Quality Assurance Project Plan for:
Upper-Central Muskegon River & Upper Manistee River Watersheds Stream Monitoring Program

Missaukee Conservation District
6180 W. Sanborn Road Lake City, MI

SECTION A: PROGRAM DESCRIPTION AND QUALITY OBJECTIVES

A3. Distribution List

Sherry Blaszak, District Manager
Missaukee Conservation District
6180 W. Sanborn Road
Lake City, MI 49651

Mark Johnson
Wexford Missaukee Career Technical Center
9901 E 13th St
Cadillac, MI 49601

Muskegon Watershed Assembly
1009 Campus Dr. JOH 303,
Big Rapids, MI 49307

Paul Steen, MiCorps Program Manager
Huron River Watershed Council
1100 North Main Street
Ann Arbor, Michigan 48104

A4. Program Organization

Management Responsibilities:

Sara Huetteman Education Coordinator Missaukee Conservation District, 6180 W. Sanborn Rd., Lake City, MI 49651; 231.839.7193; Sara.Huetteman@macd.org.

The MCD Education Coordinator, is the Program Manager for the volunteer stream monitoring program. The Program Manager is responsible for maintaining quality assurance oversight (QA manager) and reports to the District Manager. Additional responsibilities include:

- Develop, implement, and maintain oversight of the Quality Assurance Project Plan.
- Attend an 8-hour training session provided by MiCorps.
- Promote volunteer stream monitoring programs and recruit volunteers.
- Research necessary equipment needed for stream monitoring collection events.
- Coordinate volunteer stream monitoring training sessions.
- Coordinate volunteer stream monitoring data collections.
- Debrief Stream Team Lead Volunteers before and after data collections.
- Coordinate macroinvertebrate identification sessions.
- Conduct habitat assessments of stream monitoring collection sites.

- Implement database development, data entry and analysis.
- Promote programs at conservation district events, meetings, and through various media outlets.
- Develop quarterly narrative reports.
- Attend MiCorps Conferences annually.
- Develop and submit Maintenance Grant proposals annually as available through MiCorps.
- Assist with community outreach and education through local library and school partnerships

Sherry Blaszak, District Manager. Missaukee Conservation District, 6180 W. Sanborn Rd., Lake City, MI 49651; 231.839.7193; sherry.blaszak@macd.org.

Sherry, or the District Manager, provides administrative and budget oversight for the program and assists the Program Manager when necessary. Responsibilities include:

- Assist with budget oversight and development of quality financial reports.
- Purchase equipment needed for sampling and keep records of items.
- Assist with coordination of volunteer stream monitoring collection events.
- Assist with the development and submission of Maintenance and other MiCorps grants as available.

Field Responsibilities:

Program Manager is responsible for all activities in the field and the management of volunteers including providing a program overview, equipment distribution and directions to sites.

Volunteer Stream Leaders: Volunteers trained in MiCorps collection protocols and methods. Responsible for leading a volunteer group through monitoring procedures at one sampling site during each monitoring event. Team Leaders should be familiar with the variety of Macroinvertebrates and help pickers find them from the collected sample. Team Leaders are also responsible for returning all equipment, biological samples, and data sheets to the Program Manager.

Volunteer Collectors: are in the water and should be trained in the protocol and proper sampling methods to sample all in-stream habitats that exist at the site and provide sample contents to Pickers. Relevant experience can be substituted for MiCorps Training.

Volunteer Pickers: Are under the direction and oversight of Stream Team Leaders during monitoring events. Pickers are responsible for sorting through the samples collected by the Collector, picking out the macroinvertebrates from the sorting tray, putting them in a collection jar, and preserving them in alcohol for later identification.

Laboratory Responsibilities:

The Program Manager will assist volunteers through identification and verify results. Missaukee Conservation District will provide laboratory space, equipment, and identification tools. Program Manager will seek assistance in identifying macroinvertebrates from local experts for example the Ausable Institute or Baker College, as needed.

Corrective Action:
Program Manager will assume the role of initiating, developing, approving, and implementing corrective actions in regards to volunteer behavior and violations in following the sampling protocol. Any problems or injuries are reported to the District Manager.

A5. Problem Definition/Background

The Muskegon River, located in north-central Michigan, incorporates over 2,350 square miles of land. The river is 212 miles long, with a 575-ft. drop in elevation between the source and the mouth at Lake Michigan. Missaukee County is one of the eight counties within which the Muskegon watershed is contained. Approximately 94 tributaries flow directly into the mainstem and two primary tributaries-- West Branch of the Muskegon River and Clam River--flow through Missaukee County. Nutrient and chemical pollution peaked in the mid-1900s having a significant effect on the watershed. Today, sedimentation from uplands is a significant pollutant. Water quality is good, overall, in most of the watershed with the majority of pollution issues located around cities and below dams. These areas of concern are not as prevalent in the Upper-Central area of the watershed. However, comprehensive invertebrate studies are not available for the Muskegon River watershed.

The Upper Manistee River and its tributaries are prized as cold-water trout habitats. Thermal influences from man-made and natural dams may affect fish communities within the watershed. Other negative influences include unconsolidated sand deposits which have lowered the stream channel rating. As with the Muskegon River watershed, the Upper Manistee is a quality watershed, overall. No comprehensive invertebrate studies have been conducted in the Manistee watershed. Wetlands and forest cover made up the majority of land cover in the watershed in 1992, however, in a 2003 report (Appendix 1) the area of forests and wetlands had significantly decreased while agricultural lands increased dramatically. The transition in land use has made monitoring more important as streamside buffers are removed and water drawn for irrigation has increased.

With two major watersheds flowing through Missaukee County, monitoring both is important to the Conservation District to track the impacts of erosion and run-off. Helping the community protect water, soil and air remains a top priority for the district and getting the community involved, builds connections and helps promote best management practices in agriculture, forestry and construction.

A6. Program Description

In 2015 and again in 2018, MCD received millage support from voters to increase conservation and stewardship efforts across the county. As water quality is important to our constituents and the mission of our agency, we seek to create a community water quality monitoring effort in the form of aquatic macroinvertebrate surveys. As we monitor both the Upper Manistee and Upper-Central Muskegon watersheds, it is our intent to collaborate and share data findings with other organizations involved with stream monitoring in the lower areas of each watershed.

