, commercial, residential, agricultural, proximity to combined sewer outfalls, holding ponds, storm drains, etc)

Organization Information.

- In one paragraph, state the organization's mission, goals, relevant programs, activities and accomplishments.
- Describe the relevant qualifications of project staff/volunteers that will ensure the success of the project.

Partners.

- Describe any other partners in the project, their roles, and commitments.
- Describe any other sources of funding not listed on page 1 of the proposal or on the budget, and include other grants you have received, that relate to this proposal.

Project Sustainability.

- Describe any water quality activities that will continue after the project is completed.
- Indicate the length of time your organization is committed to maintaining the volunteer monitoring activities funded by this grant.

Evaluation.

- Describe how the project will be evaluated, including how improvements will be defined and measured.
- Describe how the data will be used, disseminated, and reported to the Surface Water Quality Division of the DEQ.

Work Plan

Maximum three-pages. Use 11 or 12-point font on 8 ½" x11" paper.

- The plan should be presented by task (with sub-tasks, as necessary), with an estimated percentage of time given to each task. The estimated percentage of time for all tasks should total 100%. For each of the tasks, identify who will be responsible for carrying out the task.
- All work plans must include the following mandatory tasks:
  1. Development and submission of status reports following SWQD guidance, and at a frequency included in the contract (usually quarterly).
  2. Development and submission of a final report following SWQD guidance, at the end of the project.
  3. Submission of a release of claims statement (a standard form letter) at the end of the project.
  4. Providing products and deliverables. This should include all data collected, in both hard copy and electronic format (if possible).

Timetable

Include a timetable of activities, showing when each task will be completed. This should be presented in a table format and cover all months or quarters of the project. If by quarter, include in the timetable the months included in each quarter (i.e. quarter 1: Oct, Nov, Dec).

Budget Information

Fill out the two-page Grant Application Budget Information form included in Appendix A of this information packet, using the directions below. Note that this form is available electronically on our web site: www.deq.state.mi.us/swq.

Note: Column 3, Local Match. Local match is a financial commitment made by the grant recipient and other local agencies to help implement the project. A 25% local match is required of all applications. **Labor, in-kind services, and materials can count as match.** In column three of the budget sheet, include local match amounts for each budget category (staffing costs, fringe benefits, etc.).

How to Calculate Minimum Match Required

Note: A minimum of 25% local match is required of all applicants. Minimum match required is calculated by first determining the total cost of implementing a project. Second, calculate the minimum local match required by multiplying the total cost of implementing the project by 25%. The total project cost minus the local match equals the requested grant amount. For example, if the total cost of a project is $150,000, the local match would need to be $37,500, and the remaining cost of the project ($112,500) would be the amount requested in grant funds.

Total Cost X .25 = Local Match

Total Cost - Local match = Grant Funds

Example: $150,000 X .25 = $37,500 Local Match
$150,000 - $37,500 = $112,500 Grant Fund

Note also:

- Whatever you commit to as match will become part of your contractual obligation if your project is selected for funding. Be sure to make your match commitment realistic.
- Other Clean Michigan Initiative funds and other Clean Water Act funds awarded as grants from the state cannot be used as matching funds.
- Match activities will be held to the same standards as grant-funded activities.
- Match cannot be earned until the starting date in a contract.
- Local Match beyond the 25% is encouraged.
- Round off to the nearest dollar.

Column 1, Budget Categories, and Column 2, Grant Funds.

1. Staffing Costs.
    - In column 1, list each staff person (project manager, senior analyst, clerical, etc.), the estimated number of hours each person will work on the project and their hourly rate. Place the costs for each staff person (number of hours times hourly rate) in columns 2 and 3.
    - Each staff person listed under staffing cost should also be included in the work plan.
    - Staffing costs for staff in agencies other than the grant recipient should be budgeted under Contractual.
    - Add subtotals.

2. Fringe Benefits. This can include insurance, FICA, federal, state and local taxes, vacation and sick time, and workers compensation.
    - Most agencies have set fringe benefit rates. Use your agency's fringe benefit rate, up to 40% maximum.
    - In column 1, list each staff person and their fringe rate. Put the dollar amount corresponding with each staff person in columns 2 and 3.
    - SWQD reserves the right to request applicants to supply information indicating how their fringe benefits were calculated.
    - Add subtotals.

3. Contractual Services. Contractual costs are services provided by staff or agencies other than the grant recipient. Any services not provided by the grant recipient should be listed here. If any part of the work in the grant is to be subcontracted, your grant application must include a description of all work to be subcontracted. The State reserves the right to approve all subcontractors for this project and reserves the right to require the Grant recipient to replace subcontractors found to be unacceptable.
    - In column 1 list all contractual services. Put estimated amounts in columns 2 and 3.
    - All contractual services included here should also be included in the work plan.
    - Subtotal contractual costs.

4. Project Equipment, Supplies and Materials

    4a. Project Equipment.
    - Equipment is defined as an article of nonexpendable, tangible personal property having a useful life of more than one year.
    - The purchase of equipment less than or equal to $1,000 is allowed using grant funds. Equipment greater than $1,000 cannot be purchased using grant funds but can be purchased using match funds.

- Itemize equipment on the budget form and explain any cost that may appear out of the ordinary.

4b. Project Supplies and Materials.

- For supplies and materials specify the type of supplies and materials charged against the grant in column 1. Itemize printing, postage, and other supplies and materials. Explain any cost that may appear out of the ordinary.
- Place corresponding costs of supplies and materials in columns 2 and 3.
- Subtotal equipment, supplies and materials.

5. Travel Costs.
   - Show mileage separate from lodging and meals in column 1.
   - Mileage costs should be shown in columns 2 and 3 as number of miles times mileage rate. ($.31 per mile is the highest allowable rate).
   - Under "Other" on the budget form, include travel other than mileage directly related to carrying out the project. Conferences and other training fees are typically not directly related to carrying out a project and will not be funded.
   - Subtotal travel costs.

6. Indirect Costs. Indirect costs have been referred to as the cost of doing business. Typical indirect costs are associated with but not limited to office space, telephones, office equipment rental and usage, and general office supplies.
   - Most agencies have a set indirect rate. Use your agency's indirect rate, up to 20% of salary and fringe benefits.
   - In column 1, indicate the rate at which indirect costs are being calculated, what the rate is based on, and the resulting indirect costs.
   - Add indirect costs in columns 2 and 3.
   - Subtotal indirect costs.

7. Totals. Add the subtotals for each budget category. *Note that the Totals at the bottom of the budget sheet should be the same as those on page one of your proposal.*

Sources of Match. At the bottom of the second page of the budget sheet, indicate the source(s) of local match and the corresponding dollar value, provided by the applicant or other local sources.

Appendix A

Michigan Department of Environmental Quality
Surface Water Quality Division (SWQD)

Volunteer Monitoring Grant Application Cover Sheet

(Authorized by 1994 P.A. 451).

Project Name: _____

Project Location (Primary County): _____

Watershed Impacted by Project _____

Organization Name: _____

Organization FAX #: ____-____-____ Organization Phone: ____-____-____

Contact Person: _____, _____
(name) (title)

Contact Person's E-Mail (if available): _____

Organization Address: (street name and #) _____

(City, zip code) _____

Duration of Project: Years:____ Months: _____ Preferred start date: ____/____
Month/year

Grant Amt. Requested: $_____ + Local Match: $_____ = Project Total: $_____

Person w/ Grant Acceptance Authority: _____, _____
(name) (title)

Signature: _____

DEQ

Michigan Department of Environmental Quality

Surface Water Quality Division

GRANT APPLICATION BUDGET INFORMATION

(Authorized by 1994 P.A. 451)
(Completion of this form is required in order to receive grant consideration).

Applicant's Name _____

Project Name _____

Column 1 BUDGET CATEGORIES	Column 2 GRANT FUNDS	Column 3 LOCAL MATCH	Column 4 CATEGORY TOTAL
STAFFING COST: (# hours X rate of pay)			
Staffing Cost Subtotal:			
FRINGE BENEFITS: (____%)			
Fringe Benefits Subtotal:			
CONTRACTUAL SERVICES:			
Contractual Services Subtotal:			

Column 1 BUDGET CATEGORIES	Column 2 GRANT FUNDS	Column 3 LOCAL MATCH	Column 4 CATEGORY TOTAL
PROJECT SUPPLIES AND EQUIPMENT			
Project Supplies and Materials (itemize):			
Project Equipment (itemize): (over $1000* remains property of the State of Michigan)			
Project Supplies and Equipment Subtotal:			
TRAVEL:			
Mileage X mileage rate:			
Lodging:			
Meals:			
Other:			
Travel Subtotal:			
PROJECT SUBTOTAL			
INDIRECT COSTS (Rate _____%)	(not to exceed 20%)		
GRAND TOTAL (add subtotals)			

Grand Total Grant Funds Requested + Grand Total Local Match = Project Total

SOURCES OF MATCH:

_____
_____
_____
_____

DOLLAR VALUE COMMITTED:

_____
_____
_____
_____

SOURCE OF O& M

_____
_____

DEQ

Michigan Department of Environmental Quality

Surface Water Quality Division

EXAMPLE GRANT APPLICATION BUDGET INFORMATION

(Authorized by 1994 P.A. 451)
(Completion of this form is required in order to receive grant consideration).

Applicant's Name _____

Project Name _____

Column 1 BUDGET CATEGORIES	Column 2 GRANT FUNDS	Column 3 LOCAL MATCH	Column 4 CATEGORY TOTAL
STAFFING COST: (# hours X rate of pay)			
Project Manager (68.5 x $32.31)	$2,213.00	$0.00	$2,213.00
Supervising Sanitarian (68.5 x $19.85)	$1,360.00	$0.00	$1,360.00
Clerical (17 x $11.40)	$194.00	$0.00	$194.00
Technician (295 x $8.00)	$2,360.00	$0.00	$2,360.00
Staff (17 x $19.41)	$0.00	$330.00	$330.00
Staffing Cost Subtotal:	$6,127.00	$330.00	$6,457.00
FRINGE BENEFITS:			
Project Manager (25.9%)	$573.00	$0.00	$573.00
Supervising Sanitarian (25.9%)	$352.00	$0.00	$352.00
Clerical (25.3%)	$49.00	$0.00	$49.00
Technician (9.7%)	$229.00	$0.00	$229.00
Staff (28.5%)	$0.00	$94.00	$94.00
Fringe Benefits Subtotal:	$1,203.00	$94.00	$1,297.00
CONTRACTUAL SERVICES:			
Private lab analysis (550 samples x $12)	$6,600.00	$0.00	$6,600.00
In-house lab analysis (550 samples x $12)	$0.00	$6,600.00	$6,600.00
Contractual Services Subtotal:	$6,600.00	$6,600.00	$13,200.00

Column 1 BUDGET CATEGORIES	Column 2 GRANT FUNDS	Column 3 LOCAL MATCH	Column 4 CATEGORY TOTAL
PROJECT SUPPLIES AND EQUIPMENT			
Project Supplies and Materials (itemize):			
Waders	$290.00	$0.00	$290.00
Cooler	$50.00	$0.00	$50.00
Ice	$100.00	$0.00	$100.00
Signs and posts	$50.00	$0.00	$50.00
Pole for taking samples	$100.00	$0.00	$100.00
Postage	$50.00	$0.00	$50.00
Advertising	$400.00	$0.00	$400.00
Printing	$216.00	$0.00	$216.00
Project Equipment (itemize): (over $1,000+ remains property of the State of Michigan)			
Project Supplies and Equipment Subtotal:	$1,256.00	$0.00	$1,256.00
TRAVEL:			
Mileage X mileage rate: (4,371 x .31/mile)	$1,355.00	$0.00	$1,355.00
Lodging:			
Meals:			
Other:			
Travel Subtotal:	$1,355.00	$0.00	$1,355.00
PROJECT SUBTOTAL	(70.2%) $16,541	(29.8%) $7,024	(100%) $23,565
(not to exceed 20%) **INDIRECT COSTS (Rate _____%)**	$1,089.00	$462.00	$1,551.00
GRAND TOTAL **(add project subtotals + indirect costs)**	$17,630.00	$7,486.00	$25,116.00

Grand Total Grant Funds Requested + Grand Total Local Match = Project Total

SOURCES OF MATCH:

Grant recipient

DOLLAR VALUE COMMITTED:

$7,486

SOURCE OF O& M

Appendix B

Surface Water Quality Grants: Terms and Conditions of Grant Awards

Responsibilities of Grant Recipients

- Grant recipients will be required to carry out all obligations contained in the project contract with DEQ. A project contract consists of standard "boilerplate" language (some of which has been simplified and included here), the applicant's work plan, timetable and budget information, and a compensation clause.
- SWQD also reserves the right to review and approve all products developed and paid for by grants or used for local match. All such products become the property of the State of Michigan.
- Grant recipients will be responsible for meeting the match amount committed to in the project contract.
- Grant recipients must submit a Quality Assurance Project Plan within 60 days of grant award.
- Additional requirements, relevant to an individual project, may be specified in the project contract.

Subcontracts

- The grant recipient will be required to secure professionally qualified personnel and/or subcontractors necessary to perform the duties of the project contract. The State reserves the right to approve all subcontractors for the project and to require the grant recipient to replace subcontractors found to be unacceptable.
- The grant recipient will be required to assume responsibility for all contractual activities included in their work plan whether or not they perform them. Further, the State will consider the grant recipient the sole point of contact with regard to contractual matters, including payment of any and all charges resulting from the project contract. The grant recipient is totally responsible for adherence by the subcontractor to all provisions of the project contract.

Reporting

- All grants must submit status reports to the DEQ within 30 days of the closing of each quarter of the grant period. A quarterly status report consists of 1) a narrative status report, detailing the status of each task, and 2) a financial status report documenting expenditures for that quarter. Copies of quarterly status reports shall be submitted to and approved by the DEQ before reimbursement payments will be made. Submit copies as follows:

    1. Original quarterly status report to the SWQD Administrative staff in Lansing, with three copies of any products developed.
    2. One copy of the quarterly status report and one copy of any products developed to the SWQD Project Administrator.
    3. The SWQD reserves the right to request annual progress reports of any grant recipient.
    4. Final project reports will be submitted to and approved by the SWQD Project Administrator before the final grant payment will be made.
    5. Final reports should detail what was attempted in the project, what worked, what didn't, and any lessons learned. Final reports should also include all monitoring data collected, if it has not already been submitted to SWQD.

6. Failure to submit quarterly reports to the SWQD in a timely fashion may result in contract cancellation by the State.

Audit Requirements

All grant recipients must follow audit requirements provided by the SWQD.

Incurring Costs

The State of Michigan is not liable for any cost incurred by the grant recipient or any subcontractor prior to the signing of a project contract. Liability of the State is limited solely to the terms and conditions of this request and any resulting grant. The State fiscal year is October 1 through September 30. Grants awarded in any given fiscal year are contingent upon enactment of both federal and state legislative appropriations.

Officials Not to Benefit

No member of or delegate to Congress or the Legislature shall be admitted to any share or part of the project contract or to any benefit that may arise therefrom.

Unfair Labor Practices

Pursuant to 1980 Public Act 278, as amended, MCL 423.231, et seq, the State shall not award a Contract or subcontract to an employer whose name appears in the current register or employers failing to correct an unfair labor practice compiled pursuant to Section 2 of the Act. The United States National Labor Relations Board compiles this information.

A Contractor of the State, in relation to the Contract, shall not enter into a Contract with a subcontractor, manufacturer, or supplier whose name appears in this register. Pursuant to Section 4 of 1980 Public Act 278, MCL 423.324, the State may void any Contract if, subsequent to award of the Contract, the name of the Contractor as an employer, or the name of the subcontractor, manufacturer, or supplier of the Contractor appears in the register.

APPENDIX C

MODEL QUALITY ASSURANCE PROJECT PLAN

Water Quality Monitoring Of the Pentwater River Watershed By Citizen Volunteers

Quality Assurance Project Plan (QAPP)

May 1998

Supported By:

Michigan Department of Environmental Quality
Natural Resources Conservation Service
West Shore Community College

Project Manager: _____
Gary Kohlhepp, MDEQ-Lansing

Assistant Project Manager: _____
Charamy Butterworth, MDEQ-Grand Rapids

Field Leader: _____
Mark Kelley, Natural Resources Conservation Service (NRCS)

Laboratory Manager: _____
Helal Hamdy, West Shore Community College

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QAPP Distribution List

Gary Kohlhepp, Project Manager, MDEQ-Lansing, 517-335-1289
Charamy Butterworth, Assistant Project Manager, MDEQ-Grand Rapids, 616-356-0210
Mark Kelly, Field Leader, NRCS-Shelby, 616-861-4967
Hamdy Helal, Laboratory Manager, West Side Community College, 616-845-6211

Project/Task Organization

Name	Project Title/Responsibility
Gary Kohlhepp	Project Manager
Charamy Butterworth	Assistant Project Manager
Mark Kelly	Field Leader; Volunteer-MDEQ Liaison
Hamdy Helal	Laboratory Manager
Dorothy Schramm	Volunteer Monitor
Norm Myers	Volunteer Monitor
Ted Borgeld	Volunteer Monitor
Joe Primozich	Volunteer Monitor
Michael Kruer	Volunteer Monitor
Jim MacGregor	Volunteer Monitor
Susan Wygant	Volunteer Monitor
Donald Van Zile	Volunteer Monitor
Lew Carlson	Volunteer Monitor
Don Hasniegar	Volunteer Monitor

Data users include the volunteers, MDEQ-Surface Water Quality Division, NRCS, West Shore Community College, and area high schools.

Problem Definition and Background

The predominant land use in the Pentwater River watershed is agriculture. Therefore, water quality problems in this system are likely the result of the runoff of sediments and/or nutrients from farm fields. Pesticides also may impact water quality. Because pollution sources are diffuse and inputs are pulsed based on precipitation, biological and habitat assessments are more effective than chemical monitoring in detecting problems. The primary objectives of this volunteer monitoring project are to:

1. develop a long-term record of benthic macroinvertebrate communities and habitat quality;
2. determine whether water quality is changing over time (trends);
3. screen for water quality problems throughout the watershed; and
4. educate area citizens about water quality issues in the watershed.

A future monitoring objective is to evaluate the effectiveness of Best Management Practices (BMPs) or other actions as they are implemented at specific locations.

If there is evidence of degraded water quality at a site, the MDEQ will be informed of the findings to evaluate whether more detailed monitoring is required. Data also will be used by MDEQ to help identify priority sites for sampling during the 5 year cycle in which the Pentwater River is assessed. Local government entities will be provided data when some action is required for which county or municipal governments have authority. Interested area citizens will receive data summaries that describe overall water quality in the watershed, potential threats to water quality, and actions being taken to address/reduce these threats. Finally, the information will be used to educate the local community college and high school students about water quality issues.

Project Description

Training in sample collection and assessment procedures was provided by MDEQ in July 1997, and an additional training session will be held in spring 1998 for newly recruited volunteers. Training consists of laboratory and field sessions over two half-days. A training session will be held every spring for new volunteers and as a refresher session for existing volunteers.

Beginning in spring 1998, 10 randomly chosen sites throughout the watershed will be monitored twice per year, once in April and once in September. Additional sites can be added as more volunteers are recruited or when a problem at a specific location is suspected. Volunteers will sample benthic invertebrates and enumerate the relative abundance of major Orders (Ephemeroptera, Diptera, Plecoptera, etc.). These data will be used to calculate a water quality index value, by which sites are rated as excellent, good, fair, or poor. Volunteers will sample all habitats within a stream reach to ensure a complete assessment of organisms that are present. Approximately 30 minutes will be spent on benthic invertebrate monitoring. These data are the primary means for assessing site condition.

Volunteers also will evaluate habitat and physical conditions at each site. They will note the relative proportions of substrate, riparian vegetation, and the extent of sedimentation. Observations concerning land use and potential sources/causes of stress also will be recorded. These physical observations are necessary as a complement to the benthic data in order to fully evaluate site conditions.

Volunteer data will be entered into a database maintained by MDEQ. Prior to entry, data will be checked for errors. MDEQ will summarize results from the entire watershed and prepare an annual report for interested stakeholders by February of each year. These reports will be used to guide site selection during the next field season, though in general the same sites will be monitored each year.

Data Quality Objectives

Accuracy and Precision

It is more difficult to generate quantitative goals for accuracy and precision for benthic invertebrate and habitat measurements than it is for chemical measurements. A benthic invertebrate index score used to rank sites is described on the Volunteer Stream Survey Form (attached). The measurement range for this numerical value is 0 to 72. In any given stream reach, there are likely to be some taxa that are very rare, and would not be found even by professional biologists after a long search.

Therefore, unlike chemical measurements, it is impossible to quantify the accuracy of a benthic invertebrate score. It is, however, possible to outline precision goals. The goal for precision among volunteer monitors is that multiple measurements of a stream reach should yield invertebrate scores in which the difference between the maximum and minimum score is not more than 9 points. This value is based on the potential for a site to contain one rare Group One taxa (which would impact the score by 5 points), one rare Group 2 taxa (which would impact the score by 3 points), and one rare Group 3 taxa (which would affect the score by 1 point). A difference of 9 points assumes that one individual found all of these rare taxa while another did not find any of them. In addition, it seems probable that precision would be affected by the number of taxa present. It is difficult to set different precision goals based on scores *a priori*, but this issue will be reviewed as data are collected. As QA/QC procedures are implemented, MDEQ will consider setting precision goals based on the number of taxa present.

With regard to the habitat assessment, there are a number of attributes for which volunteers are asked to estimate relative percentages. The program goal is that the maximum and minimum estimates differ by less than 20%. These and other accuracy and precision goals are listed in Table 1.

Table 1. Accuracy and precision goals for measurements taken by citizen volunteers.

Measurement	**Accuracy**	**Precision**
Benthic invertebrate scores	NA	+ or - 9 points
Water temperature	+ or - 0.5 degrees C	+ or - 20%
Stream width	+ or - 2 feet	+ or - 10%
Stream depth	+ or - 3 inches	+ or - 25%
Stream velocity	+ or - 2 cfs	+ or - 25%
% estimates (substrate, riparian vegetation, land use)	NA	+ or - 20%
Category estimates (substrate embeddedness, stream shading, bank erosion, woody debris)	NA	All responses in 2 adjacent categories

NA = Not Applicable

It should be noted that these goals are initial estimates. Some likely will need to be revised as the program develops and monitoring and QA data become available. In some cases, precision goals may need to be relaxed, while in others it may be feasible to make the goals more restrictive. This QAPP will be updated periodically to reflect any necessary modifications.

Representativeness

The initial 10 monitoring sites are randomly dispersed throughout the watershed to ensure that they are representative. As new volunteers are recruited, future sites will either be chosen randomly or

based on known problems or activities being implemented. This site selection process ensures that data are representative of the watershed and reflect specific activities and concerns in the area.

Likewise, the assessment procedures will ensure that the data are representative of each location. At each site, volunteers will evaluate a 300 ft. stream reach, ensuring that any unusual microhabitat patches do not overly influence the results. Because streams in this watershed have variable physical characteristics, benthic invertebrates will be collected from all available habitat types and composited for scoring. This procedure will allow site scores to reflect the entire community at each location.

Comparability

The MDEQ has developed standardized habitat and benthic invertebrate collection and analysis procedures for use by volunteers across Michigan. Volunteers who collect data for use by MDEQ must undergo training by MDEQ or by an entity approved by MDEQ. Further, all data are recorded on standard data forms and maintained in the same database. These procedures, training requirements, and data management activities ensure that not only are data collected by volunteers within a watershed comparable, but that data collected by organizations throughout the state are comparable.

Completeness

These data will not be used for legal or compliance purposes, and there are no statistical reasons why a certain percentage of the anticipated data must be collected. However, it is recognized that failure to monitor even a few sites twice per year could be indicative of waning volunteer interest in the program. Therefore, a target of 90% completeness will be established for the Pentwater River watershed. When data are not collected as scheduled from a site, MDEQ and volunteer leaders will attempt to ascertain the reasons for this failure and correct them if possible. Unfavorable weather on several consecutive weekends in the spring, for example, may lead to failure to achieve the 90% target, about which nothing can be done. However, if a volunteer consistently shows a lack of interest or commitment, then we will work with that individual to identify reasons for the apathy and try to remedy any problems. In extreme cases, it may be necessary to find another volunteer to take over a site.

Training Requirements and Certification

Training is provided by MDEQ or another qualified individual. A "qualified individual" is defined as someone with two years experience in benthic invertebrate monitoring and habitat assessment procedures. Eventually, it is anticipated that experienced volunteers will be able to train new volunteers, thus minimizing the need for MDEQ staff to perform this task. However, MDEQ will be present for training sessions given by inexperienced trainers to ensure quality.

Volunteers are required to attend 2 half-day training sessions. The first half-day is conducted in a classroom and the following topics are covered:

1. Goals of the volunteer monitoring program;
2. Safety protocols;

3. Description of needed equipment;
4. Explanation of field data sheet (volunteer stream survey form;
5. Slide show demonstrating various stream habitat characteristics; and
6. Identification of a reference collection of benthic invertebrates using a dichotomous key.

During the second half-day session, participants visit 2 stream sites to sample invertebrates and assess habitat quality. This gives volunteers an opportunity to "get their feet wet" and to ask questions that may not have occurred in the classroom setting. Volunteers also can practice benthic invertebrates identifications in the field.

Performance will be measured by an annual side-by-side monitoring event with volunteers and MDEQ. Results will be compared to evaluate data consistency. If some results are questionable, then the source of any problems will be identified and steps taken to remedy the situation. Volunteers are required to demonstrate competence in the identification (to Order) of a reference collection of benthic invertebrates in the laboratory using a basic taxonomic key. Volunteers also are asked to keep voucher specimens so that identifications can be verified periodically.

Documentation and Records

Volunteers will complete the volunteer stream survey form during each site visit. Information includes the stream name, station number, location (road crossing if applicable), county, township, date, time, and name(s) of the investigator(s), as well as habitat and benthic invertebrate data. All data sheets will be returned to Mark Kelley, Field Leader, at the NRCS office in Shelby, MI. Copies of the data sheets will be sent to MDEQ, where data will be entered into a volunteer monitoring program database. The field data sheets will be stored at the NRCS office for 5 years and at the MDEQ office in Lansing for 10 years. All records in the database will be maintained, ensuring that historical data are not lost. QA documentation generated from this project will be maintained by MDEQ for 5 years.

Volunteers will collect and preserve (in jars with 90% ethanol) one or a few specimens of all invertebrate taxa found at a site for laboratory identification (if necessary) and verification purposes. These jars will be clearly labeled, identifying the stream name and location, collection date and time, and the name(s) of the volunteer(s) that collected the data. Voucher specimens will be stored and maintained for 3 years by the Laboratory Manager, Hamdy Helal, at West Shore Community College.

Project Design and Sampling Process

The Pentwater River watershed sites are sampled twice per year, once in April and once in September. A sampling visit includes an assessment of stream habitat quality and the collection and identification (either in the field or laboratory) of benthic macroinvertebrates. Volunteers are asked to wait at least 5 days after heavy precipitation before sampling. There is a place on the field data sheet to note the extent of precipitation in the previous 5 days. It is recognized that during extremely wet periods (common in April), sampling may have to be delayed. However, this situation is to be avoided if possible because of invertebrate life history characteristics.

Volunteers are encouraged to work in groups of two or more, and safety procedures are discussed during the training sessions (see attached "Safety Guidelines"). If a volunteer cannot make a scheduled sampling visit for any reason, they must notify their partner(s) and the Field Leader, and volunteers and the Field Leader will attempt to find a replacement. If a replacement cannot be found, then the site visit may have to be rescheduled or canceled. Final decisions will be made by the Field Leader.

If site access requires crossing private property, then volunteers must seek permission from the owner. If the owner refuses permission, then a nearby alternate site will be selected.

The initial 10 sites were chosen randomly (with consideration of accessibility) to ensure reasonably broad coverage of the watershed. As more volunteers are recruited, additional sites will be chosen either randomly or in response to specific issues or concerns. For example, if a new road is planned, then a site will be selected to measure potential impacts. If cattle access to the stream is noted, then a nearby site may be selected to document the extent of the problem. If a farm implements BMPs, then a nearby site will be chosen to document improvements in stream quality. This site selection process will ensure that volunteer monitoring provides both an overview of water quality in the Pentwater River watershed and information about suspected or known stressors.

Sampling Method Requirements

Volunteers will visually inspect the stream reach to assess habitat. The only equipment needed is a thermometer to record the air and water temperature, and a tape measure to determine stream width and depth. It is recommended that volunteers use an orange or apple to measure current velocity. Specific procedures are attached ("Volunteer Monitoring Procedures").

For benthic invertebrate collections, volunteers will use 3' by 3' kick-nets with a mesh size of 400 microns. Samples will be preserved in jars with 90% ethanol. There is no specific holding time for preserved specimens, but laboratory identifications should be completed within one month of a site visit. Prior to leaving a site, volunteers are instructed to wash the kick nets and remove invertebrates that may remain on the net. Specific procedures are attached ("Volunteer Monitoring Procedures").

Sample Handling and Custody Requirements

The only samples that are brought into the laboratory are benthic invertebrates. Volunteers will clearly label the jars (using pencil), with information about sample location, date and time, and collectors. After identification (if necessary), these voucher specimen jars will be turned over to the Laboratory Manager, who will maintain them for 3 years. A reference collection of taxa found in the watershed, based on voucher specimens, will be maintained indefinitely by the college.

Analytical Methods Requirements

The habitat and benthic macroinvertebrate assessment methods have been developed by the MDEQ for the volunteer monitoring program and are attached to this QAPP ("Volunteer Monitoring Procedures"). These methods are consistently used by volunteer organizations throughout Michigan.

Quality Control Requirements

All Pentwater River watershed volunteers will convene annually and conduct a site assessment at the same location, along with MDEQ staff. The purpose of this activity is to ensure that all volunteers are following proper procedures and to evaluate variability among individual assessments. If a volunteer is not following recommended procedures, then the problem(s) will be pointed out by MDEQ and the proper procedure will be explained and/or demonstrated. The habitat evaluations by volunteers and MDEQ staff will be compared for accuracy and variability. If variability among volunteers is high (based upon best professional judgment since habitat assessments are not quantitative), then the Project Manager will attempt to determine the reasons for the variability (e.g. whether it is spread among all variables, or is confined to one or a couple of variables). These issues will be addressed at the next training session. It is anticipated that variability among volunteers will decrease as they gain more experience and confidence in the monitoring procedures.

With regard to benthic macroinvertebrates, the goal is for the minimum and maximum scores to differ by < 10 points, as described in the "Data Quality Objectives" section above. If variability is greater than 10 points, then the Project Manager will determine whether differences are caused by different sampling efficiency among volunteers and/or by problems with invertebrate identifications. Once the cause of the variability is determined, it will be addressed at the next training session. Volunteers may be asked to practice invertebrate identification in the laboratory, or to work with an experienced individual to improve sampling efficiency. Volunteers are asked to maintain voucher specimens from each sampling event, and the identifications of each individual will be checked once per year (at least for the first 2 years of the program). If a sample has multiple misidentifications, then results will be flagged or discarded and the volunteer will be provided with additional training.

Equipment Testing, Inspection, and Maintenance Requirements

Kick nets will be inspected for tears/holes in the mesh by volunteers prior to each sampling event. Nets with holes will be repaired or, as a last resort, replaced. Volunteers are required to thoroughly rinse and clean kick nets prior to returning from the field. Nets will be stored at the West Shore Community College biology laboratory. Voucher specimen jars also will be inspected by volunteers for cracks prior to sample collection. Thermometers will be checked each year to ensure that they are in working order and giving accurate readings.

Instrument Calibration and Frequency

The only instruments requiring calibration are the thermometers. This will be done by placing thermometers into a jar of water at room temperature and taking readings from each. If one is

found to differ from the others by more than 1 degree C, it will be properly discarded and replaced. These calibrations will be done once per year.

Inspection and Acceptance Requirements For Supplies

The Pentwater River watershed volunteers use kick-nets for benthic macroinvertebrate sampling, and preserve voucher specimens in jars with 90% ethanol. The nets, jars, and thermometers are purchased from a scientific supply house and are inspected upon arrival for any defects or problems. Defective materials are immediately returned to the supplier for replacement.

Data Acquisition Requirements

Macroinvertebrate pollution tolerance groupings and index calculations are based on 1995 volunteer monitoring guidance from U.S. EPA. Habitat categories also are based on this guidance, as well as forms used by other volunteer organizations. County and U.S. Geological Survey maps are used for site selection.

Data Management

The field data sheet is reviewed by volunteers prior to leaving a site to ensure that the forms are fully completed and that nothing is left blank (unless there is a specific reason). The Field Leader also will examine the data sheets for completeness when submitted by volunteers. At that time, volunteers will be questioned about any omissions or possible errors. The Field Leader will spot check the invertebrate score calculations to ensure accuracy. The Laboratory Manager will inspect voucher collections to ensure that they are properly labeled, and any necessary corrections/additions will be made. Voucher specimens will be checked once a year to ensure the accuracy of identifications.

Data will be entered into a spreadsheet/database designed by MDEQ for the statewide volunteer monitoring program. The quality of data entry will be evaluated by comparing 20% of the data sheets to the appropriate database records. If multiple errors are found, then all data sheets will be compared with their database records, and steps will be taken to address the source of the data entry errors.

Assessments and Response Actions

As mentioned previously, all volunteers will convene once per year with the Field Leader and Project Manager to assess performance and variability. Problems will be corrected by demonstrating proper techniques to individuals not following recommended sampling and assessment procedures. Volunteers are required to attend annual refresher training sessions, which will help to ensure that proper procedures are consistently followed. Identifications of voucher specimens will be checked annually for accuracy, and volunteers that appear to be having difficulty will receive additional instruction from the Field Leader and/or the Project Manager.

Reports

The Project Manager will produce an annual report summarizing the Pentwater River watershed monitoring results from the previous field season (spring and autumn sampling). This report, to be completed each February, will be distributed to all volunteers, project participants, and any others who request it. In addition to the monitoring results, the report will describe any problems that occurred, QA results, notable achievements, how the data were used by federal, state, and local agencies, a list of monitored sites, and the names of volunteers and future project sponsors. Data also will be compared to those collected in previous years to establish water quality trends in the Pentwater River watershed.

An annual statewide report also will be prepared by MDEQ that summarizes data collected by all volunteer organizations in Michigan. As more groups adopt the standard procedures developed by the state and generate similar, consistent types of data, such comparisons become relatively easy and valuable. This report will show where volunteer data are being collected, list the participating organizations, and identify sites of high quality as well as sites that are degraded. The report will point out areas chosen for detailed assessment by MDEQ biologists based on volunteer information.

Data Review, Validation, and Verification Requirements

All data collected during this project will be reviewed by the Project Manager to determine whether the QA objectives are met. The Project Manager will decide whether data are accepted, rejected, or qualified. The main reason for rejecting data is likely to be poor identification of invertebrates.

Validation and Verification Methods

Field data sheets will be reviewed by the Field Leader for completeness, unusual measurements, and accuracy of calculations. In addition, the Field Leader and Project Manager will check invertebrate identifications by each volunteer once per year to verify data accuracy. Any problems in these areas will be corrected through the annual training sessions. Suspect data will either be dropped or flagged as appropriate. A subset (20%) of the database records will be compared to the field data sheets to ensure the accuracy of the data entry procedure. If numerous errors are found, all data sheets will be compared to their respective database records to correct errors.

Reconciliation With Data Quality Objectives

During the annual QA monitoring effort, the benthic macroinvertebrate index scores will be compared to assess variability among volunteers. If the difference between the minimum and maximum score is greater than 9 points, then corrective steps will be taken. This may involve additional training in sampling procedures and/or taxonomic identifications. It is expected that variability will decrease as volunteers gain more experience and confidence in the methods. Differences in the habitat assessments also will be analyzed to determine whether interpretation problems exist. The Field Leader and Project Manager will decide whether to discard data and the remedial actions that are necessary to improve the quality of volunteer data.