The overall goal of the volunteer monitoring program is to build community connection to the river systems and guide community organization in projects that can protect and improve water quality. The MiCorps program was created through an executive order by Governor Jennifer M. Granholm to assist, formerly the Michigan Department of Environmental Quality, now Department of Environment, Great Lakes and Energy, in collecting water quality data for use in water resources management and protection programs. This program provides standardized assessment and data recording procedures that can be easily used by trained volunteers. Specific objectives of this project include collecting baseline data, characterizing stream ecosystems, identifying water quality problems, determining water quality trends, and informing and educating the public about water quality issues and aquatic ecology. Volunteer stream monitoring activities will continue to be supported by the Missaukee Conservation District into the future.

Overall program goals are thus:

1. Educate citizens of Missaukee County and raise awareness about water quality.
2. Promote stewardship and monitoring of Missaukee's water resources: The Upper Manistee River and Upper-Central Muskegon River watersheds with a special focus on tributaries of the Muskegon River. Establish baseline conditions to monitor changes over time.
3. Create a sustainable volunteer monitoring program and encourage county residents to expand monitoring to lakes, road-stream crossings, and cleanup efforts.
4. Identify problem areas where degradation has occurred and where best management practices or remediation may be implemented.

Missaukee County is a highly agricultural area. An extension of the stream monitoring program will include chemical water monitoring near or downstream of croplands. In partnership with our Michigan Agriculture Environmental Assurance Program (MAEAP) technician, based in the MCD office, we wish to engage and educate local farmers about water quality issues. Educational outreach will include working with local schools and libraries to promote stream monitoring and water quality. Our Education Coordinator will be heading the majority of educational activities through those outlets. Stream Leaders will also become part of educational outreach through sportsman's clubs and district held events.

MCD will utilize the Michigan Clean Water Corps (MiCorps) Volunteer Stream Monitoring Procedures to establish baseline conditions along with the chemical monitoring. Sampling periods will happen twice a year and occur within a two-week window if multiple days are needed: May and September/October. Stream monitoring will consist of at least two stream locations in each watershed, adding more sites if volunteers are available. MCD will furnish all necessary monitoring equipment to volunteers. The procedures and data forms include two types of assessments: stream habitat assessment (Appendix 2) and macroinvertebrate identification and assessment (Appendix 3). The stream habitat assessment is a visual assessment of stream conditions and watershed characteristics conducted every 5 years. The macroinvertebrate sampling procedure provides a measure of stream health. The assessments cover approximately 300 linear feet of stream at each site.

A7. Data Quality Objectives

Precision/Accuracy:
Accuracy is the degree of agreement between the sampling result and the true value of the parameter or condition being measured. Accuracy is most affected by the equipment and the procedure used to measure the parameter. Precision refers to how well you are able to reproduce the result on the same sample, regardless of accuracy.

The purpose of this project is to gauge stream health by measuring the total diversity of macroinvertebrate taxa. Precision and accuracy of the program will be maintained through following standardized MiCorps procedures. The Program Manager must be trained in MiCorps procedures at the annual MiCorps training led by MiCorps staff. MiCorps staff conduct a method validation review (the “side-by-side” visit) with the Program Manager on 08.23.2017 to ensure their expertise, which consisted of supervising the Program Manager’s macroinvertebrate sampling and sorting methodology to ensure that they are consistent with MiCorps protocol. If a problem arises with a subset of macroinvertebrates, a thorough check may be requested.

Precision and accuracy of field collection will be maintained by conducting consistent volunteer team leader training. Volunteer team leaders will be trained upon joining the program, and retrained every three years (at a minimum). Techniques under Volunteer Stream Monitoring Quality Assurance Program Plan Guidance Version 5 review shall include:

- collecting style (must be thorough and vigorous)
- habitat diversity (must include all available habitats and be thorough in each one) • picking style (must be able to pick thoroughly through all materials collected and pick all sizes and types of macroinvertebrates)
- variety and quantity of organisms (must ensure that diversity and abundance at site is represented in sample)
- transfer of collected macroinvertebrates from the net to the sample jars (specimens must be properly handled and jars correctly labeled).

Precision and accuracy of data will be maintained through careful macroinvertebrate identification. Volunteers may identify macroinvertebrates in the field, but these identifications and counts are not official. All macroinvertebrate samples are stored in isopropyl during field collection and until ID, then stored in ethanol for long-term preservation in air tight jars. The Program Manager will check at least 10% of the specimens processed by experts to verify results (with a concentration on hard to identify taxa). If more than 10% of specimens checked were misidentified, then the Program Manager will review all the specimens processed by that expert and reassess if that person should be considered an expert for future sampling events.

Bias:
At every sample site, a different team will sample there at least once every three years to examine the effects of bias in individual collection styles. If needed the Program Manager will accompany teams to observe their collection techniques and note any divergence from protocols. Teams that do not meet quality standards are retrained in the relevant methods and the Program Manager will reevaluate their collection during the subsequent sampling event.

It is also possible that the Program Manager can conclude that all sampling was valid and the discrepancy between samples is due to natural variation (such as the site changing over time or unrepresentative sampling conditions).

Completeness:
Completeness is a measure of the amount of valid data actually obtained versus the amount expected to be obtained as specified in the original sampling design. It is usually expressed as a percentage. For example, if 100 samples were scheduled but volunteers sampled only 90 times due to bad weather or broken equipment, the completeness record would be 90%.

Following a quality assurance review of all collected and analyzed data, data completeness is assessed by dividing the number of measurements judged valid by the number of total measurements performed. The data quality objective for completeness for each parameter for each sampling event is 90%. If the program does not meet this standard, the Program Manager will consult with MiCorps staff to determine the main causes of data invalidation and develop a course of action to improve the completeness of future sampling events.

Representativeness:
Study sites are selected to represent the full variety of stream habitat types available locally. All available habitats within the study site will be sampled and documented to ensure a thorough sampling of all of the organisms inhabiting the site. Resulting data from the monitoring program will be used to represent the ecological conditions of the contributing watershed.

Sampling after extreme weather conditions may result in samples not being representative of the normal stream conditions. Weather conditions are noted on the data sheet and any

negative trend in score will be noted if gathered after extreme weather.

Comparability:

Comparability represents how well data from one stream or study site can be compared to data from another. To ensure data comparability, all volunteers participating in the monitoring program follow the same sampling methods and use the same units of reporting. The methods for sampling and reporting are based on MiCorps standards that are taught at annual training sessions by MiCorps staff. The Program Manager will train volunteers to follow those same methods to ensure comparability of monitoring results among other MiCorps programs. To the extent possible, the monitoring of all study sites will be completed on a single day, and certainly within a two-week time frame.

If a Program Manager leaves the position and a new Program Manager is hired, the new hire will attend the next available training given by MiCorps staff.

A8. Special Training/Certifications

Program Manager: Required to attend MiCorps training session with the state Project Manager as well as the identification sessions held at the annual conferences.

Stream Team Lead Volunteers: Must attend a MiCorps training session *or* a water quality training session prior to leading sampling efforts in the field. The training will be led by the Program Manager and/or qualified Stream Team Lead Volunteer. The training will certify volunteers in MiCorps stream monitoring procedures including macroinvertebrate collection methods and data sheet information collection. Training will also cover MCD specific program goals, objectives, quality assurance practices, and field safety. Stream Team Lead Volunteers will be required to attend at least one water quality training every two years. Training will be offered 1-2 times a year, prior to the sampling window, based on interest and current number of Stream Team Lead Volunteers.

Volunteer Collectors: New collectors should attend a MiCorps Leader Training, water quality training or have prior experience sampling for macroinvertebrates.

Identification: Special training is not required.

SECTION B: PROGRAM DESIGN AND PROCEDURES

B1. Study Design and Methods

Site Selection:

Sites were chosen based on the following criteria

- Site-level concerns such as problem road/stream crossings, recreational impacts, nutrient run off, or below dam sites. Distinct segments were determined by differences in adjacent and/or upstream land use.
- Public accessibility

In all cases the site should:

- Be representative of the stream surveyed
- Contain a diverse range of habitats
- Allow for the assessment of 300 feet of stream length and at least 20 feet away from road crossing.

Study Locations:

MCD will sample and assess six to ten stream locations within two watersheds: Upper Manistee and Upper Central Muskegon Rivers. Sampling efforts in the Upper-Central Muskegon River Watershed will focus mainly on the Clam River. The Clam River is an area of concern as it travels through agricultural operations and town centers.

Sampling sites in the Upper Manistee River Watershed:

1. **UMAN01:** Hopkins Creek at Lucas Rd (44°28'15.49"N, 85°17'11.98"W). This road/stream crossing has been identified in the *Upper Manistee River Watershed Management Plan* as one of the 14 sites within the watershed as a critical area.
2. **UMAN02:** Ham Creek at Lanning Rd (44°29'20.61"N, 85°15'28.72"W). Road/stream crossing site on state forest land. Identified as having moderate erosion by the Conservation Resource Alliance (CRA).
3. **UMAN03:** Morrisy Creek at East 12 Rd/West Simpson Rd (44°25’54.68”N, 85°17’33.73”W). Road/stream crossing identified as having moderate erosion by the CRA.

Sampling sites in the Upper-Central Muskegon River Watershed:

1. **UC-MUS01:** Clam River at Cadillac Pathways Trail (44°17'2.31"N, 85°20'3.34"W). This section of the Clam River is located within a well-used recreational area, just outside the city of Cadillac. The site is often used as a campsite and non-motorized boat launch.
2. **UC-MUS02:** Mosquito Creek at MSU Research Station (44°18'24.13"N, 85°12'6.77"W). This is a partner site with the research station. The main use of land at the research station is pasture land for cattle. This site is also below the dam used to raise/lower the lake levels of Lake Missaukee.
3. **UC-MUS04:** Quist Farms - 8-mile road (44.20055, -85.05277)
4. **UC-MUS05:** Ben D Jeffs River Park (44.33602, -84.88415) This site is public property and easy to meet up at and further up in the watershed. (relocating this sample site from a stream crossing off M-55 to a park two miles away for safety reasons and it's a more strategic site along the watershed.)
5. **UC-MUS06:** Ransom Property at 6478 Blue Rd (44.26058, -84.96434). This site is on private property belonging to a MCD Board Director who has given their permission for use. The site was chosen for ease of access and proximity to the main branch of the Muskegon River.

Frequency and Timing: Macroinvertebrate communities are sampled annually in the spring (mid-May) and fall (late-September/early October) as long as accessibility doesn't become an issue. New sites are added as volunteer and personal community interest occurs or problems are detected. For each sampling event that is not completed in one day, monitoring by volunteers will be completed within two-weeks.

If a site is temporarily inaccessible, due to factors such as prolonged high water, and isn't resolved in two-weeks, then no monitoring data will be collected during that time and there will be a gap in the data.

If a team is unable to monitor their site for any reason during the specified time, Team Leaders must contact the Program Manager as soon as possible so the Program Manager can arrange for another team to complete the monitoring. If no team is available, the Program Manager and another staff member, if feasible, will sample the site. Otherwise, the site will go unmonitored for that season.

Study Methods

Stream Habitat Assessment: The Program Manager and volunteers will complete a Habitat Assessment every 3-5 years during the fall season immediately following the macroinvertebrate sampling or at least within two weeks of the sample event. The Habitat Assessment will follow the procedure and datasheet given in Appendix 2.

The Habitat Assessment is a critical piece of the monitoring process and will be used to monitor changes in stream habitat over time, which may result in changes in water quality and corresponding macroinvertebrate diversity. As many of the parameters within the Habitat Assessment are qualitative, personal bias is inherent. To account for bias and personal discrepancies, The Program Manager or a stream leader will have on hand a copy of MiCorps Stream Monitoring Procedures, which details the qualitative criteria, and helps clarify questions. All final Habitat Assessment data sheets will be reviewed by the Project Manager for correctness and completeness. There are places on the data sheet to record unusual procedures or accidents. Any variation in procedure should be explained on the data sheet.

Macroinvertebrate Sampling: The benthic population is sampled within a 2-week period in May and September-October. All equipment to be used for this sampling is listed in under B2. To sample the benthic community, multiple collections will be taken from each habitat type present at the site including riffle, rocks or other large objects, leaf packs, submerged vegetation or roots, and depositional areas, while wading and using a D-frame kick net as outlined in the MiCorps Survey/Sampling Techniques which will accompany each sampling team. The trained Collector will transfer the material from the net into buckets. The remaining volunteers (Pickers) will pick through samples, sorting into trays and preserving them in jars of 70% ethyl alcohol for later identification. During the collection, the Collector will provide information to the team Stream Leader in response to questions on the data sheet that review

all habitats to be sampled, the state of the creek, and any changes in methodology or unusual observations. The Stream Leader will instruct and assist other team members in detecting and collecting macroinvertebrates in the sorting pans, including looking under bark and inside of constructions made of sticks or other substrates. Potential sources of variability such as weather/stream flow differences, season, and site characteristic differences will be noted for each event and discussed in study results. There are places on the data sheet to record unusual procedures or accidents, such as losing part of the collection by spilling. Any variations in procedure should be explained on the data sheet. (Appendix 3.)