APPENDIX D

DATA TRANSMITTAL MEMO TO SWQD BIOLOGISTS

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

INTEROFFICE COMMUNICATION

April 25, 2002

TO: Kevin Goodwin
Great Lakes and Environmental Assessment Section
Surface Water Quality Division

FROM: Nicole Vidales
Great Lakes and Environmental Assessment Section
Surface Water Quality Division

SUBJECT: Mill Creek Monitoring Project Volunteer Data

To assist you in developing your biosurvey monitoring strategy for Fiscal Year 2002, I am providing you with information collected by volunteers in your watershed. There are two volunteer efforts in the St. Clair watershed, the Mill Creek Monitoring Project and Michigan State University (MSU) 4-H Adopt-a-Stream Program. Data contained in this packet are from the Mill Creek Monitoring Project only. We have just received the MSU 4-H Adopt-a-Stream data and it has not yet been entered into our database. However, I can provide you with the actual data sheets if you are interested. We have data sheets from fall 2001.

To document and compare the effects of dredging and river restoration techniques on Mill Creek (see attached brochure), volunteers began collecting macroinvertebrate and habitat data on the north, south, and main branch of Mill Creek in 1999 (Appendix A). Macroinvertebrates were collected from all available habitats and identified to Order or Family level (see Instream Data Sheet), and the abundance of each taxon estimated as Rare (< 10 individuals) or Common (> 10 individuals). The total stream quality score was then calculated, recorded, and used to rank the site as excellent, good, fair, or poor (Appendix B). The raw data sheets, which include the exact findings of the macroinvertebrate community also are available to you upon request.

If you have any suggestions, especially on how we can improve the way in which we are providing data, other sites that this group should assess, and the type of data that volunteers collect, please let me know.

cc: Gerald Saalfeld, GLEAS
Gary Kohlhepp, GLEAS

Volunteer Monitoring Annual Report - Appendix A

Organization Name	Waterbody Name	County	# of Times Sampled		Start Date	Funding Year
Mill Creek Monitoring Project	Mill Creek	St. Clair	1		4/21/2001	FY00
Mill Creek Monitoring Project	North Branch Mill Creek	St. Clair	3		4/21/2001	FY00
Mill Creek Monitoring Project	South Branch Mill Creek	Lapeer	6		5/29/1999	FY00
Mill Creek Monitoring Project	South Branch Mill Creek	St. Clair	36		5/25/1999	FY00

Volunteer Monitoring Annual Report - Appendix B

Organization Name	Waterbody Name	Location	Sampling Date	Ranking	Score
Mill Creek Monitoring Project	Mill Creek	Bricker Road	4/21/2001	Good	46.6
Mill Creek Monitoring Project	North Branch Mill Creek	Bricker Road	9/29/2001	Excellent	59
Mill Creek Monitoring Project	South Branch Mill Creek	Cade Road	5/29/1999	Good	43.7
Mill Creek Monitoring Project	South Branch Mill Creek	Cade Road	10/2/1999	Fair	19.4
Mill Creek Monitoring Project	South Branch Mill Creek	Cade Road	9/22/2001	Fair	31.1
Mill Creek Monitoring Project	South Branch Mill Creek	Cade Road	5/27/2001	Good	34.2
Mill Creek Monitoring Project	South Branch Mill Creek	Cade Road	10/7/2000	Good	36
Mill Creek Monitoring Project	South Branch Mill Creek	Cade Road	6/2/2000	Fair	28.5
Mill Creek Monitoring Project	South Branch Mill Creek	Frantz property	10/7/2001	Fair	29.2
Mill Creek Monitoring Project	South Branch Mill Creek	Frantz property	6/2/2001	Good	38.5
Mill Creek Monitoring Project	South Branch Mill Creek	Frantz property	10/7/2000	Fair	25.8
Mill Creek Monitoring Project	South Branch Mill Creek	Frantz property	5/27/2000	Fair	31.1
Mill Creek Monitoring Project	South Branch Mill Creek	Frantz property	10/24/1999	Good	36.6
Mill Creek Monitoring Project	South Branch Mill Creek	Frantz property	5/31/1999	Good	38.5
Mill Creek Monitoring Project	South Branch Mill Creek	Fulton Road	5/28/1999	Good	36.2
Mill Creek Monitoring Project	South Branch Mill Creek	Fulton Road	10/8/2000	Good	40.2
Mill Creek Monitoring Project	South Branch Mill Creek	Fulton Road	5/26/2001	Good	45.6
Mill Creek Monitoring Project	South Branch Mill Creek	Fulton Road	10/13/2001	Fair	29.9
Mill Creek Monitoring Project	South Branch Mill Creek	Fulton Road	10/2/1999	Fair	26.4
Mill Creek Monitoring Project	South Branch Mill Creek	Fulton Road	5/30/2000	Good	41.4
Mill Creek Monitoring Project	South Branch Mill Creek	Jeddo Road	6/2/2000	Excellent	48.7
Mill Creek Monitoring Project	South Branch Mill Creek	Jeddo Road	10/2/1999	Fair	32.7
Mill Creek Monitoring Project	South Branch Mill Creek	Jeddo Road	11/7/2001	Excellent	53.8
Mill Creek Monitoring Project	South Branch Mill Creek	Jeddo Road	6/2/2001	Excellent	57
Mill Creek Monitoring Project	South Branch Mill Creek	Jeddo Road	5/28/1999	Excellent	51.8
Mill Creek Monitoring Project	South Branch Mill Creek	Jeddo Road	10/7/2000	Good	46.7

Volunteer Monitoring Annual Report - Appendix B

Organization Name	Waterbody Name	Location	Sampling Date	Ranking	Score
Mill Creek Monitoring Project	South Branch Mill Creek	Jordan Road	5/29/1999	Excellent	51.1
Mill Creek Monitoring Project	South Branch Mill Creek	Jordan Road	10/2/1999	Good	38.5
Mill Creek Monitoring Project	South Branch Mill Creek	Jordan Road	5/27/2000	Good	41.4
Mill Creek Monitoring Project	South Branch Mill Creek	Jordan Road	10/8/2000	Good	46.2
Mill Creek Monitoring Project	South Branch Mill Creek	Jordan Road	5/26/2001	Excellent	55.3
Mill Creek Monitoring Project	South Branch Mill Creek	Jordan Road	11/7/2001	Excellent	50.7
Mill Creek Monitoring Project	South Branch Mill Creek	Norman Road	5/27/2000	Good	36.5
Mill Creek Monitoring Project	South Branch Mill Creek	Norman Road	10/6/2001	Fair	27.7
Mill Creek Monitoring Project	South Branch Mill Creek	Norman Road	6/2/2001	Good	45.1
Mill Creek Monitoring Project	South Branch Mill Creek	Norman Road	10/8/2000	Good	36.4
Mill Creek Monitoring Project	South Branch Mill Creek	Norman Road	10/2/1999	Good	37.5
Mill Creek Monitoring Project	South Branch Mill Creek	Norman Road	6/2/1999	Good	40.6
Mill Creek Monitoring Project	North Branch Mill Creek	Sterling Road	4/21/2001	Fair	30.8
Mill Creek Monitoring Project	North Branch Mill Creek	Sterling Road	9/29/2001	Fair	31.8
Mill Creek Monitoring Project	South Branch Mill Creek	Yale City Park	9/22/2001	Excellent	55.4
Mill Creek Monitoring Project	South Branch Mill Creek	Yale City Park	5/27/2000	Fair	28.6
Mill Creek Monitoring Project	South Branch Mill Creek	Yale City Park	10/2/1999	Good	37
Mill Creek Monitoring Project	South Branch Mill Creek	Yale City Park	5/25/1999	Fair	27
Mill Creek Monitoring Project	South Branch Mill Creek	Yale City Park	5/28/2001	Good	44.8
Mill Creek Monitoring Project	South Branch Mill Creek	Yale City Park	10/12/2000	Good	43.5

The Effects of Dredging vs. The Effects of River Restoration On Mill Creek

Mill Creek Volunteer Monitoring Project
First Annual Report
October, 2000

BACKGROUND

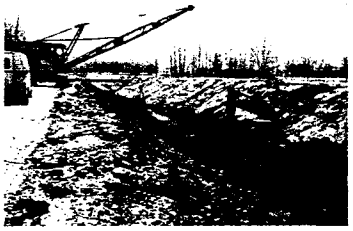
Before a compromise was reached, local residents were at odds for 10 years over the merits of a proposed drainage project, which called for dredging 17 miles of Mill Creek. The proposed dredging project was designed to begin at the point where Mill Creek crosses Wheeling Road in Lapeer County and extend downstream about 17 miles to a point just upstream of the city of Yale in St. Clair County. Most of the creek in the project area had not been dredged since 1957 and had begun to revert to its pre-dredging characteristics. Trees, shrubs and grasses shaded the banks. Three miles of the section slated for dredging had never been dredged and was a natural stream. Over the years, obstructions, included a collapsed bridge; log jams, rock dams and beaver dams, had formed in the creek and were impeding its flow. Because the project area is very flat, with less than 1 1/2 ft. a mile of fall, these obstructions were holding back quite a lot of water.

Those who favored the 17-mile dredging project fell into two categories. Farmers who were farming in flood plains or low-lying areas, which had once been swamps and cranberry bogs, claimed that they needed the creek dug out to lower the water table so that their field tiles could work more efficiently. Land developers also wanted the creek dredged because they reasoned that their land could be more easily developed if it had better drainage.

Those who opposed the 17-mile dredging project did so for a variety of reasons. Some objected to the high cost of dredging, which was estimated to be about $4 million. Those people only wanted the obstructions removed, which was estimated to cost between $100,000 and $200,000. Township officials were worried about assessments the four townships in the project area would be required to pay. Lynn Township officials declared that Lynn Township did not have the money to pay its share of the cost. Farmers who operated farms that did not need improved drainage objected to "subsidizing" the farmers who were planting crops in areas that were unsuitable for that purpose. People, who lived downstream of the proposed project, expressed their fears about erosion and flooding. Yale residents were alarmed by the engineering studies, which projected that the dredging would cause increased flooding in the city. Some people feared they would lose their homes and other buildings, which were located in what would become drain easements. Lastly, many opposed the 17-mile dredging project because it would destroy the natural beauty of the creek as well as the wildlife habitat that the creek provided. In general, those who opposed the dredging project wanted a less costly and more environmentally friendly project.

Dredging- The term "dredging,' as used in this report, refers to the conventional method of drain excavation and maintenance used by Drain commissioners in Michigan. It is still done as it's been done for over a hundred years; by engineering the drain or creek as a channel with a uniform bottom width, uniform slope of banks, and a plotted grade for the bottom of the channel. This makes it easy for the engineers to calculate the amount of water the channel will carry and for the amount of excavation to be specified for bidding by contractors.

Bends and meanders in the watercourse are eliminated as much as possible. All trees and shrubs are removed from one or both sides of the channel to create a travelway for the excavation equipment and an area for the spreading of "spoils," which are the materials excavated. Trees and woody debris are usually burned and what remains is buried. The banks and right-of-way are seeded with grasses. The travelway is usually kept clear by yearly spaying of herbicides or brush-hogging, so that excavation equipment has easy access for future maintenance. The excavated channel usually grows up quickly with cattails or aquatic weeds and has to be sprayed frequently or excavated again.



Dredging

River Restoration Techniques of George Palmiter

River Restoration Techniques of George Palmiter - George Palmiter pioneered restoration techniques in the 1970s that are now used in great variety in many parts of the continent. His techniques are described in U.S. Army Corps of Engineers "Contributing Report 82-CR1" and are evaluated in U.S. Army Corps of Engineers "Policy Study 84-PS-3." Palmiter's current methods are more complex than some other river restoration techniques. He first removes logjams, beaver dams and other obstructions. Then, he stabilizes eroded banks with logs, brush bundles, and revegetation. He makes bank corrections by removing selected trees and shrubs where the stream is too narrow. He creates current deflectors with natural materials to narrow the channel where the stream is too wide, to wash out sand bars in the center of the stream and to change the flow characteristics where there are problems such as severe bank erosion. He follows up with subsequent adjustments and maintenance.

His motto is, "Let the river do the work." Silt and sediment are washed out of the stream channel mimicking natural processes, and end up in floodplains and other parts of the stream where the current slows. George was heralded by the Corps of Engineers for articulating the importance of shade to maintaining good drainage as well as good stream habitat. When shade is maintained on watercourses, they don't plug up with sun-loving aquatic weeds and they require much less human maintenance.

This project was made possible with funding from the
Department of Environmental Quality, Surface Water Quality Division.
The conclusions and data interpretations that are expressed in this report are solely those of the MCVMP.

MILLCREEK VOLUNTEER MONITORING PROJECT REPORT

INTRODUCTION

The Mill Creek Volunteer Monitoring Project (MCVMP) is part of the Michigan Volunteer Monitoring Program, which began after the Michigan Department of Environmental Quality (DEQ) completed "A Strategic Environmental Quality Monitoring Program For Michigan's Surface Waters" in 1997. One of the goals identified in the strategy is to increase the number of stream and river miles assessed throughout the state by developing partnerships with citizen volunteer monitoring groups. Volunteer groups participating in the monitoring program are asked to collect data on a core set of parameters, particularly benthic macroinvertebrates and habitat, using standard forms. The collected data is verified by a DEQ biologist and entered into their data base. The data is then transmitted to the biologist working in the project's watershed, who then uses it to identify areas of possible concern.

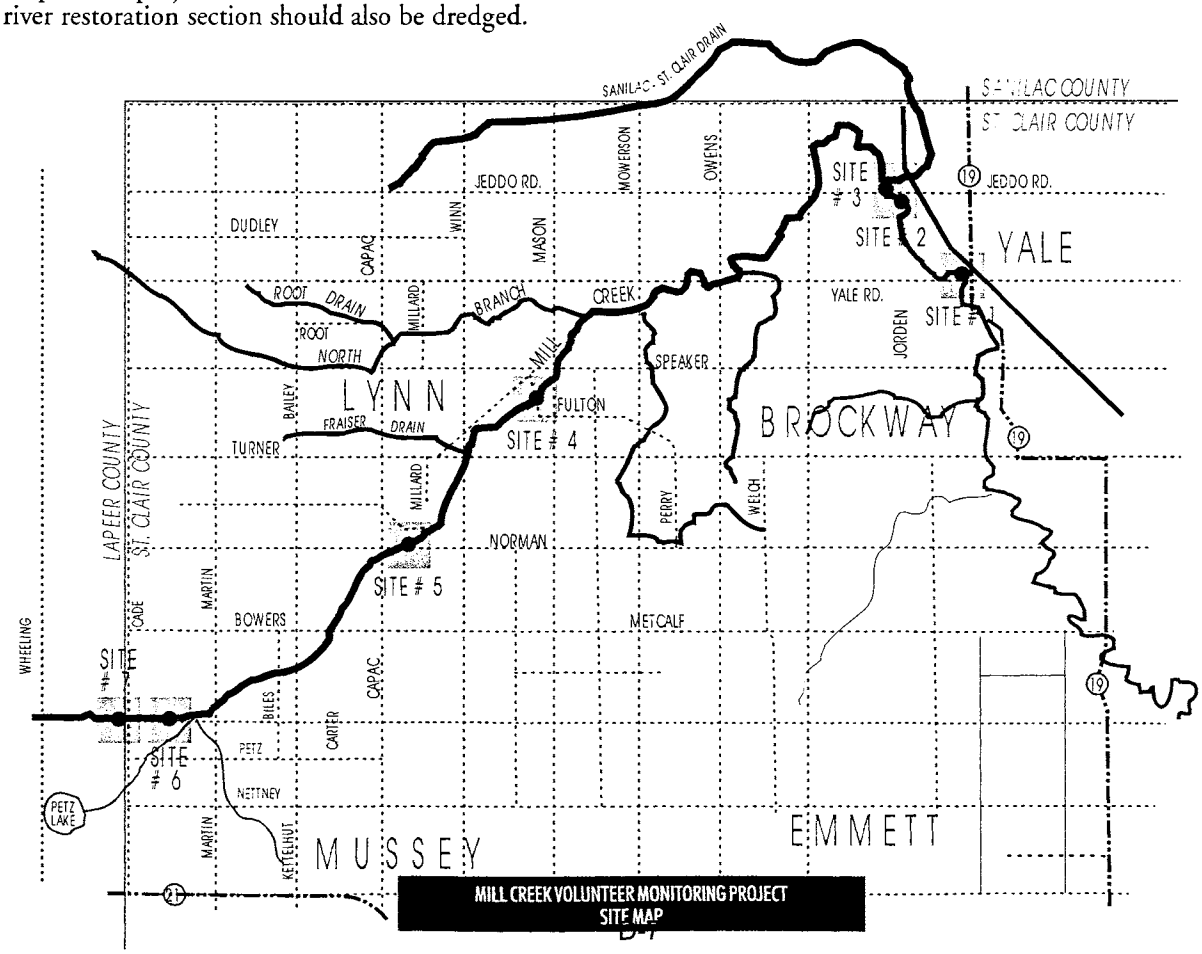
The MCVMP was initiated in the spring of 1999 after volunteers contacted the DEQ and asked how to set up a monitoring program for a section of Mill Creek, where a drainage project would be taking place. The drainage project had been very controversial and after 10 years of legal wrangling, a compromise had been reached between the South Branch of Mill Creek Intercounty Drainage Board and local elected officials. The compromise consisted of dredging only 1.75 miles of what was originally intended to be a 17mile *Dredging Project* and using the more environmentally friendly *River Restoration* techniques of George Palmiter on the remaining 15.25 miles.

In June 2001 the Intercounty Drainage Board will decide if the compromise project has been successful or if the 15.25 mile river restoration section should also be dredged.

The volunteers were worried by the fact that no specific criteria were chosen by the Intercounty Drainage Board, other than increased water conveyance, on which to base the June 2001 dredging decision. The volunteers decided to set up the MCVMP and gather additional data including photos and other information on soil erosion, benthic macroinvertebrates and stream bank habitat, which they felt should also be factored into the June 2001 decision.

Monitoring sites were carefully selected, in order to compare sections of the creek before and after dredging to sections of the creek before and after river restoration. Two sites were selected, within the river restoration section, which had never been dredged. Two sites were chosen which had not been dredged since 1957 and would now have river restoration techniques applied. Lastly, two sites were selected, which would be dredged as part of the compromise drainage project.