All invertebrate sample jars receive a label printed with a label maker, to include date (at least month/year), and location. The Stream Leader is responsible for labeling and securely closing the jars, and returning all jars and all equipment to the Program Manager. Upon return to the building, the collections are checked for labels, the data sheets are checked for completeness and for correct information on the number of jars containing the collection from the site, and the jars are secured together with a rubber band and site label and placed together in one box. They are stored in the central office until they are examined and counted on the day of identification (same day if possible or within one to two weeks). The data sheets are used on the identification day, after which they are entered in the MiCorps database and remain on file indefinitely.

Macroinvertebrate Identification: The identification session will be held indoors at the Health Department Community Room or similar venue with tables and chairs with proper lighting.. Together the program manager, volunteers, and aquatic macroinvertebrate experts, if available, will sort, identify, and count specimens collected at sampling locations. The sample identifier checks the data sheet and jars to ensure that all the jars, and only the jars, from that collection are present prior to emptying them into a white pan for sorting. If any specimens are separated from the pan during identification, a site label accompanies them. Volunteers will sort presented specimens into groups based on physical similarities, which will be further sorted and identified by the Program Manager/expert to order level. All identifications are verified by the Program Manager. Data is recorded on the corresponding site-specific MiCorps order level macroinvertebrate data sheet (Appendix 3). When identification of a sample is complete, the entire collection is placed in a single jar of fresh alcohol with a poly-seal cap and a printed label on the jar and stored at room temperature at the MCD office for at least 10 year after collection. The alcohol is carefully changed (to avoid losing small specimens) in the jars every few years. Old alcohol will be watered down and drained down the sink.

We do not assume that a single collection represents all the diversity in the community, but rather we consider our results reliable only after repeated collections spanning at least three years. Our results are compared with other locations in the same river system that have been sampled in the same way. All collectors attend an instream training session, and most sites are sampled by different collectors at different times to diminish the effects of bias in individual collecting styles. Samples where the diversity measures diverge substantially from past samples at the same site are resampled by a new team within two weeks. If a change is confirmed, the

site becomes a high priority for the next scheduled collection. Field checks include checking all data sheets to make sure each habitat type available was sampled, and the team leader examines several picking trays to ensure that all present orders have been collected.

Equipment Quality Control:

- Maintain a detailed inventory of equipment including dates of purchase, dates of last usage, and any repairs made
- All equipment replacements and storage is the responsibility of the Program and District Managers and MCD.
- Check to make sure equipment is in working order and not damaged prior to a sampling event.
- Clean equipment after field use
    - Conduct a visual inspection of gear before and after any sampling; thoroughly inspect and remove all plants, dirt and mud, and any other visible debris like seeds, shoots, animals, insects, and eggs from clothing and equipment.
    - After sampling is done for the day, let dry for at least 5 days before using gear again.
        - If going to another site on the same sampling day, disinfect with dilute bleach and allow to sit for 10 minutes before rinsing with tap water and towel dry all equipment before leaving the site.
    - If necessary, Team Leaders should use high pressure hot washes to clean monitoring equipment if areas are known to be infected by invasive species.
        - Be on the lookout for New Zealand mud snails.
    - Additional details can be found in the MiCorps Volunteer Monitoring Invasive Species Prevention Kit Use Guide which is located with monitoring supplies, or at https://www.hrwc.org/volunteer/decontaminate/

Data Analysis Quality Control

- Field datasheets and labels will be verified by volunteers in the laboratory
- Macroinvertebrate identification will be verified by a trained volunteer or program manager
- Calculations will be completed by at least two volunteers and verified by the Program Manager
- Hard copies of data will be reviewed for errors by comparing to field data sheets

Variability: Possible sources of variability in data include team leader experience, volunteer commitment, and the subjective nature of some evaluations. Inconsistent macroinvertebrate scores and/or habitat assessments will be addressed by the Program Manager. Re-sampling may be conducted if assessments result in inadequate sampling procedures.

B2. Instrument/Equipment Testing, Inspection, and Maintenance

Sampling Equipment: Stream Team Leader will acquire equipment needed for macroinvertebrate sampling from the Program Manager at the district office. Each kit will include:

- Clipboard and writing equipment
- Map, directions, and GPS coordinates for their sampling site(s).
- MiCorps Macroinvertebrate Data Sheet.
- MiCorps Stream Habitat Data Sheet, fall only, if they agree to conduct the assessment.
- 1 laminated MiCorps Survey/Sampling Techniques and volunteer role descriptions.
- Sampling tools: buckets, D-nets, waders (if needed), and rinsing bottle
- Collection tools: forceps, eye droppers, magnifiers, sorting trays, collection jars, and 70% ethanol
- First Aid kit
- Travel table

In the event the Program Manager finds equipment insufficient for sampling, they will be responsible for repairing or replacing equipment prior to use in the field. Problems encountered in the field or laboratory will be noted and resolved accordingly. All equipment will be stored at the MCD office.

B3. Inspection/Acceptance for Supplies and Consumables

Prior to the sampling event, the Program Manager will organize all equipment and data sheets needed. The Program Manager will determine when new supplies are needed or no longer usable and conduct repairs. New supplies will be ordered by the District Manager. Inspections, repairs, and re-ordering will be documented on the equipment database.

B4. Non-direct Measurements

Not applicable.

B5. Data Management

Raw data will be entered and managed in Microsoft Excel workbooks by the Program Manager. Data will be entered into the database within a month of the collection data. All data is backed up on the district's cloud storage. Data will be entered from the database directly into the MiCorps online database by the Program Manager or a trained volunteer. Hard copy data sheets will be filed at the MCD office for at least 5 years. Critical sites' data sheets will be kept indefinitely.

Macroinvertebrates: Data are summarized for reporting, the method for calculating that metric is included in Appendix 3. Macroinvertebrates are stored in a single jar of fresh alcohol with a poly-seal cap and a printed label on the jar and stored at room temperature at the MCD office for at least 10 years after collection. The alcohol is

carefully changed (to avoid losing small specimens) in the jars every few years. Old alcohol will be watered down and drained down the sink.

Data Analysis: All calculations will be checked twice. Hard copies of all computer entered data should be reviewed for errors by comparing to field data sheets. Data analysis methods will periodically be reviewed by qualified professionals.

SECTION C: SYSTEM ASSESSMENT, CORRECTION, AND REPORTING

C1. System Audits and Response Actions

Volunteer Team Leaders trained by the Program Manager ensure that quality assurance protocols are followed and report any issues possibly affecting data quality. When significant issues are reported, the Program Manager may accompany groups in the field to perform side-by-side sampling and verify the quality of work by the volunteer team. In the event a group is determined to have done a poor job sampling, a performance audit to evaluate how people are doing their jobs of collecting and analyzing the data is accomplished through side-by-side sampling and identification. During side by side sampling a team of volunteers and an outside expert sample the same stream. The statistic for checking this side-by-side sample is given in the Bias section (A7).

A system audit is conducted following each spring and fall monitoring event to evaluate the process of the project. The system audit consists of the Program Manager, any other program leader, and one or two active volunteers, and is a start to end review of the monitoring process and how things could be improved for the next event.

If deviation from the QAPP is noted at any point in the sampling or data management process, the affected samples will be flagged and brought to the attention of the Program Manager and the team that collected the sample. Re-sampling is conducted as long as the deviation is noted soon after occurrence and volunteers are available (two-week window). Otherwise, a gap must be left in the monitoring record and the cause noted. All corrective actions are documented and communicated to MiCorps staff.

Details of the process for assessing data quality are outlined in section A7. Response to quality control problems is also included in section A7.

C2. Data Review, Verification, and Validation

A standardized data-collection form is used to facilitate spot-checking to ensure that forms are completely and correctly filled out. The Program Manager or a single trained volunteer reviews the data forms before they are stored in a computer or file cabinet. After data has been compiled and entered into a computer file, it is verified with raw data from field survey forms.

C3. Reconciliation and Data Quality Objects

Data quality objectives are reviewed annually to ensure that objectives are being met.

Deviations from the data quality objectives are reported to the Program Manager and MiCorps staff for assessment and corrective action. Also, data quality issues are recorded as a separate item in the database and are provided to the Program Manager and data users. Response to and reconciliation of problems that occur in data quality are outlined in Section A7.

C4. Reporting

Throughout the duration of this program, quality control reports are included with quarterly project reports that are submitted to MiCorps. Quality control reports provide information regarding problems or issues arising in quality control of the project. These could include, but are not limited to: deviation from quality control methods outlined in this document relating to field data collection procedures, indoor identification, data input, diversity calculations and statistical analyses. Program Manager generates annual reports sharing results of the program with volunteers, special interest groups, local municipalities, and relevant state agencies. Data and reports will be made available through the organization's website.

APPENDIX 1:
UPPER MANISTEE RIVER
NATURAL RIVER MANAGEMENT PLAN

I. UPPER MANISTEE RIVER WATERSHED

A. *THE WATERSHED*

The Upper Manistee River watershed is located in the northwestern portion of Michigan's Lower Peninsula. It has a drainage area of 590 square miles. The watershed includes parts of five counties: Antrim, Otsego, Crawford, Kalkaska and Missaukee. The mainstream is approximately 78 miles long and originates in southeast Antrim County (approximately six miles from the village of Alba), at an elevation of 1,250 feet. From this point the river meanders southerly until it reaches a point about six miles west of Grayling, in Crawford County. Here, the river turns and meanders southwesterly until it reaches the planning area boundary of the Wexford/Missaukee County Line. The Manistee continues flowing southwesterly until it ultimately discharges to Manistee Lake and then Lake Michigan at the City of Manistee. Along the way, the river is fed by large tributaries such as the North Branch as well as many other smaller tributaries. The river has a total drop in elevation from the headwaters to the planning area boundary of 315 feet, an average of four feet per mile.

B. *CLIMATE*

The watershed offers a climate typical of Michigan's "north country" that is strongly affected by Lake Michigan. The warm days and cool nights offer a pleasant summer haven for residents and tourists. Winter’s abundant snowfall provides excellent conditions for skiing, snowmobiling, and other winter sports.

Weather data for the Manistee basin indicates a record high of 107 degrees F and low of -45 degrees F, both recorded in the Grayling-Fife Lake Area. Mean January and July temperatures are 17.4 and 58.7 degrees F, respectively. The average low temperature for January is 10.4 degrees F, while the average high temperature for July is 80.2 degrees F. The average length of growing season is 121 days.

The summer season yields 34 percent of the annual precipitation, with another 30 percent occurring during the fall. The low occurs in February with an average monthly yield of 1.44 inches. Annual precipitation averages 32.04 inches.

C. *TRANSPORTATION AND AREA GOVERNMENT*

One major US highway, US 131, currently crosses the western end of the Upper Manistee watershed. This is a limited-access highway from southwest Michigan to just south of Cadillac. From Cadillac, it becomes a two-lane highway that crosses the Manistee River mainstream north of Manton, downstream of the planning area. A new limited-access highway is proposed to replace this section of US-131 in the future.

Two State highways traverse the river or tributaries in the watershed, including M-72 in Kalkaska County and M-66 in Kalkaska and Missaukee counties. In addition, many paved and unpaved year-round county roads, as well as seasonal roads and two-tracks, are present in all counties.

Commercial airline service is available at Traverse City, west of the watershed. Although there are rail lines in the watershed, no passenger rail service is available.

The watershed includes portions of five counties and 20 townships, although only 17 townships have any appreciable stream mileage. There are no incorporated municipalities in the Upper Manistee River watershed.

D. *GEOLOGICAL HISTORY*

The predominating historical influence on the Manistee River is, of course, its geologic background. The unique conditions left by the Pleistocene glaciers that advanced and retreated from this portion of Michigan's Lower Peninsula provided the ecological framework for the plant and animal communities in the watershed. Many of the characteristics that make this river system worthy of consideration for Natural River designation are directly attributable to the porous nature of the glacial outwash deposited between the Lake Border and Port Huron Moraine.

Meltwaters pouring off the Port Huron ice sheet carved out two large discharge channels running east and west. The present-day Manistee River "under-fits" the westerly channel, resulting in the appearance of a large river valley and delta formed by a relatively small river. The Au Sable River occupies the easterly channel, discharging to Lake Huron at Oscoda.