Before the drainage project was undertaken, Mr. Gary Kohlhepp of the DEQ trained the volunteers. Since the training took place at a site in the Yale Park and data were collected there, the park-site was added to the MCVMP as a volunteer training site. The seven sites were sampled in the spring and again in the fall of 1999, before the drainage project was begun. In the spring of 2000, a year after the MCVMP was initiated and after the compromise drainage project was completed; the sites were sampled again. **The First Annual Mill Creek Volunteer Monitoring Project Report presents a summary of the short-term effects of dredging versus the short-term effects of river restoration on Mill Creek.**

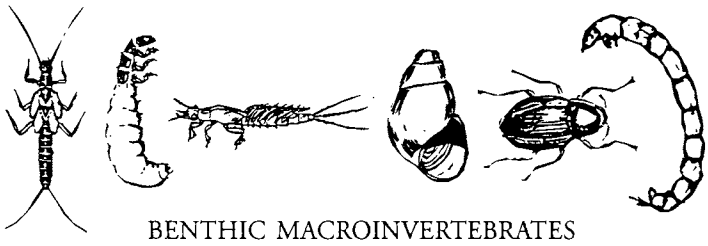


MILL CREEK VOLUNTEER MONITORING PROJECT SITE MAP

TRAINING AND DATA COLLECTION

DATA COLLECTION

The volunteer monitoring program requires volunteers to wade into the stream and collect benthic macroinvertebrates, using nets. Macroinvertebrates are animals that can be seen with the naked eye, which do not have backbones. The term "benthic" means bottom dwelling. Therefore, benthic macroinvertebrate are animals without backbones, which live on the bottom of streambeds or logs and plants in the stream channel. Some examples include insect larvae and nymphs, snails, clams, crayfish, aquatic worms and leeches.



BENTHIC MACROINVERTEBRATES

Volunteers collect samples from every different type of stream habitat in each 300-foot site. The samples are then taken to the Yale Park where they are poured into white enamel flat pans. The volunteers carefully remove the macroinvertebrates from the water samples and preserve them in alcohol. They are identified using the identification keys provided by DEQ and are sorted into the following categories; sensitive, somewhat sensitive or tolerant. This data is then recorded on the score sheet provided by the DEQ. Sensitive macroinvertebrates, such as stonefly and mayfly nymphs, are widely recognized as excellent indicators of good water quality while tolerant macroinvertebrates, such as water scorpions and leeches, can tolerate poor water conditions. The score sheet is designed to rank each site for water quality as either "excellent", "good", "fair" or "poor".

Volunteers learn sampling techniques at Site #1.

The program also requires volunteers to record the average stream width and depth, surface water velocity, water characteristics (runs, riffles, pools and eddies) and stream flow. In addition, the substrate composition, substrate embeddedness, and the amount of siltation, are recorded. The volunteers observe and collect data on the riparian vegetation, stream shading, bank erosion, woody debris, aquatic plants, any obvious pollution sources, weather conditions, any fish or wildlife present, as well as the surrounding land uses at each site. Photographs are taken to document the volunteer's observations of the sites.

The preserved macroinvertebrates, the score sheets and photographs are taken to Lansing. The macroinvertebrates are verified by a DEQ biologist, the data is entered into their database and transmitted to the biologist working in that watershed.

Site#1 Training Site - Yale Park

Volunteers at Yale Park remove, sort and identify benthic macroinvertebrates from creek samples taken at various sites.

This site was not originally intended to be part of the MCVMP. The volunteers were trained at the site, and since data were gathered while the volunteers were being trained, it was decided to record the data and to use the site as a training location for new volunteers. Most of the time at the site is spent showing the volunteers the proper way to collect macroinvertebrates and how to record the data on the score sheets. The data from this site will not be discussed in this report.

RIVER RESTORATION SITES
-NEVER DREDGED-

SITE #2

Site #2 is directly downstream from the Jeddo Road Bridge in St. Clair County. A wood lot of several acres covers the land on the East Side of the creek. On the West Side a home sits high up on a steep, tree covered bank. The home's yard slopes down to the creek. A road ditch trickles down through the yard. In the spring and fall of 1999, volunteers observed that the water, near the bridge, was shallow with riffles and a sand and gravel bottom. A little farther downstream the water deepened. There were pools, runs and eddies in this area. Woody debris was common at the site.

Before River Restoration - Spring 1999 - *"Excellent"*

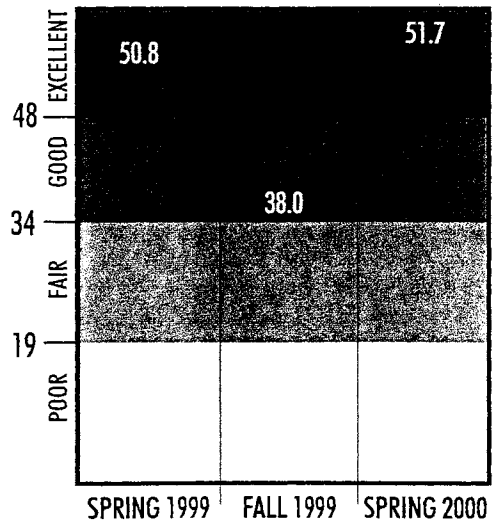
- The average width of the creek was 41 ft.
- The average depth was 2.5 ft.
- The surface water velocity .33 ft. per second.
- Woody debris was common.
- No erosion problems were detected.
- Hundreds of small fish, ranging in size from less than 1 inch to several inches, were found at this site. Volunteers also observed larger fish jumping. Broken fishing lines were found tangled on some woody debris, which makes it probable that people fish from the bridge.
- In the spring of 1999, site#2 tested "excellent" for water quality using the DEQ Benthic Macroinvertebrate Score Sheet. Seventeen different kinds of macroinvertebrates were collected including the following sensitive macroinvertebrates; beetle adults, Caddisfly larvae, Mayfly nymphs, Gilled Snails, Stonefly nymphs and a Blackfly larva.

Before River Restoration - Fall 1999 - *"Good"*

- The average width was 43 ft.
- The average depth was 2 ft.
- The surface water velocity was .26 ft. per second.
- Woody debris was common.
- No erosion problems were detected.
- Hundreds of small fish, ranging in size from less than 1 inch to several inches, were found.
- Site#2 dropped to "good" for water quality in the fall using the DEQ Benthic Macroinvertebrate Score Sheet. Thirteen different kinds of macroinvertebrates were found including the following sensitive macroinvertebrates; beetle adults, Caddisfly larvae, Mayfly nymphs and Stonefly nymphs.

After River Restoration - Spring 2000 - *"Excellent"*

- The average width was 44.5ft.
- The average depth was 2.26 ft.
- The surface water velocity increased to 2.5ft. per second.
- Woody debris was common.
- The stream bank vegetation remained intact.
- No new bank erosion was observed.
- Hundreds of small fish were found, at the site.
- The site again tested "excellent" for water quality using the DEQ Benthic Macroinvertebrate Score Sheet. Sixteen different kinds of macroinvertebrates were found, including the following sensitive macroinvertebrates; beetle adults, Caddisfly larvae, Mayfly nymphs, Gilled Snails and Stonefly nymphs.



RIVER RESTORATION SITES
-NEVER DREDGED-

SITE #3

Site#3 is just downstream of the point where the Sanilac-St.Clair Drain empties into Mill Creek. The site is on private property on Jordon Road, North of Jeddo Road, in St. Clair County. On the West Side of the creek, a home sits at the top of the bank above a floodplain with a yard sloping down to the water. On the East Side of the creek there is a cattle pasture. In 1999, good-sized trees were scattered along both banks. In the middle of the creek was a small island formed from sediment carried downstream after the Sanilac - St.Clair Drain was dredged several years ago. Upstream of the island were large rocks, which had been piled up in the creek years ago and used as stepping-stones by the property owner. The water was shallow on both sides of the island and flowed quickly, causing riffles. Upstream of the rocks and downstream of the island, the water was deeper with runs, pools and eddies. The bottom was sandy and gravely.

Before River Restoration - Spring 1999 - *"Excellent"*

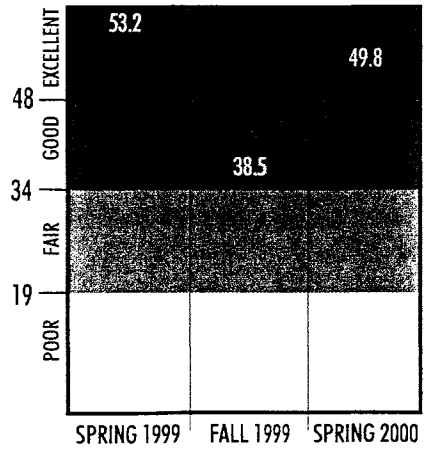
- The average width of the creek was 32 ft.
- The average depth was 14 inches.
- Surface water velocity was 1.1 ft. per second.
- Woody debris was common.
- No erosion problems were detected.
- Quite a few small fish were found, though not as many as at Site #2.
- In the spring of 1999 site #3 tested "excellent" for water quality using the DEQ Benthic Macroinvertebrate Score Sheet. Eighteen different kinds of benthic macroinvertebrates were found, including the following sensitive macroinvertebrates; beetle adults, Caddisfly larvae, Mayfly nymphs, Gilled Snails, and Stonefly nymphs.

Before River Restoration - Fall 1999 - *"Good"*

- The average width of the creek was 31.7 ft.
- The average depth was 1 ft.
- Surface velocity was .7 ft. per second.
- Woody debris was common.
- No erosion problems were detected.
- Quite a few small fish were found, though not as many as at Site #2.
- In the fall of 1999 site #3 tested "good" using the DEQ Benthic Macroinvertebrate Score Sheet. Twelve different kinds of benthic macroinvertebrates were found, including the following sensitive macroinvertebrates; beetle adults, Caddisfly larvae, Mayfly nymphs and Stonefly nymphs.

After River Restoration - Spring 2000 - *"Excellent"*

- The average width was 28 ft.
- The average depth was 3 ft.
- The surface water velocity increased to 2.5ft. per second.
- The stream bank vegetation remained intact.
- No new bank erosion was observed.
- Most of the stepping stones had been removed.
- Some woody debris had been removed from the channel, but it was still common along the edges.
- More small fish were found at the site.
- The site once again tested "excellent" for water quality using the DEQ Benthic Macroinvertebrate Score Sheet. Eighteen different kinds of benthic macroinvertebrate were collected including the following sensitive macro-invertebrates; beetle adults, Caddisfly larvae, Mayfly nymphs, and Gilled Snails.



RIVER RESTORATION SITES
-LAST DREDGED 1957-

SITE #4

Site # 4 is directly downstream from the Fulton Road Bridge in St. Clair County. The site is difficult to sample because the bottom is soft and there are very steep, high banks from the 1957 dredging. At the top of the bank on both sides is 50 ft. of grass, and beyond that farm fields. Throughout the site, the bank slopes are mostly grass-covered with a few large trees. Near the bridge, however, the vegetation is thicker with shrubs and trees. The channel was choked with weeds and aquatic plants in the fall of 1999. Sandbars and peninsulas impeded the flow of the creek.

Before River Restoration - Spring 1999

The volunteers who were sent to sample this site in the spring of 1999 went to the wrong side of the bridge. Only one volunteer was brave enough to enter the stream in this bad location. The other volunteers were afraid they would sink in so deep that they would not be able to get out.

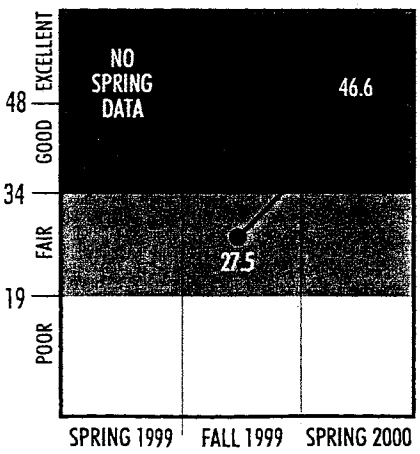
- The data collected in the spring of 1999 does not apply to site #4 because it was not collected from the correct location.

Before River Restoration - Fall 1999 - *"Fair"*

- The average width was 29 ft.
- The average depth was 2.5 ft.
- The surface water velocity was so slow that no movement could be detected.
- Deep sediment, aquatic plants, weeds and sandbars impeded the flow.
- Woody debris was rare.
- Moderate erosion was observed in a few bare places caused by water running down the slopes from the top of the bank. A large tree had toppled over on the north bank.
- No fish were found.
- The site tested "fair" for water quality using the DEQ Benthic Macroinvertebrate Score Sheet. Nine different kinds of benthic macroinvertebrates were collected, including the following sensitive macroinvertebrates; beetle adults, Caddisfly larvae and Gilled Snails.

After River Restoration - Spring 1999 - *"Good"*

- The average width was 22.75 ft.
- The average depth was 1.5 ft.
- The surface water velocity increased to .66 ft. per second.
- The stream bank vegetation remained the same.
- The sandbars and peninsulas had been removed from the channel, but the bottom was still covered with deep sediment.
- There were fewer weeds and aquatic plants in the channel.
- No new bank erosion was observed.
- Several fish were collected.
- The site tested "good" for water quality using the DEQ Benthic Macroinvertebrate Score Sheet. Seventeen different kinds of benthic macroinvertebrates were collected including the following sensitive macro-invertebrates; beetle adults, Caddisfly larvae, Mayfly nymphs and Gilled Snails.



RIVER RESTORATION SITES
-LAST DREDGED 1957-

SITE #5

Site # 5 extends from 250 ft. downstream to 50 ft. upstream of the Norman Road Bridge in St. Clair County. The bank slopes on both sides of the creek are steep from the 1957 dredging and are grass covered. Young trees are on the banks downstream of the bridge. At the top of the east bank on the downstream side of the bridge are several acres of trees and shrubs. Beyond the trees and shrubs is residential property. On the west side of the creek crops are planted to within 5 - 15 ft. from the top of the bank. Upstream of the bridge there is only one tree. Farming is being done on the south east side of the creek. Weeds are growing on the south west side because the creek is too close to the road to allow planting of crops.

Downstream from the Norman Road bridge.

An irrigation pump upstream from bridge, using creek to water sod.

Before River Restoration - Spring 1999 - *"Good"*

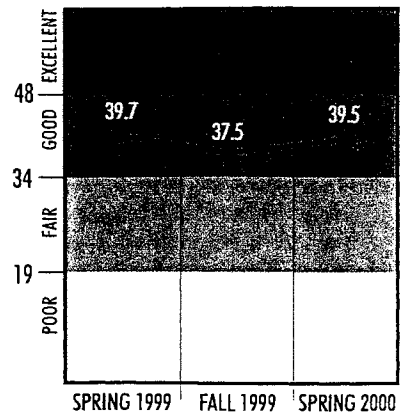
- The average width of the creek was 17.6 ft.
- The average depth was 11 inches.
- Surface water velocity was .095 ft. per second.
- Woody debris was common.
- Aquatic plants were abundant.
- Erosion caused by runoff from the farm fields was detected, as well as some bank slumping.
- No fish were found.
- In the spring of 1999 site #5 tested "good" for water quality using the DEQ Benthic Macroinvertebrate Score Sheet. Fifteen different kinds of benthic macroinvertebrates were found, including the following sensitive macroinvertebrates; beetle adults, Mayfly nymphs, Gilled Snails.

Before River Restoration - Fall 1999 - *"Good"*

- The average width of the creek was 21 ft.
- The average depth was 1.4 ft.
- Surface velocity was .04 ft. per second.
- Woody debris was present.
- Aquatic plants were abundant.
- There was 2.5 ft. of sediment.
- No new bank erosion was observed.
- No fish were found.
- In the fall of 1999 site #5 tested "good" for water quality using the DEQ Benthic Macroinvertebrate Score Sheet. Twelve different kinds of benthic macroinvertebrates were found, including the following sensitive macroinvertebrates; beetle adults, Caddisfly larvae, Mayfly nymphs and Gilled Snails.

After River Restoration - Spring 2000 - *"Good"*

- The average width was 23.8 ft.
- The average depth was 1.66 ft.
- Surface water velocity increased to .3 ft. per second.
- The stream bank vegetation remained intact.
- No new bank erosion was observed.
- Woody debris had been removed from the channel but it was still present along the edges.
- Sod farming was now being done on the southeast side, upstream from the bridge. Pipes and a pump had been placed in the creek so that water could be pumped from the creek to irrigate the sod.
- No fish were caught.
- The site again tested "good" for water quality using the DEQ Benthic Macroinvertebrate Score Sheet. Fourteen different kinds of benthic macro-invertebrates were collected including the following sensitive macroinvertebrates; beetle adults, Mayfly nymphs and Gilled Snails.



COMPROMISE DRAINAGE PROJECT
- DREDGING SITES -

SITE #6

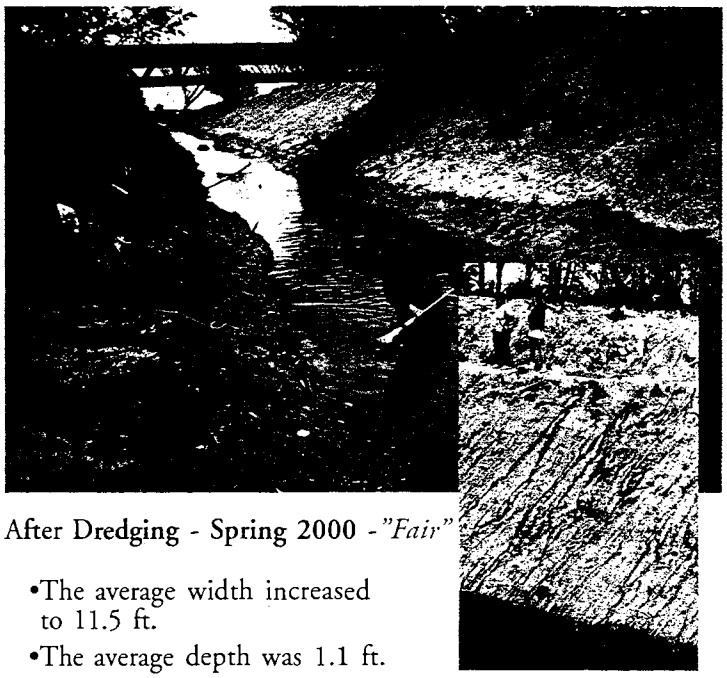
Site # 6 is located on private property directly downstream from a small, private bridge. The site is approximately .75 miles downstream from Cade Road in St. Clair County. The banks here were so steep from the 1957 dredging, volunteers used a rope tied to a tree to climb down to the bottom of the slope and to pull themselves back up the bank. Trees, grasses, and tall weeds covered the banks right up to the edge of the water in the spring and fall of 1999. At the top of the south bank was a strip of trees about 10-15 ft. wide with a farm field beyond. On the north side, at the top of the bank there was grass and then a farm field.

Before Dredging - Spring 1999 - *"Good"*

- The average width of the creek was 8 ft.
- The average depth was 11 inches.
- Surface water velocity was .5 ft. per second.
- Woody debris and fallen leaves were abundant in the channel. Gravel and lots of snail shells covered the bottom of the channel near the bridge.
- No erosion problems were detected other than some bank slumping.
- One fish was caught.
- In the spring of 1999 site #6 tested "good" for water quality using the DEQ Benthic Macroinvertebrate Score Sheet. Twelve different kinds of benthic macroinvertebrates were found, including the following sensitive macroinvertebrates; beetle adults, Mayfly nymphs and Gilled Snails.

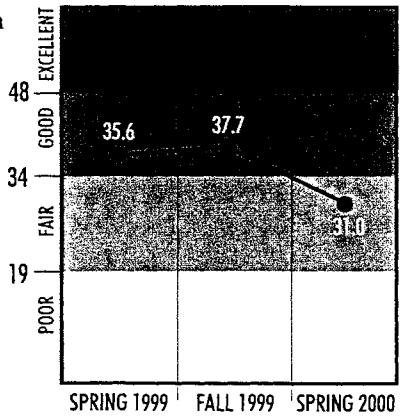
Before Dredging - Fall 1999 - *"Good"*

- The average width of the creek was 8 ft.
- The average depth was 10.6 inches.
- Surface velocity was .03 ft. per second. The property owner noted the water was slow due to a beaver dam about a mile downstream.
- Woody debris and fallen leaves were abundant in the channel. Gravel and snail shells covered the channel bottom near the bridge.
- No new erosion problems were observed.
- Four fish were caught.
- In the fall of 1999 site #6 tested "good" for water quality using the DEQ Benthic Macroinvertebrate Score Sheet. Thirteen different kinds of benthic macroinvertebrates were found, including the following sensitive macroinvertebrates; beetle adults, Caddisfly larvae and Gilled Snails.



After Dredging - Spring 2000 - *"Fair"*

- The average width increased to 11.5 ft.
- The average depth was 1.1 ft.
- Surface water velocity increased to .59 ft. per second.
- All vegetation except some grass had been removed from the north bank.
- Upstream of the private bridge, even the grass was gone. On the south side, only one or two small trees next to the bridge remained. The only vegetation remaining within the drain easement was grass and tree stumps.
- The leaves and woody debris, as well as the gravel and snail shells had been scooped out and removed by machines.
- Erosion was extensive. The entire north bank upstream of the bridge was especially bad. Deep cracks ran down the steep, bare banks.
- No fish were found.
- The site tested "fair" for water quality using the DEQ Benthic Macroinvertebrate Score Sheet. Ten different kinds of benthic macroinvertebrates were collected including the following sensitive macroinvertebrates; beetle adults, Mayfly nymphs and Gilled Snails.



COMPROMISE DRAINAGE PROJECT
- DREDGING SITES -

SITE #7

Site # 7 is directly upstream from the Cade Road Bridge in Lapeer County. Although the banks were steeply sloped in 1999 from previous dredgings in 1957 and again in 1994, the vegetation was thick along both banks and included small trees, shrubs and weeds. On the south side at the top of the bank was at least an acre of grass and weeds in front of a home and yard. Large pine trees were on top of the north bank. Beyond the trees was a yard and a house. Although the vegetation on the banks was thick, the only tall trees were on top of the banks, providing very little shading for the stream.

Before Dredging - Spring 1999 - *"Good"*

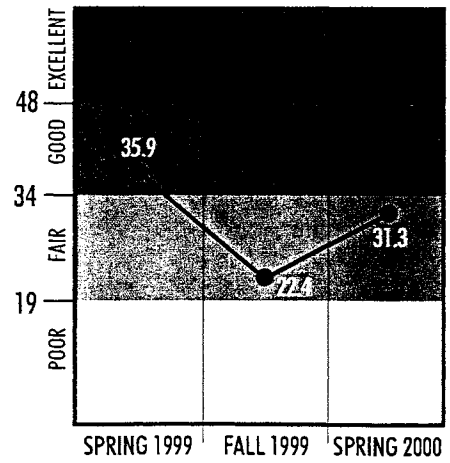
- The average width of the creek was 18 ft.
- The average depth was 1.5 ft..
- Surface water velocity was .14 ft. per second.
- Algae covered approximately 75% of the water surface. Filamentous algae grew in thick masses below the surface. Deep sediment and algae made sampling difficult.
- No woody debris was observed
- No erosion problems were noticed.
- No fish were caught.
- In the spring of 1999 site #6 tested "good" for water quality using the DEQ Benthic Macroinvertebrate Score Sheet. Thirteen different kinds of benthic macroinvertebrates were found, including the following sensitive macroinvertebrates; beetle adults, Caddisfly larvae and Mayfly nymphs.

Before Dredging - Fall 1999 - *"Fair"*

- The average width of the creek was 18 ft.
- The average depth was 3 ft.
- Surface velocity was undetectable.
- Surface algae was gone, but algae remained below the surface.
- No woody debris was observed.
- No new erosion was detected.
- No fish were caught.
- In the fall of 1999 site #6 tested "fair" for water quality using the DEQ Benthic Macroinvertebrate Score Sheet. Six different kinds of macroinvertebrates were found, including the following sensitive macroinvertebrates; beetle adults and Caddisfly larvae.

After Dredging - Spring 2000 - *"Fair"*

- The average width decreased to 8.44 ft. due to sediment carried into channel by erosion. Due to lower water level, measurement was taken at a narrower point on the slope.
- The average depth was 10 inches.
- Surface water velocity increased to .48 ft. per second.
- All vegetation had been stripped from the south bank. The north bank was bare from water's edge to halfway up the bank.
- Surface algae was gone, but a little algae remained below the surface.
- Erosion was extensive. Deep cracks were cut into the sides of the banks from water running down bare slopes. Sediment deposits had formed where each road ditch emptied into the creek. One 10 ft. section downstream from the site had collapsed. At the water line, the banks were being cut away by the movement of the water.
- Four fish were caught.
- The site tested "fair" for water quality using the DEQ Benthic Macroinvertebrate Score Sheet. Twelve different kinds of benthic macroinvertebrates were collected. The only sensitive macroinvertebrates identified were beetle adults and Mayfly nymphs.



MONITORING UPDATES

Because the erosion conditions at Site #7 were so bad, the volunteers decided to periodically check the site until it would be monitored again in the fall of 2000.

Erosion at Site # 7 worsened. After The St. Clair County Soil Erosion and Sedimentation Control Agent *and other citizens complained to the DEQ, the banks were reshaped in June, 2000. Erosion continued even after the June reshaping.*

Although the site was dredged in February, it was not seeded until the end of June. In August, only a little grass was growing on the slopes, algae was returning and the reshaped banks were eroding.

Prairie Grass had been donated to the Intercounty Drain Board *by* Pheasants Forever. *However, it was not planted on the slopes. Instead, it was planted on the top of the banks, except for downstream of Cade Road where it was only planted on the far side of an access road, where it does little to protect the bank from erosion.*

The riprap which had been placed around the face of the new culvert at Site#7 was full of loose dirt and after complaints to DEQ, the riprap had to be replaced.

SUMMARY

- Surface water velocity increased at all six sites.
- The two dredged sites were stripped of most of their stream bank vegetation while the vegetation at the four river restoration sites remained intact.
- Extensive bank erosion occurred at site #6 and Site #7 after they were dredged. No new bank erosion occurred at the four river restoration sites.
- The dredged sites had their banks reshaped only four months after they were dredged because they were eroding and collapsing. Two months after the banks were reshaped, they were eroding again.
- Sediment was already collecting on the bottom of the dredged sites only four months after they were dredged. In spots the sediment was deep enough to make the channel narrower.
- The two sites which have never been dredged have very little sedimentation. The only exception is the silt-island at Site #3, which was formed after the Sanilac-St. Clair Drain was dredged several years ago.
- Algae and weeds were already growing back at the dredged sites five month after they were dredged.
- Only the sites which have never been dredged tested "Excellent" for water quality using the DEQ Benthic Macroinvertebrate Score Sheet. These sites tested "Excellent again in the spring of 2000, after river restoration.
- Only the sites which were dredged in 2000 ranked lower for water quality, suing the DEQ Benthic Macroinvertebrate Score Sheet, after the compromise drainage project was completed. Both of these sites tested "Good' in the spring of 1999 and both only tested "Fair" in the spring of 2000.

CONCLUSION

The data collected for the Mill Creek Volunteer Monitoring Project reveals the harmful effects dredging has had on the water quality and stream bank habitat of Mill Creek. The data also indicates that the river restoration techniques of George Palmiter have been far less harmful. Therefore, the MCVMP volunteers recommend that the 15.25 mile river restoration section of Mill Creek not be dredged.

Regardless of the decision made by the Intercounty Drain Board in June, 2001, the MCVMP will continue to monitor these sites, gather data and issue annual reports.

MCVMP wishes to thank the DEQ staff, District #8 - Michigan United Conservation Clubs, The Izaak Walton League, Tip of the Mitt Watershed Council and the League of Women Voters of the Blue Water Area for their contributions to this project.

For more information about the Mill Creek Volunteer Monitoring Project or to find out how to become a volunteer, contact:

Terry Gill, MCVMP Project Manager, (810)387-3379.

For more information about the Michigan Volunteer Monitoring Program, contact:

Nicole Vidales, Surface Water Quality Division,
Department of Environmental Quality, (517) 241-9534.

APPENDIX E

SUMMARY OF MACROINVERTEBRATE COMMUNITY RANKINGS, 1998-2001

APPENDIX E. SUMMARY OF MACROINVERTABRATE COMMUNITY RANKINGS, 1998-2001

Organization Name	Waterbody Name	Location	Sampling Date	Ranking	Score
Allegan Conservation District	Miller Creek	136th Street	11/8/2000	Excellent	69.8
Central Lake Superior Watershed Partnership	Big Creek	Baldwin Property	11/15/2000	Fair	25.6
Central Lake Superior Watershed Partnership	Big Creek	Baldwin Property	5/19/2000	Fair	26.3
Central Lake Superior Watershed Partnership	Salmon Trout River	Below Lower Dam	6/5/2001	Good	45
Central Lake Superior Watershed Partnership	Salmon Trout River	Below Lower Falls	6/5/2001	Good	43.7
Central Lake Superior Watershed Partnership	Cedar Creek	County Road 480	5/31/2001	Fair	30.4
Central Lake Superior Watershed Partnership	Cedar Creek	County Road 480	11/17/2000	Fair	27.2
Central Lake Superior Watershed Partnership	West Branch Chocolay River	County Road 545	11/10/2000	Fair	25.1
Central Lake Superior Watershed Partnership	West Branch Chocolay River	County Road 545	5/19/2001	Good	41.5
Central Lake Superior Watershed Partnership	Salmon Trout River	East and Main Branch Conf	6/5/2001	Good	45.5
Central Lake Superior Watershed Partnership	Silver Lead Creek	Former Dam	5/1/2001	Good	35.4
Central Lake Superior Watershed Partnership	Silver Lead Creek	Former Dam	11/10/2000	Fair	24.6
Central Lake Superior Watershed Partnership	Silver Lead Creek	Former Dam Upstream	11/10/2000	Fair	24.6
Central Lake Superior Watershed Partnership	Silver Creek	US 41 and M 28	11/10/2000	Fair	23.7
Central Lake Superior Watershed Partnership	Silver Creek	US 41 and M 28	5/31/2001	Fair	26.5
Clinton River Watershed Council	Middle Branch Clinton River	25 Mile Road	9/29/1999	Excellent	54.4
Clinton River Watershed Council	North Branch Clinton River	33 Mile Road	9/30/1999	Excellent	62.4
Clinton River Watershed Council	Red Run Drain	Chicago Street	9/30/1999	Good	34.6
Clinton River Watershed Council	Clinton River	Community Bible Church	5/19/2000	Fair	24.2
Clinton River Watershed Council	Main Branch Clinton River	Dequindre Road	9/25/1999	Good	44
Clinton River Watershed Council	Main Branch Clinton River	Drayton Plains Nature Cent	10/8/1999	Fair	30.3
Clinton River Watershed Council	Main Branch Clinton River	Fowler Road	9/29/1999	Fair	20.6
Clinton River Watershed Council	Middle Branch Clinton River	M-59	10/9/1999	Fair	23
Clinton River Watershed Council	Middle Branch Clinton River	M-59	6/5/1999	Fair	27
Clinton River Watershed Council	Paint Creek	Orion Road	5/26/2000	Fair	20.6
Clinton River Watershed Council	Middle Branch Clinton River	Riverside Glen	6/3/2000	Fair	19.9

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Organization Name	Waterbody Name	Location	Sampling Date	Ranking	Score
Clinton River Watershed Council	Main Branch Clinton River	Riverside Park	9/29/1999	Fair	30.7
Clinton River Watershed Council	North Branch Clinton River	Romeo Plank	5/3/2000	Fair	24.8
Clinton River Watershed Council	Clinton River	Sterling Heights Nature Ce	5/21/2000	Fair	25.3
Clinton River Watershed Council	Stony Creek	Stony Creek Metropark	9/29/1999	Fair	27.6
Clinton River Watershed Council	Stony Creek	Stony Creek Metropark Ups	9/29/1999	Good	45.4
Clinton River Watershed Council	Stony Creek	Tienken Road	9/29/1999	Excellent	60.3
Clinton River Watershed Council	Main Branch Clinton River	Utica Road	5/28/1999	Good	41.6
Clinton River Watershed Council	Main Branch Clinton River	Utica Road	10/2/1999	Good	44
Clinton River Watershed Council	North Branch Clinton River	Wolcott Mills Metropark	9/29/1999	Good	47.4
Friends of the Devils River	South Branch Devils River	Nicholson Hill Road	10/14/1999	Excellent	53.4
Friends of the Devils River	South Branch Devils River	Nicholson Hill Road	6/8/2000	Good	45.2
Friends of the Devils River	South Branch Devils River	Scott Road	11/9/1999	Fair	19.5
Friends of the Devils River	South Branch Devils River	Scott Road	6/8/2000	Fair	19.4
Friends of the Devils River	North Branch Devils River	US 23	11/9/1999	Fair	30.4
Friends of the Devils River	North Branch Devils River	US 23	6/14/2000	Good	36.8
Friends of the Rouge River	Middle Branch Rouge River	10 Mile Road	10/6/2001	Fair	26.6
Friends of the Rouge River	Middle Branch Rouge River	10 Mile Road	5/19/2001	Fair	24.3
Friends of the Rouge River	Bishop Creek	11 Mile Road	10/6/2001	Good	34.1
Friends of the Rouge River	Bishop Creek	11 Mile Road	5/19/2001	Fair	28.7
Friends of the Rouge River	Johnson Creek	5 Mile Road	10/6/2001	Poor	11.4
Friends of the Rouge River	Johnson Creek	5 Mile Road	5/19/2001	Good	43.6
Friends of the Rouge River	Johnson Creek	6 Mile Road	10/6/2001	Poor	9.2
Friends of the Rouge River	Johnson Creek	6 Mile Road	5/19/2001	Good	37.8
Friends of the Rouge River	Middle Branch Rouge River	6 Mile Road	5/19/2001	Poor	13.1
Friends of the Rouge River	Upper Rouge River	8 Mile Road	10/18/1999	Poor	17.2
Friends of the Rouge River	Pebble Creek	8314 Danvers Court	10/6/2001	Fair	30.9

APPENDIX E. SUMMARY OF MACROINVERTABRATE COMMUNITY RANKINGS, 1998-2001

Organization Name	Waterbody Name	Location	Sampling Date	Ranking	Score
Friends of the Rouge River	Pebble Creek	8314 Danvers Court	5/19/2001	Good	40.2
Friends of the Rouge River	Tonquish Creek	Ann Arbor Road	10/24/1999	Poor	15.2
Friends of the Rouge River	Tonquish Creek	Ann Arbor Road	5/19/2001	Poor	13.4
Friends of the Rouge River	Tonquish Creek	Ann Arbor Road	10/6/2001	Poor	15.6
Friends of the Rouge River	Rouge River	Ann Arbor Trail Road	5/13/1999	Poor	16.4
Friends of the Rouge River	Lower Rouge River	Brady Road	10/12/1999	Fair	22.6
Friends of the Rouge River	Fowler Creek	Cherry Hill Road	10/6/2001	Fair	32.3
Friends of the Rouge River	Fowler Creek	Cherry Hill Road	5/19/2001	Fair	29.3
Friends of the Rouge River	Franklin Creek	Franklin Cider Mill Parking	5/19/2001	Fair	28.4
Friends of the Rouge River	Rouge River	Gill Road and Colioy	5/13/1999	Poor	18.8
Friends of the Rouge River	Main Branch Rouge River	Hawthorn Road	5/19/2001	Fair	25.8
Friends of the Rouge River	Main Branch Rouge River	Hawthorn Road	10/6/2001	Fair	23.9
Friends of the Rouge River	Rouge River	Hines Drive	5/13/1999	Fair	29
Friends of the Rouge River	Lower Rouge River	Michigan Street	10/18/1999	Poor	14
Friends of the Rouge River	Fellows Creek	Powell Road	5/19/2001	Fair	31.8
Friends of the Rouge River	Fellows Creek	Powell Road	10/6/2001	Fair	20.1
Friends of the Rouge River	Johnson Creek	Seven Mile Road	10/6/2001	Fair	19.6
Friends of the Rouge River	Johnson Creek	Seven Mile Road	5/19/2001	Fair	26
Friends of the Rouge River	Main Branch Rouge River	Telegraph Road	5/17/2001	Fair	21.2
Friends of the Rouge River	Middle Branch Rouge River	Waterford Bend	10/6/2001	Poor	16.3
Friends of the St. Joe River	McCoy Creek	Buchanan Road	5/18/1999	Fair	30.2
Friends of the St. Joe River	Swan Creek	Dallas Street	5/12/1999	Excellent	49.5
Friends of the St. Joe River	St. Joe River	M-49	5/11/1999	Fair	27.7
Friends of the St. Joe River	Dowagiac Creek	Pucker Street	5/12/1999	Good	35.7
Grand Traverse Bay Watershed Initiative	Kids Creek	11th Street	9/30/2001	Poor	7.2
Grand Traverse Bay Watershed Initiative	Kids Creek	11th Street	6/29/2001	Poor	14.2