E. *HISTORICAL HUMAN INFLUENCES*

Earliest archaeological evidence of human inhabitants dates to the Paleo-Native American period, over 10,000 years ago. These were nomadic people who followed herds of game animals. By 500 BC, there was a change to a more sedentary lifestyle as people established camps for a season or more and agricultural practices were developed.

Forty-three archeological sites are listed in the watershed (Table 1). Actual scholarly study of the Manistee River archaeology has been limited. Numerous burial mounds associated with the Late Woodland Period are located along the riverbanks. The majority of sites excavated to date are relatively small seasonal villages used during the harvest of fish, game and plants.

Numerous sites were discovered during a 1965 archaeological investigation of the area between Sharon (Kalkaska County) and Sherman (Wexford County). These included Native American burials, village locations and transient campgrounds. Most were dated between 8,000 BC and 500 AD.

Prior to European exploration in the first half of the 1600's, Native American tribes including the Ottawas, Potawatomis and Chippewas used the Manistee River watershed and its resources. The Native American "Manistee River" name has several documented meanings, including "river at whose mouth are islands," "river with white bushes along the banks," "crooked river," and "spirit of the woods."

Many area tribes intentionally burned certain areas in the watershed to manage habitat and vegetation types. This activity likely stopped near the time of the first European exploration when French explorers came to the region, primarily motivated by the fur trade (Jean Nicolet, in 1634, is thought to be the first white man to visit northern Michigan). The tribes built no large permanent settlements, but traveled to stations throughout the Manistee River watershed to hunt, fish and gather the region's rich plant resources. They continued these activities throughout the French and British regimes in Michigan, spanning the years roughly between 1634 and 1812.

In 1760, the English took control of northern Michigan from the French. The newly formed United States of America laid claim to the former French and British colonial territories in the Great Lakes region in 1776. A January 1805 Act of Congress provided for the organization of the Territory of Michigan. Ottawas, Chippewas and Potawatomis joined with Tecumseh and the British in an unsuccessful effort to repel the U.S. during the War of 1812. On October 13, 1813 General Lewis Cass was appointed Civil Governor of Michigan Territory. He created the first county, Michilimackinac, bounded on the east by the Cheboygan River, the south by the Manistee River, the west by the Manistique River, and by Canada on the north.

In 1821 and again in 1836, Ottawa bands living along the Manistee ceded title to their lands to the United States. By 1830, the Government Land Office survey of Michigan had begun, creating the township, range, and section system we now have. Prior to this time, the Manistee River watershed was still relatively undeveloped by non-natives. In 1837 came statehood for Michigan and in 1840, the creation of counties as we know them today.

Non-natives were late in developing the watershed. The interior portion of the watershed was not logged until after 1870, as the river was choked with logjams. The Manistee River contained so much wood that it was rare to find a long stretch of open water. Prior to construction of the Manistee Bridge (now the M-37 bridge north of Sherman, downstream of the planning area), the only river crossing was via a log jam so solid horses and livestock could cross. Logging company crews clearing the river for log drives did not reach Sherman until 1870.

A review of H.R. Page's 1885 "History of Manistee County" gives a glimpse of the characteristics of the river in pre-European settlement days. In 1869, an exploration of the Manistee River was made under the direction of the ironically named River Improvement Company. A.S. Wordsworth, leader of the survey party, wrote an account of that survey, an excerpt of which follows:

"September 18th, in two canoes, so light we could carry them upon our shoulders, we commenced descent of the Manistee, from Section 18, T28N, R4W [near Deward in the upper reaches of the planning area]. The spring sources of this stream are in hardwood timber land, but changing to pine land near the south boundary of T29N; thence for sixty miles on either bank is good pine land, or pine plains, some cork pine, but mostly Norway pine; …the Manistee decidedly floatable for saw logs from Section 18, T28N, R4W: stream fifty feet wide, well defined banks; extreme freshet rise two feet.... Soon after crossing the western boundary of Range 6 west [Sharon area], we encountered the first flood jam worthy of notice upon the river. This jam is 20 rods [330 feet] up and down the stream: estimated expense of removal, $40 per lineal foot or $800.

“These jams date back in buried centuries. As evidence, we find deep-worn trails around them, where Indians have dragged their canoes; also soil accumulations from fallen leaves and freshet of the stream, with forest growth. Cutting to the heart of a cedar twenty inches in diameter, growing over the center [of the log jam], I counted 160 years growth.

“The eleven flood jams of the Manistee [that the party encountered] have a lineal extent, by the thread of the river, of 263 rods [4,340 feet]. Expense of working a channel through them, thirty feet wide; in round numbers, $10,000; wing jams and snags, etc., etc., say $5,000; in all, $15,000. One mile below the last named flood jam, commence lumbermen's rollways; thence downstream they become noticeable features of the river.

"Two miles down the stream, we encountered a jam of floating sawlogs of one and one-half mile extent, over or around which we were compelled to drag or carry our canoes, and pack our camp

'fixens,' and rock, clay, sand, gravel and soil specimens. At the foot we found a force of nine men at work breaking the jam.

"We here see the last of the 'Grayling,' a fish allied to the speckled trout, and called by the residents, the 'Manistee' fish. They are in great abundance near bend waters; they feed, at this season, upon a small, white miller, and readily take a fly-hook, often darting above the surface to secure their prey. Their average length is ten inches, weighing from six to twelve ounces. Hundreds can be taken with a single hook, in a day. They are the "grayling" of English and Scotch waters.

"The Manistee River has been long known as one of the most remarkable streams in the Northwest in this, that it never floods, seldom freezes, and is never affected by droughts. The secret of these singular features of the river is found in the fact that it is fed with springs which flow into the stream from its banks every few rods, so that it is safe to say there are more than a thousand spring streams that bubble up and empty their pure waters into the river within fifty miles of Manistee. These streams vary in size from a small rill to a good mill stream. Everywhere along the banks of this beautiful river they boil out and bubble up in their crystal beauty, affording water as pure and sweet as any in the world; and this probably accounts for the great abundance of the grayling fish, which is sweeter meated and every way as gamey as the brook trout."