APPENDIX E. SUMMARY OF MACROINVERTABRATE COMMUNITY RANKINGS, 1998-2001

Organization Name	Waterbody Name	Location	Sampling Date	Ranking	Score
Grand Traverse Bay Watershed Initiative	Northport Creek	2nd & Rose	9/29/2001	Poor	5.3
Grand Traverse Bay Watershed Initiative	Northport Creek	2nd Street	6/30/2001	Poor	2.1
Grand Traverse Bay Watershed Initiative	Kids Creek	Front Street	5/1/2002	Poor	3.3
Grand Traverse Bay Watershed Initiative	Northport Creek	Johnson Road	4/23/2002	Poor	18.5
Grand Traverse Bay Watershed Initiative	Kids Creek	Maple Street	6/29/2001	Poor	2.1
Grand Traverse Bay Watershed Initiative	Kids Creek	Maple Street	9/30/2001	Poor	0
Grand Traverse Bay Watershed Initiative	Northport Creek	Northport Village	4/23/2002	Fair	27
Grand Traverse Bay Watershed Initiative	Kids Creek	Silver Lake Road	5/1/2002	Fair	27.6
Grand Traverse Bay Watershed Initiative	Leo Creek	South Shore Drive	6/30/2001	Poor	4.3
Grand Traverse Bay Watershed Initiative	Kids Creek	State Hospital	5/1/2002	Poor	16.3
Grand Traverse Bay Watershed Initiative	Leo Creek	Suttons Bay	9/29/2001	Poor	4.2
Grand Traverse Bay Watershed Initiative	Suttons Bay Creek	Suttons Bay Marina	4/22/2002	Good	36.9
Lenawee Conservation District	South Branch Raisin River	Adrian	4/27/2002	Fair	31.9
Lenawee Conservation District	River Raisin	Blood Road	4/27/2002	Good	42.8
Lenawee Conservation District	River Raisin	Boat Launch Bridge	4/27/2002	Good	40.7
Lenawee Conservation District	Little Raisin River	Brewer	4/27/2002	Good	36.8
Lenawee Conservation District	Goose Creek	Brooklyn	4/27/2002	Good	46.1
Lenawee Conservation District	River Raisin	Ida - Maybee Road	4/27/2002	Excellent	55.6
Lenawee Conservation District	River Raisin	M-34	4/27/2002	Good	35.4
Lenawee Conservation District	Evans Creek	Maumee Street	4/27/2002	Good	37.4
Lenawee Conservation District	Saline River	Milan Wilson Park	4/27/2002	Poor	12.6
Lenawee Conservation District	South Branch Saline River	Mill Pond Park	4/27/2002	Fair	30.3
Lenawee Conservation District	South Branch Macon Creek	Petersburg Road	4/27/2002	Excellent	50.6
Lenawee Conservation District	River Raisin	Sharon Hollow	4/27/2002	Good	39.9
Lenawee Conservation District	River Raisin	Telegraph Road	4/27/2002	Good	39.3
Michigan Lakes and Streams Association	North Branch Black River	103rd	10/7/1999	Poor	15.4

APPENDIX E. SUMMARY OF MACROINVERTABRATE COMMUNITY RANKINGS, 1998-2001

Organization Name	Waterbody Name	Location	Sampling Date	Ranking	Score
Michigan Lakes and Streams Association	North Branch Black River	103rd	5/10/2000	Fair	26.2
Michigan Lakes and Streams Association	Spice Bush Creek	104th Avenue	5/10/2000	Good	40.3
Michigan Lakes and Streams Association	Spice Bush Creek	104th Avenue	10/7/1999	Good	42.7
Michigan Lakes and Streams Association	Scott Creek	107th Street	10/7/1999	Good	35.4
Michigan Lakes and Streams Association	Scott Creek	107th Street	5/10/2000	Good	40
Michigan Lakes and Streams Association	North Branch Black River	113th Avenue	10/9/1999	Fair	24.9
Michigan Lakes and Streams Association	North Branch Black River	113th Avenue	5/10/2000	Fair	25.9
Michigan Lakes and Streams Association	Cedar Creek	16th Avenue	5/10/2000	Fair	21.5
Michigan Lakes and Streams Association	Cedar Creek	16th Avenue	7/10/1999	Fair	31.5
Michigan Lakes and Streams Association	Haven and Max Lake Drain	45th Street	10/7/1999	Poor	18
Michigan Lakes and Streams Association	Haven and Max Lake Drain	45th Street	5/10/2000	Good	42
Michigan Lakes and Streams Association	Black River Extension Drain South Br	52nd Street	5/10/2000	Fair	22.5
Michigan Lakes and Streams Association	Black River Extension Drain South Br	52nd Street	7/10/1999	Poor	15.8
Michigan Lakes and Streams Association	Great Bear Lake Drain South Branch	52nd Street	5/10/2000	Fair	32.8
Michigan Lakes and Streams Association	Great Bear Lake Drain South Branch	52nd Street	7/10/1999	Fair	22.5
Michigan Lakes and Streams Association	Barber Creek	54th Street	10/7/1999	Good	37.7
Michigan Lakes and Streams Association	Barber Creek	54th Street	5/10/2000	Good	44.8
Michigan Lakes and Streams Association	Main Branch Black River	54th Street	5/10/2000	Fair	28.4
Michigan Lakes and Streams Association	Main Branch Black River	54th Street	10/7/1999	Good	39.2
Michigan Lakes and Streams Association	Main Branch Black River	60th Avenue	10/7/1999	Good	41.8
Michigan Lakes and Streams Association	Main Branch Black River	70th Street	5/10/2000	Good	44.4
Michigan Lakes and Streams Association	Main Branch Black River	70th Street	7/7/1999	Good	37.6
Michigan Lakes and Streams Association	South Branch Black River	70th Street	10/7/1999	Good	42.5
Michigan Lakes and Streams Association	South Branch Black River	70th Street	5/10/2000	Fair	25
Michigan Lakes and Streams Association	South Branch Black River	Breedsville	7/10/1999	Fair	22.5
Michigan Lakes and Streams Association	South Branch Black River	Breedsville	5/10/2000	Poor	12.3

APPENDIX E. SUMMARY OF MACROINVERTABRATE COMMUNITY RANKINGS, 1998-2001

Organization Name	Waterbody Name	Location	Sampling Date	Ranking	Score
Michigan Lakes and Streams Association	Black River	Tin Shanty Bridge	9/30/2000	Excellent	73.7
Michigan Lakes and Streams Association	South Branch Black River	Village Park, Hamilton Aven	5/10/2000	Poor	18
Michigan Lakes and Streams Association	South Branch Black River	Village Park, Hamilton Aven	7/6/2000	Fair	24.5
Mill Creek Monitoring Project	Mill Creek	Bricker Road	4/21/2001	Good	46.6
Mill Creek Monitoring Project	North Branch Mill Creek	Bricker Road	9/29/2001	Excellent	59
Mill Creek Monitoring Project	South Branch Mill Creek	Cade Road	5/29/1999	Good	43.7
Mill Creek Monitoring Project	South Branch Mill Creek	Cade Road	10/2/1999	Fair	19.4
Mill Creek Monitoring Project	South Branch Mill Creek	Cade Road	5/27/2001	Good	34.2
Mill Creek Monitoring Project	South Branch Mill Creek	Cade Road	6/2/2000	Fair	28.5
Mill Creek Monitoring Project	South Branch Mill Creek	Cade Road	10/7/2000	Good	36
Mill Creek Monitoring Project	South Branch Mill Creek	Cade Road	9/22/2001	Fair	31.1
Mill Creek Monitoring Project	South Branch Mill Creek	Frantz property	10/7/2000	Fair	25.8
Mill Creek Monitoring Project	South Branch Mill Creek	Frantz property	10/7/2001	Fair	29.2
Mill Creek Monitoring Project	South Branch Mill Creek	Frantz property	5/31/1999	Good	38.5
Mill Creek Monitoring Project	South Branch Mill Creek	Frantz property	10/24/1999	Good	36.6
Mill Creek Monitoring Project	South Branch Mill Creek	Frantz property	5/27/2000	Fair	31.1
Mill Creek Monitoring Project	South Branch Mill Creek	Frantz property	6/2/2001	Good	38.5
Mill Creek Monitoring Project	South Branch Mill Creek	Fulton Road	10/13/2001	Fair	29.9
Mill Creek Monitoring Project	South Branch Mill Creek	Fulton Road	5/26/2001	Good	45.6
Mill Creek Monitoring Project	South Branch Mill Creek	Fulton Road	10/8/2000	Good	40.2
Mill Creek Monitoring Project	South Branch Mill Creek	Fulton Road	5/28/1999	Good	36.2
Mill Creek Monitoring Project	South Branch Mill Creek	Fulton Road	5/30/2000	Good	41.4
Mill Creek Monitoring Project	South Branch Mill Creek	Fulton Road	10/2/1999	Fair	26.4
Mill Creek Monitoring Project	South Branch Mill Creek	Jeddo Road	11/7/2001	Excellent	53.8
Mill Creek Monitoring Project	South Branch Mill Creek	Jeddo Road	10/7/2000	Good	46.7
Mill Creek Monitoring Project	South Branch Mill Creek	Jeddo Road	10/2/1999	Fair	32.7

APPENDIX E. SUMMARY OF MACROINVERTABRATE COMMUNITY RANKINGS, 1998-2001

Organization Name	Waterbody Name	Location	Sampling Date	Ranking	Score
Mill Creek Monitoring Project	South Branch Mill Creek	Jeddo Road	5/28/1999	Excellent	51.8
Mill Creek Monitoring Project	South Branch Mill Creek	Jeddo Road	6/2/2001	Excellent	57
Mill Creek Monitoring Project	South Branch Mill Creek	Jeddo Road	6/2/2000	Excellent	48.7
Mill Creek Monitoring Project	South Branch Mill Creek	Jordan Road	5/29/1999	Excellent	51.1
Mill Creek Monitoring Project	South Branch Mill Creek	Jordan Road	10/2/1999	Good	38.5
Mill Creek Monitoring Project	South Branch Mill Creek	Jordan Road	5/27/2000	Good	41.4
Mill Creek Monitoring Project	South Branch Mill Creek	Jordan Road	5/26/2001	Excellent	55.3
Mill Creek Monitoring Project	South Branch Mill Creek	Jordan Road	11/7/2001	Excellent	50.7
Mill Creek Monitoring Project	South Branch Mill Creek	Jordan Road	10/8/2000	Good	46.2
Mill Creek Monitoring Project	South Branch Mill Creek	Norman Road	6/2/1999	Good	40.6
Mill Creek Monitoring Project	South Branch Mill Creek	Norman Road	10/2/1999	Good	37.5
Mill Creek Monitoring Project	South Branch Mill Creek	Norman Road	5/27/2000	Good	36.5
Mill Creek Monitoring Project	South Branch Mill Creek	Norman Road	10/6/2001	Fair	27.7
Mill Creek Monitoring Project	South Branch Mill Creek	Norman Road	6/2/2001	Good	45.1
Mill Creek Monitoring Project	South Branch Mill Creek	Norman Road	10/8/2000	Good	36.4
Mill Creek Monitoring Project	North Branch Mill Creek	Sterling Road	9/29/2001	Fair	31.8
Mill Creek Monitoring Project	North Branch Mill Creek	Sterling Road	4/21/2001	Fair	30.8
Mill Creek Monitoring Project	South Branch Mill Creek	Yale City Park	5/28/2001	Good	44.8
Mill Creek Monitoring Project	South Branch Mill Creek	Yale City Park	5/27/2000	Fair	28.6
Mill Creek Monitoring Project	South Branch Mill Creek	Yale City Park	9/22/2001	Excellent	55.4
Mill Creek Monitoring Project	South Branch Mill Creek	Yale City Park	10/2/1999	Good	37
Mill Creek Monitoring Project	South Branch Mill Creek	Yale City Park	5/25/1999	Fair	27
Mill Creek Monitoring Project	South Branch Mill Creek	Yale City Park	10/12/2000	Good	43.5
Muskegon Conservation District	Silver Creek	Hyde Park Road	11/21/2001	Poor	13.6
Muskegon Conservation District	Duck Creek	Nestrom Road	11/21/2001	Good	38.2
Muskegon Conservation District	Duck Creek	Orshall Road	11/15/2001	Fair	25.4

APPENDIX E. SUMMARY OF MACROINVERTABRATE COMMUNITY RANKINGS, 1998-2001

Organization Name	Waterbody Name	Location	Sampling Date	Ranking	Score
Muskegon Conservation District	Ruddiman Creek	Sherman Road	10/28/2001	Fair	21.3
Muskegon Conservation District	Duck Creek	Simonelli Road	10/29/2001	Fair	27.2
Muskegon Conservation District	Ruddiman Creek	Winchester Street	10/28/2001	Poor	8.3
Muskegon Conservation District	Ryerson Creek	Yuba Street	11/5/2001	Fair	32.1
Northern Tittabawassee River Task Force	Cedar River	Canoe Launch Site	5/19/1999	Excellent	60.2
Northern Tittabawassee River Task Force	North Branch Cedar River	Eaton Road	10/28/1998	Good	41.7
Northern Tittabawassee River Task Force	Cedar River	Gladwin City Park	5/19/1999	Fair	24.8
Northern Tittabawassee River Task Force	Cedar River	North Park	5/22/2001	Excellent	60.7
Oceana County Conservation District	South Branch Pentwater River	104th Avenue	10/23/2000	Fair	24
Oceana County Conservation District	South Branch Pentwater River	104th Avenue	6/12/2000	Good	34.6
Oceana County Conservation District	South Branch Pentwater River	104th Avenue	7/22/1998	Excellent	50.6
Oceana County Conservation District	Huftile Creek	112th Avenue	10/8/2000	Good	34.1
Oceana County Conservation District	Huftile Creek	112th Avenue	8/9/1998	Fair	24.2
Oceana County Conservation District	Huftile Creek	112th Avenue	5/5/1999	Poor	17.1
Oceana County Conservation District	Huftile Creek	112th Avenue	9/26/1999	Poor	14
Oceana County Conservation District	Huftile Creek	112th Avenue	10/4/1999	Poor	5.2
Oceana County Conservation District	Huftile Creek	112th Avenue	6/18/2000	Fair	22
Oceana County Conservation District	Crystal Creek	120th Avenue	7/21/1999	Excellent	57.2
Oceana County Conservation District	Crystal Creek	120th Avenue	10/13/2000	Fair	32
Oceana County Conservation District	Crystal Creek	120th Avenue	10/26/1998	Fair	31.9
Oceana County Conservation District	Crystal Creek	120th Avenue	6/13/2000	Good	34.3
Oceana County Conservation District	Crystal Creek	120th Avenue	4/26/1999	Good	41.5
Oceana County Conservation District	Crystal Creek	120th Avenue	8/12/1998	Good	34
Oceana County Conservation District	Crystal Creek	120th Avenue	9/21/1999	Good	43.8
Oceana County Conservation District	North Branch Pentwater River	120th Avenue	11/8/1999	Fair	30.9
Oceana County Conservation District	North Branch Pentwater River	120th Avenue	6/21/2000	Good	34.8

APPENDIX E. SUMMARY OF MACROINVERTABRATE COMMUNITY RANKINGS, 1998-2001

Organization Name	Waterbody Name	Location	Sampling Date	Ranking	Score
Oceana County Conservation District	North Branch Pentwater River	120th Avenue	10/3/1998	Poor	15
Oceana County Conservation District	North Branch Pentwater River	120th Avenue	10/17/2000	Fair	29.1
Oceana County Conservation District	North Branch Pentwater River	120th Avenue	5/1/1999	Fair	30.5
Oceana County Conservation District	South Branch Pentwater River	120th Avenue	9/24/1999	Good	44.3
Oceana County Conservation District	South Branch Pentwater River	120th Avenue	5/4/1999	Fair	26.6
Oceana County Conservation District	South Branch Pentwater River	120th Avenue	9/29/1998	Fair	28.2
Oceana County Conservation District	South Branch Pentwater River	120th Avenue	6/22/2000	Good	41.3
Oceana County Conservation District	South Branch Pentwater River	120th Avenue	10/4/2000	Excellent	54.6
Oceana County Conservation District	South Branch Pentwater River	140th Avenue	8/12/1998	Good	35.4
Oceana County Conservation District	South Branch Pentwater River	72nd Avenue	5/11/1999	Fair	28.9
Oceana County Conservation District	South Branch Pentwater River	72nd Avenue	6/14/2000	Good	37
Oceana County Conservation District	South Branch Pentwater River	72nd Avenue	10/26/1998	Fair	25.7
Oceana County Conservation District	South Branch Pentwater River	72nd Avenue	10/21/2000	Good	35.5
Oceana County Conservation District	South Branch Pentwater River	72nd Avenue	7/21/1999	Good	41.3
Oceana County Conservation District	South Branch Pentwater River	72nd Avenue	11/9/1999	Fair	22.9
Oceana County Conservation District	South Branch Pentwater River	72nd Avenue	7/29/1998	Fair	28.4
Oceana County Conservation District	Donaldson Creek	84th	11/9/1999	Fair	30.8
Oceana County Conservation District	Donaldson Creek	84th	5/11/1999	Fair	30
Oceana County Conservation District	Donaldson Creek	84th	10/20/2000	Good	39.1
Oceana County Conservation District	Cedar Creek	96th Avenue	6/10/2000	Good	38.1
Oceana County Conservation District	Cedar Creek	96th Avenue	10/8/1999	Good	35
Oceana County Conservation District	Cedar Creek	96th Avenue	5/5/1999	Good	36.2
Oceana County Conservation District	Cedar Creek	96th Avenue	10/3/1998	Fair	29.3
Oceana County Conservation District	Cedar Creek	96th Avenue	7/5/1998	Good	42.8
Oceana County Conservation District	Cedar Creek	96th Avenue	10/1/2000	Good	34.6
Oceana County Conservation District	North Branch Pentwater River	96th Avenue	6/16/2000	Fair	31.5