The onset of the logging era began what may have been the greatest human influence on the river system. Large-scale removal of logs changed fisheries and wildlife habitat and the very character of the area. The loggers not only removed numerous logjams and large woody debris from the stream channel, they rolled logs down the banks (the "rollways") and drove them to market in the spring. Without trees to stabilize the exceptionally sandy soils in the area, huge amounts of sediment entered the river. Although erosion and sediment transport are natural functions in a stream environment, such a massive artificial influx of additional sediment often overwhelms natural stream processes. Once in the stream, the increased sediment load begins to affect the aquatic environment. The deposition of sand and sediment along the stream bottom causes the stream to overflow its banks. As this occurs, sediment begins to flow laterally and cover the edges of the stream. As the sediment builds up, the stream channel begins to braid, forming several channels in a wider, flatter area. Stream temperatures rise, and fish lose valuable habitat for feeding, resting, and spawning.

These effects can be observed on the Manistee River. The upper stretches in the Deward Tract are beginning to recover from the logging era. However, just downstream from Cameron Bridge, the river begins to widen, has a lower gradient and becomes braided. This sandy braided condition is at least partially the result of sedimentation following the de-vegetation of the uplands surrounding the river.

From the early 1840's to 1940, the lifestyles of the Native American people, and thus their influence on the river, underwent several changes due in part to the increased presence of non-natives. After the 1855 Treaty of Detroit, Ottawas formed new permanent agricultural settlements south of the watershed. By the late 1870s, many Ottawas had sold or lost title to their lands, and migrated to the outskirts of newly formed towns or more isolated areas, still primarily relying on the natural resources of the area to earn a living.

In 1900, the Manistee River was proclaimed Michigan's last great "un-harnessed" river, capable of producing 40,000 horsepower of electricity. Stronach Dam on the Pine River, the major tributary to the lower Manistee, was the first hydroelectric dam on the system, being completed in 1912. Stronach Dam originally supplied power to the City of Manistee. The Michigan Railway Company

acquired the project around 1915, with the intention of supplying power to a proposed electric railway. Consumers Power Company acquired the project in 1917 after the electric railway plans were abandoned and operated the plant until July 8, 1953.

Downstream of the planning area, Tippy Dam was completed and began producing power in 1918 and Hodenpyl Dam in 1925. Tippy Dam was then called Junction Dam, being at the confluence of the mainstream and South Branch Manistee, as the Pine River was formerly called. Fortunately, the Upper Manistee escaped the immediate effects of large hydropower facilities.

The construction of these and other smaller dams had a great influence on the river system. Dams have a variety of effects on river ecosystems. They influence flow patterns and alter channel cross-sections. They fragment the river system, blocking drift and migration by fish and other aquatic organisms. They change river temperatures (making some areas unsuitable for native fish to survive), increase evaporation and reduce stream flow, disrupt sediment and woody debris transport and modify water quality. They can also cause significant direct fish mortalities. Impoundments also result in a loss of riverine habitat and the subsequent changes in fish and aquatic invertebrate populations. The Manistee River shows all of these effects.

The onset of the "modern age" saw a restructuring of the economic and social order in many communities, native and non-native, and with it new influences of the watershed. With lesser reliance on the natural resources of the area for subsistence, increased agricultural, urban and residential uses began to have a greater impact.

From 1933 to 1942, enrollees in the many Civilian Conservation Corps (CCC) camps in the Upper Manistee River watershed had a significant impact on the river system. Reforestation efforts by the corps helped hasten recovery from the devastating logging activities of the recent past. Many erosion control and habitat structures were constructed during this time. The CCC also planted millions of fish in area streams, fought forest fires and built many area campgrounds.

Oil and gas exploration also began in the watershed in the 1930's. The majority of early development occurred in Osceola, Lake, Crawford, Kalkaska and Missaukee counties during the 1940's through early 1960's. The Niagaran Reef oil development began in the late 1960's, with the majority of the activity occurring between 1969 and 1986. Several thousand wells were drilled throughout the watershed. Deep gas exploration occurred sporadically in the watershed beginning in the 1980's. Shallower Antrim gas development began in 1987, and has been widespread in the years since. The potential for additional widespread Antrim development continues to exist throughout the watershed. The Manistee River watershed has produced more oil and gas than any other watershed in the State.

Such development has come with a price. Fragmentation of the surrounding landscape by drilling pads and access roads is widespread. Pipeline corridors also fragment habitat, and have the potential to damage streams at pipeline/stream crossings. The potential for groundwater, surface water and air pollution at drilling sites is of constant concern.

Agricultural land uses can also have dramatic affects on aquatic environments, particularly where there is no vegetative buffer between agricultural areas and a stream. Although this use is limited in the Upper Manistee River system, the affects of agriculture can be seen in some areas. Tillage of soil increases erosion and sediment inputs to streams. These sediments bury gravel and cobbles critical to reproduction and survival of many fish species. Riparian vegetation is often removed, resulting is loss of habitat, warming of water temperatures and reduced filtering of contaminants.

Wetlands, important as spawning and living areas for many species and important to the water quality of the system, were frequently drained to increase land available for tillage. Water withdrawal for irrigation can reduce summer base flows and negatively impact the river.

Land development for residential and other "urban" uses also has dramatic impacts on the aquatic environment. These impacts are increasing with the recent trends of increased development of northern Michigan waterfront properties. Sediment from construction activities, removal of streamside vegetation, filling of wetland and floodplain areas, increase in impervious land area adjacent to streams resulting in warmer temperatures, increased pollutant loads and less stable flows, and discharge of pollutants from wastewater treatment plants and individual wastewater systems such as septic tank/drain fields are all examples of the documented or potential effects of urbanization on the Upper Manistee River system.

Part of the Upper Manistee's value is evident in the way it has influenced people's lifestyles since early times. Native Americans depended on the river for transportation, food, and water. Early settlers depended on it in much the same way, as it later became the sole means of transporting logs to the sawmills and thereby was very important to early residents' way of life. Today the river and its adjoining lands fill different purposes, but they are still important to everyday life. The river and lands are a recreational and commercial resource for many people. Current local culture has partly been determined by the need to meet the demands of users of the river and the surrounding resources. These demands continue to have an influence on the river corridor.

F. ***BIOLOGICAL COMMUNITIES***

1. ORIGINAL FISH COMMUNITIES

An accurate, comprehensive description of the fish community at the time of European settlement is not available. Michigan grayling were abundant in the Upper Manistee River prior to European settlement. Suckers, shiners, northern pike, and whitefish are the only other fish mentioned by early observers as associated with grayling in Michigan streams. Other species present, but not easily observed, would have been blacknose & longnose dace, sculpin, and chestnut and brook lamprey. Potamodromous species (fish that spawn in fresh water rivers but spend their adult lives in fresh water lakes) including lake sturgeon, lake trout, lake and round whitefish, burbot, walleye, and troutperch inhabited the river seasonally.