APPENDIX E. SUMMARY OF MACROINVERTABRATE COMMUNITY RANKINGS, 1998-2001

Organization Name	Waterbody Name	Location	Sampling Date	Ranking	Score
Oceana County Conservation District	North Branch Pentwater River	96th Avenue	11/8/1999	Good	35.4
Oceana County Conservation District	North Branch Pentwater River	96th Avenue	10/9/2000	Fair	32.9
Oceana County Conservation District	North Branch Pentwater River	96th Avenue	5/1/1999	Poor	18.6
Oceana County Conservation District	North Branch Pentwater River	96th Avenue	10/3/1998	Poor	10.5
Oceana County Conservation District	North Branch Pentwater River	96th Avenue	7/21/1999	Good	37.2
Oceana County Conservation District	North Branch Pentwater River	Above Hart School Property	10/7/1998	Fair	29.1
Oceana County Conservation District	South Branch Pentwater River	Earl Petersons property	5/5/1999	Good	37
Oceana County Conservation District	South Branch Pentwater River	Earl Petersons property	10/1/1999	Good	37.1
Oceana County Conservation District	South Branch Pentwater River	Earl Petersons property	6/3/1998	Good	40.5
Oceana County Conservation District	South Branch Pentwater River	Earl Petersons property	10/2/1998	Good	42.1
Oceana County Conservation District	South Branch Pentwater River	Earl Petersons property	5/5/2000	Good	35.1
Oceana County Conservation District	South Branch Pentwater River	Earl Petersons property	10/4/2000	Good	46.1
Oceana County Conservation District	North Branch Pentwater River	East of Hart School Propert	10/4/2000	Fair	33.2
Oceana County Conservation District	North Branch Pentwater River	East of Hart School Propert	10/8/1999	Fair	29.4
Oceana County Conservation District	North Branch Pentwater River	East of Hart School Propert	5/21/1999	Fair	31.3
Oceana County Conservation District	Norht Branch Pentwater River	East of Heart School Prope	6/8/2000	Excellent	50
Oceana County Conservation District	North Branch Pentwater River	Hammet Road	6/8/2000	Good	36.5
Oceana County Conservation District	North Branch Pentwater River	Hammet Road	10/8/1999	Excellent	51.6
Oceana County Conservation District	North Branch Pentwater River	Hammet Road	5/21/1999	Fair	30.7
Oceana County Conservation District	North Branch Pentwater River	Hammet Road	10/4/2000	Fair	31.6
Oceana County Conservation District	North Branch Pentwater River	Hammet Road	10/7/1998	Good	37.4
Oceana County Conservation District	North Branch Pentwater River	Hammet Road	7/15/1998	Fair	20.8
Oceana County Conservation District	North Branch Pentwater River	Hart School Property	7/15/1998	Fair	29.1
Oceana County Conservation District	South Branch Pentwater River	Henry Knipers House	10/14/1999	Fair	30.3
Oceana County Conservation District	South Branch Pentwater River	Henry Knipers House	5/14/1999	Fair	24.1
Oceana County Conservation District	South Branch Pentwater River	Henry Knipers House	7/21/1999	Excellent	55.6

APPENDIX E. SUMMARY OF MACROINVERTABRATE COMMUNITY RANKINGS, 1998-2001

Organization Name	Waterbody Name	Location	Sampling Date	Ranking	Score
Oceana County Conservation District	South Branch Pentwater River	Henry Knipers House	9/15/1998	Good	40.4
Oceana County Conservation District	South Branch Pentwater River	Mike Flynn's property	10/6/2000	Good	34.7
Oceana County Conservation District	South Branch Pentwater River	Mike Flynn's property	10/15/1998	Fair	31
Oceana County Conservation District	South Branch Pentwater River	Mike Flynn's property	5/19/1999	Fair	33.3
Oceana County Conservation District	South Branch Pentwater River	Mike Flynn's property	6/12/2000	Fair	31.3
Oceana County Conservation District	South Branch Pentwater River	Mike Flynn's property	9/30/1999	Good	37.3
Oceana County Conservation District	Hart Dam	North of Hart Dam Pool	6/22/2000	Good	37.9
Oceana County Conservation District	Hart Dam	North of Hart Dam Pool	9/28/2000	Good	39.5
Oceana County Conservation District	Hart Dam	North of Hart Dam Pool	5/7/1999	Good	37.7
Oceana County Conservation District	Hart Dam	North of Hart Dam Pool	9/30/1999	Good	44.4
Oceana County Conservation District	Hart Dam	North of Hart Dam Pool	9/22/1998	Good	36.5
Oceana County Conservation District	Cedar Creek	Oceana Drive	5/5/1999	Excellent	49.3
Oceana County Conservation District	Cedar Creek	Oceana Drive	7/5/1998	Good	36.2
Oceana County Conservation District	Cedar Creek	Oceana Drive	10/8/1999	Fair	28.8
Oceana County Conservation District	Cedar Creek	Oceana Drive	10/3/1998	Good	42.7
Oceana County Conservation District	Cedar Creek	Oceana Drive	6/10/2000	Good	37.3
Oceana County Conservation District	Cedar Creek	Oceana Drive	10/13/2000	Good	45
Oceana County Conservation District	Donaldson Creek	Polk Road	5/5/2000	Fair	33.8
Oceana County Conservation District	Donaldson Creek	Polk Road	10/1/1999	Fair	26.2
Oceana County Conservation District	Donaldson Creek	Polk Road	5/5/1999	Good	41.9
Oceana County Conservation District	Donaldson Creek	Polk Road	10/2/1998	Fair	33.8
Oceana County Conservation District	Donaldson Creek	Polk Road	6/3/1998	Good	35.1
Oceana County Conservation District	Donaldson Creek	Polk Road	10/4/2000	Fair	28.8
Oceana County Conservation District	Huftile Creek	Polk Road	9/15/1998	Good	40.6
Oceana County Conservation District	Huftile Creek	Polk Road	7/22/1998	Fair	29.1
Oceana County Conservation District	Huftile Creek	Polk Road	6/12/2000	Good	36.4

APPENDIX E. SUMMARY OF MACROINVERTABRATE COMMUNITY RANKINGS, 1998-2001

Organization Name	Waterbody Name	Location	Sampling Date	Ranking	Score
Oceana County Conservation District	Huftile Creek	Polk Road	10/14/1999	Fair	28.4
Oceana County Conservation District	Huftile Creek	Polk Road	5/14/1999	Fair	30.9
Oceana County Conservation District	Huftile Creek	Polk Road	10/23/2000	Fair	25.2
Oceana County Conservation District	Russel Creek	South end of football field	9/26/2000	Good	39.8
Oceana County Conservation District	Russel Creek	South end of football field	5/30/2000	Good	35.4
Oceana County Conservation District	Russel Creek	South end of football field	4/28/1999	Good	42
Oceana County Conservation District	Russel Creek	South end of football field	9/23/1999	Good	36.9
Oceana County Conservation District	Huftile Creek	Tyler Road	6/18/2000	Fair	25.3
Oceana County Conservation District	Huftile Creek	Tyler Road	10/8/1998	Fair	27.1
Oceana County Conservation District	Huftile Creek	Tyler Road	9/26/1998	Fair	24.2
Oceana County Conservation District	Huftile Creek	Tyler Road	10/17/2000	Good	42
Oceana County Conservation District	Huftile Creek	Tyler Road	8/9/1998	Fair	26.5
Oceana County Conservation District	South Branch Pentwater River	Tyler Road	6/13/2000	Fair	24.1
Oceana County Conservation District	South Branch Pentwater River	Tyler Road	9/21/1999	Excellent	52.8
Oceana County Conservation District	South Branch Pentwater River	Tyler Road	4/26/1999	Fair	33.4
Oceana County Conservation District	South Branch Pentwater River	Tyler Road	10/26/1998	Fair	26.5
Oceana County Conservation District	South Branch Pentwater River	Tyler Road	10/13/2000	Good	35.2
River Raisin Watershed Council	South Branch River Raisin	Benner Road	4/28/2001	Good	36.1
River Raisin Watershed Council	River Raisin	Blood Road	4/28/2001	Excellent	53.3
River Raisin Watershed Council	South Branch River Raisin	Heritage Park	4/28/2001	Fair	31.9
River Raisin Watershed Council	River Raisin	Ida Maybe Bridge	4/28/2001	Good	37.9
River Raisin Watershed Council	Evans Creek	Maumee Street	4/28/2001	Good	47.6
River Raisin Watershed Council	Saline River	Milan Park	4/28/2001	Fair	25.6
River Raisin Watershed Council	Saline River	Saline River Drive	4/28/2001	Fair	18.9
River Raisin Watershed Council	River Raisin	Telegraph Road	4/28/2001	Fair	33.7
Shiawassee River Task Force	Patterson Drain	Fish Lake Road	11/17/2001	Fair	25.1

APPENDIX E. SUMMARY OF MACROINVERTABRATE COMMUNITY RANKINGS, 1998-2001

Organization Name	Waterbody Name	Location	Sampling Date	Ranking	Score
Shiawassee River Task Force	Unnamed Tributary to Shiawassee Ri	Milford Road	11/17/2001	Good	44.7
Tip of the Mitt Watershed Council	Main Branch Boyne River	Dam Road	5/19/2000	Fair	28.9
Tip of the Mitt Watershed Council	Main Branch Boyne River	Dam Road	10/14/1999	Good	37.5
Tip of the Mitt Watershed Council	South Branch Boyne River	M-75	5/16/2000	Good	37.7
Tip of the Mitt Watershed Council	South Branch Boyne River	M-75	10/10/1999	Fair	21.9
Tip of the Mitt Watershed Council	North Branch Boyne River	US-131	10/10/1999	Fair	31.9
University of Michigan - Flint River Watershed Council	Squaw Creek	Barnes Road	9/25/1999	Poor	12.2
University of Michigan - Flint River Watershed Council	Squaw Creek	Barnes Road	4/2/2001	Good	35.5
University of Michigan - Flint River Watershed Council	Squaw Creek	Barnes Road	10/3/2001	Fair	24
University of Michigan - Flint River Watershed Council	Squaw Creek	Barnes Road	6/5/1999	Poor	17.5
University of Michigan - Flint River Watershed Council	Springbank Creek	Brigham Road	5/6/2000	Good	34
University of Michigan - Flint River Watershed Council	Springbank Creek	Brigham Road	9/25/1999	Good	38.3
University of Michigan - Flint River Watershed Council	Gilkey Creek	Burroughs Park	9/29/2001	Poor	15.3
University of Michigan - Flint River Watershed Council	Gilkey Creek	Burrough's Park	6/5/1999	Fair	29.5
University of Michigan - Flint River Watershed Council	Gilkey Creek	Burrough's Park	9/18/1999	Poor	11.2
University of Michigan - Flint River Watershed Council	Gilkey Creek	Burrough's Park	4/28/2001	Poor	5.2
University of Michigan - Flint River Watershed Council	Gilkey Creek	Burrough's Park	9/9/1999	Fair	21.5
University of Michigan - Flint River Watershed Council	Gilkey Creek	Burrough's Park	10/11/2000	Poor	18.7
University of Michigan - Flint River Watershed Council	Misteguay Creek	Burt Road	9/29/2001	Excellent	59.7
University of Michigan - Flint River Watershed Council	Misteguay Creek	Calkins Road	5/6/2000	Good	40
University of Michigan - Flint River Watershed Council	Misteguay Creek	Calkins Road	9/18/1999	Fair	32
University of Michigan - Flint River Watershed Council	Brent Run	Carpenter Road	9/18/1999	Fair	20.2
University of Michigan - Flint River Watershed Council	Brent Run	Carpenter Road	10/3/2000	Poor	10.2
University of Michigan - Flint River Watershed Council	Kearsley Creek	County Line Road	10/3/2001	Good	43.5
University of Michigan - Flint River Watershed Council	Kearsley Creek	County Line Road	10/11/2000	Fair	32.5
University of Michigan - Flint River Watershed Council	Kearsley Creek	County Line Road	4/28/2001	Good	40.8

APPENDIX E. SUMMARY OF MACROINVERTABRATE COMMUNITY RANKINGS, 1998-2001

Organization Name	Waterbody Name	Location	Sampling Date	Ranking	Score
University of Michigan - Flint River Watershed Council	Kearsley Creek	County Line Road	9/18/1999	Fair	21.2
University of Michigan - Flint River Watershed Council	Butternut Creek	Cummings Center Park	9/18/1999	Poor	10.5
University of Michigan - Flint River Watershed Council	Butternut Creek	Cummings Center Park	4/28/2001	Good	39.9
University of Michigan - Flint River Watershed Council	Butternut Creek	Cummings Center Park	9/29/2001	Excellent	49.4
University of Michigan - Flint River Watershed Council	Butternut Creek	Cummings Center Park	5/13/2000	Good	39.4
University of Michigan - Flint River Watershed Council	Butternut Creek	Cummings Center Park	6/5/1999	Fair	31.9
University of Michigan - Flint River Watershed Council	Thread Creek	Dort Highway	6/5/1999	Fair	23.2
University of Michigan - Flint River Watershed Council	Thread Creek	Dort Highway	9/9/1999	Good	37.4
University of Michigan - Flint River Watershed Council	Thread Creek	Dort Highway	9/29/2001	Fair	28.6
University of Michigan - Flint River Watershed Council	Thread Creek	Dort Highway	4/28/2001	Fair	24.3
University of Michigan - Flint River Watershed Council	Thread Creek	Dort Highway	9/18/1999	Fair	33.4
University of Michigan - Flint River Watershed Council	Thread Creek	Dort Highway	5/6/2000	Poor	11.5
University of Michigan - Flint River Watershed Council	Hasler Creek	Elba Road	10/4/2000	Fair	19.3
University of Michigan - Flint River Watershed Council	Hasler Creek	Elba Road	6/5/1999	Good	44.8
University of Michigan - Flint River Watershed Council	Hasler Creek	Elba Road	5/6/2000	Good	34.5
University of Michigan - Flint River Watershed Council	Hasler Creek	Elba Road	9/25/1999	Fair	31.3
University of Michigan - Flint River Watershed Council	Hasler Creek	Elba Road	5/2/2001	Poor	17.8
University of Michigan - Flint River Watershed Council	Hasler Creek	Elba Road Bridge	10/3/2001	Fair	32.5
University of Michigan - Flint River Watershed Council	Butternut Creek	Farrand Road	5/2/2001	Good	47.9
University of Michigan - Flint River Watershed Council	Butternut Creek	Farrand Road	9/29/2001	Good	34.6
University of Michigan - Flint River Watershed Council	Butternut Creek	Farrand Road	5/13/2000	Good	42.8
University of Michigan - Flint River Watershed Council	Kearsley Creek	For-Mar Nature Preserve	4/28/2001	Fair	23.2
University of Michigan - Flint River Watershed Council	Kearsley Creek	For-Mar Nature Preserve	5/12/1999	Fair	23.5
University of Michigan - Flint River Watershed Council	Hasler Creek	Hasler Lake Road	9/25/1999	Fair	29.8
University of Michigan - Flint River Watershed Council	North Branch Flint River	M-90	9/25/1999	Fair	19.8
University of Michigan - Flint River Watershed Council	North Branch Flint River	M-90	6/5/1999	Poor	6

APPENDIX E. SUMMARY OF MACROINVERTABRATE COMMUNITY RANKINGS, 1998-2001

Organization Name	Waterbody Name	Location	Sampling Date	Ranking	Score
University of Michigan - Flint River Watershed Council	North Branch Flint River	M-90	4/28/2001	Poor	2.1
University of Michigan - Flint River Watershed Council	North Branch Flint River	M-90	9/7/1999	Fair	31.9
University of Michigan - Flint River Watershed Council	Pine Run	Marshal Road	9/29/2001	Good	43
University of Michigan - Flint River Watershed Council	Pine Run	Marshall Road	5/6/2000	Good	37.2
University of Michigan - Flint River Watershed Council	Pine Run	Marshall Road	6/12/1999	Fair	32.4
University of Michigan - Flint River Watershed Council	Pine Run	Marshall Road	9/25/1999	Good	38.6
University of Michigan - Flint River Watershed Council	Pine Run	Marshall Road	4/28/2001	Good	39.3
University of Michigan - Flint River Watershed Council	Pine Run	Marshall Road	9/9/1999	Good	42.9
University of Michigan - Flint River Watershed Council	Brent Run	McKinley Road	10/3/2001	Good	38.6
University of Michigan - Flint River Watershed Council	Brent Run	McKinley Road	5/2/2001	Fair	33.6
University of Michigan - Flint River Watershed Council	Brent Run	McKinley Road	10/4/2000	Fair	33.7
University of Michigan - Flint River Watershed Council	Brent Run	McKinley Road	6/5/1999	Good	43.3
University of Michigan - Flint River Watershed Council	Brent Run	McKinley Road	9/25/1999	Good	38.6
University of Michigan - Flint River Watershed Council	Flint River	McKinley Road	4/28/2001	Fair	27.5
University of Michigan - Flint River Watershed Council	Flint River	McKinley Road	5/13/2000	Fair	26
University of Michigan - Flint River Watershed Council	Flint River	McKinley Road	9/18/1999	Good	34.8
University of Michigan - Flint River Watershed Council	Swartz Creek	MI School for the Deaf	6/5/1999	Fair	27.9
University of Michigan - Flint River Watershed Council	Swartz Creek	MI School for the Deaf	5/13/2000	Poor	11.3
University of Michigan - Flint River Watershed Council	Swartz Creek	MI School for the Deaf	5/2/2001	Poor	18
University of Michigan - Flint River Watershed Council	Swartz Creek	MI School for the Deaf	9/18/1999	Poor	5.1
University of Michigan - Flint River Watershed Council	Swartz Creek	Michigan School for the De	10/3/2001	Poor	10.2
University of Michigan - Flint River Watershed Council	Evergreen Creek	Millington Road	9/18/1999	Fair	30
University of Michigan - Flint River Watershed Council	Pine Run	Morgan Road	5/6/2000	Good	42.5
University of Michigan - Flint River Watershed Council	Pine Run	Morgan Road	9/18/1999	Fair	22.7
University of Michigan - Flint River Watershed Council	Silver Creek	Morseville Road	4/28/2001	Fair	32
University of Michigan - Flint River Watershed Council	Silver Creek	Morseville Road	9/29/2001	Fair	22.6

APPENDIX E. SUMMARY OF MACROINVERTABRATE COMMUNITY RANKINGS, 1998-2001

Organization Name	Waterbody Name	Location	Sampling Date	Ranking	Score
University of Michigan - Flint River Watershed Council	Farmers Creek	North of gage station	10/4/2000	Good	43.2
University of Michigan - Flint River Watershed Council	Farmers Creek	North of gage station	6/5/1999	Excellent	48.1
University of Michigan - Flint River Watershed Council	Farmers Creek	North of gage station	5/6/2000	Fair	31.6
University of Michigan - Flint River Watershed Council	Farmers Creek	North of Gage Station	10/3/2001	Good	38.3
University of Michigan - Flint River Watershed Council	Farmers Creek	North of gage station	9/25/1999	Fair	32.6
University of Michigan - Flint River Watershed Council	Farmers Creek	North of gage station	4/28/2001	Good	35.2
University of Michigan - Flint River Watershed Council	Flint River	North of Richfield Center	10/4/2000	Fair	22.4
University of Michigan - Flint River Watershed Council	Flint River	North of Richfield Center	9/18/1999	Good	42.2
University of Michigan - Flint River Watershed Council	Flint River	North of Richfield Center	5/2/2001	Poor	15.4
University of Michigan - Flint River Watershed Council	Flint River	North of Richfield Center	6/12/1999	Good	41.1
University of Michigan - Flint River Watershed Council	Flint River	North of Richfield Center	9/29/2001	Fair	29.9
University of Michigan - Flint River Watershed Council	Indian Creek	Peck Road	5/2/2001	Poor	7.1
University of Michigan - Flint River Watershed Council	Swartz Creek	Thompson Road	10/11/2000	Excellent	51
University of Michigan - Flint River Watershed Council	Swartz Creek	Thompson Road	9/25/1999	Fair	25.4
University of Michigan - Flint River Watershed Council	Swartz Creek	Thompson Road	5/6/2000	Fair	25.7
University of Michigan - Flint River Watershed Council	Plum Creek	Valentine Road	9/29/2001	Fair	30.7
University of Michigan - Flint River Watershed Council	Plum Creek	Valentine Road	4/28/2001	Good	34.7
University of Michigan - Flint River Watershed Council	Plum Creek	Valentine Road	6/12/1999	Poor	14.4
University of Michigan - Flint River Watershed Council	Plum Creek	Valentine Road	10/4/2000	Fair	31.5
University of Michigan - Flint River Watershed Council	Plum Creek	Valentine Road	5/6/2000	Fair	29
University of Michigan - Flint River Watershed Council	Plum Creek	Valentine Road	9/18/1999	Fair	33.1
University of Michigan - Flint River Watershed Council	Plum Creek	Valentine Road	9/9/1999	Good	35.4
University of Michigan - Flint River Watershed Council	Thread Creek	Valentine Road	4/28/2001	Good	40.8
University of Michigan - Flint River Watershed Council	Thread Creek	Valentine Road	10/11/2000	Good	46.8
University of Michigan - Flint River Watershed Council	Thread Creek	Valentine Road	10/6/1999	Good	41.7
University of Michigan - Flint River Watershed Council	Thread Creek	Valentine Road	5/13/2000	Good	44.1

APPENDIX E. SUMMARY OF MACROINVERTABRATE COMMUNITY RANKINGS, 1998-2001

Organization Name	Waterbody Name	Location	Sampling Date	Ranking	Score
University of Michigan - Flint River Watershed Council	Misteguay Creek	West Burt Road	9/18/1999	Poor	9
University of Michigan - Flint River Watershed Council	Misteguay Creek	West Burt Road	6/5/1999	Good	46.6
University of Michigan - Flint River Watershed Council	Misteguay Creek	West Burt Road	4/26/2001	Good	41.2
University of Michigan - Flint River Watershed Council	Misteguay Creek	West Burt Road	5/6/2000	Fair	24.3
University of Michigan - Flint River Watershed Council	Flint River	Wilder Road	10/11/2000	Excellent	54.2
University of Michigan - Flint River Watershed Council	South Branch Flint River	Wilder Road	9/18/1999	Good	43.7
University of Michigan - Flint River Watershed Council	South Branch Flint River	Wilder Road	6/5/1999	Excellent	55.2
University of Michigan - Flint River Watershed Council	South Branch Flint River	Wilder Road	9/29/2001	Excellent	53.2
University of Michigan - Flint River Watershed Council	South Branch Flint River	Wilder Road	5/2/2001	Excellent	57.4
West Michigan Environmental Action Council	Emmons Creek	76th and 84th Street, off Th	5/6/2000	Good	36.1
West Michigan Environmental Action Council	Mill Creek	Comstock Park	5/6/2000	Fair	33.8
West Michigan Environmental Action Council	Indian Mill Creek	Downstream of Alpine Aven	5/6/2000	Fair	19.5
West Michigan Environmental Action Council	Duck Creek	Freeport South of 100th Str	5/6/2000	Excellent	52.9
West Michigan Environmental Action Council	Black Creek	Podunk Avenue and 17 Mil	5/6/2000	Good	35.9
West Michigan Environmental Action Council	Honey Creek	Seidman Park (off Conserv	5/6/2000	Good	34.2
West Michigan Environmental Action Council	McCord Creek	Whitneyville Road between	5/6/2000	Good	47.4

APPENDIX F

SUMMARY OF CHEMICAL ANALYSES, 1998-2001

APPENDIX F. SUMMARY OF CHEMICAL ANALYSIS, 1998-2001

Organization Name: Clinton River Watershed Council

Waterbody Name	Location	Sampling Date	Total Phosphorus (ug/L)	Nitrate (ug/L)	Turbidity (NTU)	Soluble Reactive Phosphorus (ug/L)
Main Branch Clinton River	Shadyside Park	5/3/2000	1.0			
North Branch Clinton River	Romeo Plank	5/3/2000	1	3	20	

Organization Name: Friends of the Devils River

Waterbody Name	Location	Sampling Date	Total Phosphorus (ug/L)	Nitrate (ug/L)	Turbidity (NTU)	Soluble Reactive Phosphorus (ug/L)
Mainstem of the Devils River	Hardesty Road	11/8/1999	50	180		

Organization Name: Michigan Lakes and Streams Association

Waterbody Name	Location	Sampling Date	Total Phosphorus (ug/L)	Nitrate (ug/L)	Turbidity (NTU)	Soluble Reactive Phosphorus (ug/L)
Barber Creek	54th Street	7/7/1999	48.83	22.36	2.3	16.27
Barber Creek	54th Street	9/16/1999	41.89	13.54	11.0	10.68
Barber Creek	54th Street	3/21/2000	39.91	17.93	11.0	8.97
Barber Creek	54th Street	5/10/2000	94.84	17.40	5.0	41.12
Barber Creek	54th Street	6/29/2000	83.31	18.80	4.1	31.08
Black River Extension Drain South Br	52nd Street	7/7/1999	36.29	13.27	4.1	0.30
Black River Extension Drain South Br	52nd Street	6/29/2000	49.34	26.36	6.3	10.18
Black River Extension Drain South Br	52nd Street	3/21/2000	75.93	135.31	24.5	0.30
Black River Extension Drain South Br	52nd Street	5/10/2000	104.50	26.96	11.0	0.30
Black River Extension Drain South Br	52nd Street	9/16/1999	37.12	3.48	16.0	0.30
Cedar Creek	16th Avenue	6/29/2000	72.41	195.33	7.75	25.67
Cedar Creek	16th Avenue	7/7/1999	74.54	177.18	4.4	24.59
Cedar Creek	16th Avenue	6/16/1999	55.04	239.73	14.0	8.88
Cedar Creek	16th Avenue	3/21/2000	32.46	133.79	13.0	2.90
Cedar Creek	16th Avenue	5/10/2000	110.15	220.82	16.0	6.98
Great Bear Lake Drain South Branch	52nd Street	7/7/1999	64.93	12.12	7.5	5.23
Great Bear Lake Drain South Branch	52nd Street	6/29/2000	74.83	81.94	12.0	11.41
Great Bear Lake Drain South Branch	52nd Street	5/10/2000	161.29	47.41	45.0	0.30
Great Bear Lake Drain South Branch	52nd Street	9/16/1999	39.29	4.41	17.0	0.30

APPENDIX F. SUMMARY OF CHEMICAL ANALYSIS, 1998-2001

Organization Name: Michigan Lakes and Streams Association

Waterbody Name	Location	Sampling Date	Total Phosphorus (ug/L)	Nitrate (ug/L)	Turbidity (NTU)	Soluble Reactive Phosphorus (ug/L)
Great Bear Lake Drain South Branch	52nd Street	3/21/2000	65.50	43.67	13.5	11.37
Haven and Max Lake Drain	45th Street	6/29/2000	139.75	21.55	17.0	51.35
Haven and Max Lake Drain	45th Street	5/10/2000	97.56	22.26	12.0	24.06
Haven and Max Lake Drain	45th Street	9/16/1999	67.92	14.01	14.0	11.78
Haven and Max Lake Drain	45th Street	7/7/1999	154.29	30.77	15.0	32.18
Haven and Max Lake Drain	45th Street	3/21/2000	62.79	7.89	13.0	0.30
Main Branch Black River	70th Street	5/10/2000	107.53	68.59	14.0	0.30
Main Branch Black River	70th Street	3/21/2000	46.18	68.36	14.0	0.30
Main Branch Black River	70th Street	9/16/1999	41.13	94.90	14.0	0.30
Main Branch Black River	70th Street	7/7/1999	50.40	75.49	3.5	8.70
Main Branch Black River	54th Street	5/10/2000	67.92	24.14	5.0	0.30
Main Branch Black River	70th Street	6/29/2000	69.82	39.04	6.25	17.62
Main Branch Black River	54th Street	9/16/1999	49.48	17.35	12.0	9.29
Main Branch Black River	54th Street	6/29/2000	58.90	32.66	3.9	19.52
Main Branch Black River	54th Street	7/7/1999	59.78	26.80	3.2	21.97
Main Branch Black River	60th Avenue	6/29/2000	85.30	30.38	3.2	17.64
Main Branch Black River	60th Avenue	5/10/2000	99.95	39.52	7.0	0.30
Main Branch Black River	60th Avenue	3/21/2000	36.55	40.11	11.0	0.30
Main Branch Black River	60th Avenue	9/16/1999	46.58	12.93	12.0	4.86
Main Branch Black River	60th Avenue	7/7/1999	54.32	25.82	3.5	14.18
Main Branch Black River	54th Street	3/21/2000	30.51	58.08	11.0	0.30
North Branch Black River	113th Avenue	5/10/2000	105.19	85.89	6.0	27.67
North Branch Black River	113th Avenue	6/29/2000	85.61	83.57	6.1	35.87
North Branch Black River	103rd	7/7/1999	92.21	156.48	8.0	14.09
North Branch Black River	103rd	9/16/1999	61.74	139.45	13.0	3.12
North Branch Black River	103rd	3/21/2000	68.86	110.60	15.5	5.16

APPENDIX F. SUMMARY OF CHEMICAL ANALYSIS, 1998-2001

Organization Name: Michigan Lakes and Streams Association

Waterbody Name	Location	Sampling Date	Total Phosphorus (ug/L)	Nitrate (ug/L)	Turbidity (NTU)	Soluble Reactive Phosphorus (ug/L)
North Branch Black River	103rd	6/29/2000	96.65	112.71	8.7	31.44
North Branch Black River	103rd	5/10/2000	108.60	144.32	12.0	24.39
North Branch Black River	113th Avenue	3/21/2000	65.00	73.92	15.0	4.79
North Branch Black River	113th Avenue	7/7/1999	83.13	81.73	5.8	9.94
North Branch Black River	113th Avenue	9/16/1999	71.06	71.81	14.0	2.95
Scott Creek	107th Street	6/29/2000	49.07	112.50	5.5	8.96
Scott Creek	107th Street	9/16/1999	43.73	220.79	12.0	0.30
Scott Creek	107th Street	3/21/2000	27.84	104.64	13.0	0.30
Scott Creek	107th Street	5/10/2000	84.74	176.84	8.0	0.30
Scott Creek	107th Street	7/7/1999	53.95	158.04	4.7	4.00
South Branch Black River	Breedsville	7/7/1999	91.78	4.39	18.0	0.30
South Branch Black River	Breedsville	9/16/1999	84.81	1.64	25.0	0.30
South Branch Black River	Breedsville	3/21/2000	54.74	75.40	19.5	0.30
South Branch Black River	Breedsville	6/29/2000	101.04	27.71	20.0	10.02
South Branch Black River	Village Park, Hamilton Aven	6/29/2000	76.03	29.93	11.0	12.73
South Branch Black River	Breedsville	5/10/2000	114.17	20.62	19.0	0.30
South Branch Black River	Village Park, Hamilton Aven	9/16/1999	46.38	8.54	16.0	0.30
South Branch Black River	Village Park, Hamilton Aven	5/10/2000	109.59	11.90	14.0	0.30
South Branch Black River	70th Street	7/7/1999	73.12	45.76	6.3	24.38
South Branch Black River	Village Park, Hamilton Aven	7/7/1999	71.79	11.23	11.0	2.56
South Branch Black River	70th Street	9/16/1999	53.80	41.78	13.0	6.96
South Branch Black River	70th Street	3/21/2000	101.29	70.57	42.0	1.35
South Branch Black River	70th Street	5/10/2000	148.21	43.91	34.0	10.89
South Branch Black River	70th Street	6/29/2000	89.94	71.08	12.0	25.64
South Branch Black River	Village Park, Hamilton Aven	3/21/2000	34.68	51.87	16.0	0.30
Spice Bush Creek	104th Avenue	7/7/1999	42.87	28.80	4.6	0.30

APPENDIX F. SUMMARY OF CHEMICAL ANALYSIS, 1998-2001

Organization Name: Michigan Lakes and Streams Association

Waterbody Name	Location	Sampling Date	Total Phosphorus (ug/L)	Nitrate (ug/L)	Turbidity (NTU)	Soluble Reactive Phosphorus (ug/L)
Spice Bush Creek	104th Avenue	9/16/1999	49.88	35.25	12.0	0.30
Spice Bush Creek	104th Avenue	3/21/2000	30.39	51.64	13.0	1.22
Spice Bush Creek	104th Avenue	5/10/2000	95.33	22.26	11.0	0.30
Spice Bush Creek	104th Avenue	6/29/2000	70.15	36.29	8.5	19.16

Organization Name: Muskegon Conservation District

Waterbody Name	Location	Sampling Date	Total Phosphorus (ug/L)	Nitrate (ug/L)	Turbidity (NTU)	Soluble Reactive Phosphorus (ug/L)
Bear Creek	McMillan Road	2/5/2001	50	274		
Bear Creek	McMillan Road	1/23/2001	30	240		
Bear Creek	Giles Road	2/6/2001	60	375		
Bear Creek	Giles Road	1/23/2001	40	350		
Bear Creek	Giles Road	1/9/2001	40	330		
Bear Creek	McMillan Road	2/19/2001	<20	180		
Duck Creek	Orshell Road	1/9/2001	20	250		
Ruddiman Creek	Glenside Drive	1/9/2001	30	2040		
Ruddiman Creek	South Shore Drive	1/9/2001	40	1620		
Ryerson Creek	Getty Street	1/9/2001	760	1230		
Ryerson Creek	Yuba Street	1/9/2001	5120	500		

APPENDIX G

EXAMPLE DATABASE OUTPUT

Adjacent Land Use, Potential Sources of Water Quality Impairment, and Macroinvertebrate Taxa Collected

Organization:	Oceana County Conservation District	County:	Oceana
Waterbody Name:	South Branch Pentwater River	Survey Date:	6/3/1998
Location:	Earl Petersons property		

Adjacent Land Use:

Shrubs:	☐	Disturbed Ground:	☐
Crop Residue:	☐	No Vegetation:	☐
Rowcrop:	☑	Wetlands:	☑
Residential Lawns, Parks:	☐	Forest:	☑
Impervious Surfaces:	☐	Pasture:	☐

Potential Sources of Water Quality Impairment:

Crop Related Sources:	☐	Flow Regulation/Modification (Hydrology):	☐
Grazing Related Sources:	☐	Upstream Impoundment:	☐
Intensive Animal Feeding Operations:	☐	Construction (Highway/Road/Bridge):	☐
Highway/Road/Bridge Maintenance and Runoff:	☐	Construction (Land Development):	☐
Channelization:	☐	Urban Runoff:	☐
Dredging:	☐	Land Disposal:	☐
Removal of Riparian Vegetation:	☐	On-Site Wastewater Systems:	☐
Bank and Shoreline Erosion/Modification:	☐	Silviculture (Forestry NPS):	☐
Resource Extraction (Mining NPS):	☐	Debris in Water:	☐
Recreational/Tourism Activities (General):	☐	Industrial Point Source:	☐
Golf Courses:	☐	Municipal Point Source:	☐
Marinas/Recreational Boating (Water Releases):	☐	Natural Sources:	☐
Marinas/Recreational Boating (Bank Erosion):	☐	Source(s) Unknown:	☐

Macroinvertebrate Taxa:

Sensitive		*Moderately Sensitive*		*Tolerant*	
Beetle Adults:	☑	Alderfly Larvae:	☐	Aquatic Worms:	☐
Blackfly Larvae:	☐	Beetle Larvae:	☐	Leeches:	☐
Caddisfly Larvae:	☑	Clams:	☐	Midge Larvae:	☑
Gilled Snails:	☑	Crane Fly Larvae:	☐	Pouch Snails:	☐
Hellgrammites:	☐	Crayfish:	☑	Sowbugs:	☐
Mayfly Nymphs:	☑	Damselfly Nymphs:	☑	True Bugs:	☑
Stonefly Nymphs:	☑	Dragonfly Nymphs:	☑	Other Diptera:	☐
Water Penny:	☐	Scuds:	☑		

Total Stream Quality Score: **40.5** **Total Stream Quality Rating:** **Good**