The Boardman River was thought to be the most southerly stream that native brook trout inhabited. However, brook trout may have been native to the Manistee River watershed. A newspaper article in the Manistee Times dated Sept. 11, 1869 by George C. Depres cited that a Mr. Ruggles and other gentlemen took a large "mess" of "speckled brook trout" from Pine Creek (a Manistee River tributary downstream of the planning area). The change of the Manistee River from grayling to a trout river was attributed to competition, over-harvest, and habitat destruction during the logging era.

The first accurate fish surveys in the Manistee River were not conducted until 1958. These were done in conjunction with a lamprey study in the upper river. Thirty species of fish, including three lamprey species, were collected from 30 sampling stations in the mainstream and tributaries. Most of the sampling stations were in the Upper Manistee River, above the Smithville area on the mainstream, and tributaries. By the time the survey was conducted, the grayling, which is now extinct statewide, had been extirpated from the watershed.

2. PRESENT FISH COMMUNITIES

European settlement caused dramatic changes in the Manistee River and its watershed, many of which changed the river's fish communities. Logging, dams, agricultural and urban land use, point-source discharges, lake-level controls and introduction of exotic species, both intentional and unintentional, have all had an impact on the river system and therefore on its fish communities.

The watershed is now thought to contain 80 fish species (Table 2). Species distributions vary from one small inland lake to watershed-wide. One species has been extirpated and some are rare or threatened, while most native species are still present. Two species, the lake sturgeon and pugnose shiner, are considered “threatened” by the State of Michigan. Thirteen non-native fish species have been introduced into the watershed (Table 3). These include unintentional and intentional introductions and migrations. Many, such as sea lamprey, coho and chinook salmon in the lower river, and rainbow and brown trout, have had a profound impact on the biological and social aspects on the river and its use.

A brief description of the existing fish populations by river segment follows:

Headwaters to M-72

The best trout populations in the mainstream exist in this stretch, including good self-sustaining populations of brook and brown trout, with the former predominating. Fish habitat has partially recovered from the turn of century logging disturbances, in part due to efforts by the Upper Manistee River Restoration Committee, a partnership of public and private interests. Trout population estimates continue to show annual increases in recent years, including a nearly 21% increase in trout per acre from 1992 to 1993. This segment is classified as a "Blue Ribbon" trout stream.

M-72 to Smithville

This reach has fair to good populations of large brown trout, large numbers of young-of-the-year brook trout and a few rainbow trout in riffle areas. These populations are sustained with hatchery fish. There are also the beginnings of a coolwater community of walleye, smallmouth bass, redhorse, and white suckers downstream of Smithville. MDNR Fisheries Division, Manistee River Association, Upper Manistee River Association, and other private parties stock part of this stretch and downstream. Chestnut lamprey are abundant in this segment.

North Branch Manistee

This stream has good self-sustaining brook trout populations, with some brown trout present. Chestnut lamprey are abundant in the lower third of the segment. An occasional "tiger trout", which is a natural cross of a brook and brown trout, is reported by anglers. The area from Mecum Road to the mouth is classified as a "Blue Ribbon" trout stream.

Tributaries

Almost all tributaries are designated trout streams. Some tributaries are good fisheries, including Goose Creek (brook trout), Big Cannon Creek (brook and brown trout), Little Cannon Creek (brook trout), and Hopkins Creek (brook and brown trout. These are all naturally produced and self-sustaining fisheries.

3. MAMMALS

Beaver, mink, muskrat, raccoon, otter, cottontail rabbits, snowshoe hare and fox and red squirrels are some of the mammal species associated with the Upper Manistee River watershed. All of these species are present in moderate to very abundant populations. White-tailed deer are abundant, and are seasonally dependent upon the mainstream and tributary corridors and headwater areas in the watershed. Deer use these sites for yarding purposes when severe winters force them to abandon the uplands. Black bear, bobcat, fox and coyotes can also be found in areas of the watershed, but are seldom observed.

Two species of mammals that frequent the watershed are listed in the Michigan Natural Features Inventory (Table 4). The pine marten is considered “threatened” by the State of Michigan, while the woodland vole is a species of “special concern.”

4. BIRDS

A large variety of waterfowl nest in the watershed. The watershed is within the Mississippi Flyway used by migrating ducks and geese.

A review of the Michigan Natural Features Inventory identified eight species of birds listed as endangered, threatened or of special concern that may frequent the area. They include the bald eagle (threatened), common loon (threatened), king rail (endangered), Kirtland's warbler (endangered), loggerhead shrike (endangered), northern harrier (special concern), osprey (threatened), and red shouldered hawk (threatened). The bald eagle, loon, king rail, osprey, and red shouldered hawk are intrinsically associated with the watershed, either for habitat or feeding areas. Significant great blue heron rookeries exist within the watershed. One other scarce bird species present in the area is the pileated woodpecker, a species that thrives in mature forests.

5. AMPHIBIANS AND REPTILES

Thirty-eight species of amphibians and reptiles have been documented in the Manistee River system or its associated wetlands (Table 5). Three species are currently listed as of "special concern" in the Michigan Natural Features Inventory. They are the Massasauga rattlesnake, spotted turtle, and wood turtle. The wood turtle is of special interest in that its nesting sites are sandy stream banks and it lives in river corridors. Breeding areas are of prime importance since nesting habitat may be reduced by river rehabilitation projects that stabilize and re-vegetate eroding stream banks. Studies on the Au Sable River (Lower Peninsula) and Indian River (Upper Peninsula) on the nesting requirements of the wood turtle indicate the wood turtle is fairly selective in choosing a nesting site, preferring gentle sloping south and west facing banks. Studies in Minnesota and Wisconsin have identified commercial and casual collection as the major cause of wood turtle decline. This is partly due to the turtles’ apparent lack of fear of humans, allowing canoeists and others to easily approach and capture individuals. On-going studies also indicate that nest predation by racoons may have a major effect on population levels.

6. AQUATIC INVERTEBRATES

There are at least two areas that have unusual aquatic insect communities, in addition to the abundant invertebrate populations in the headwaters. These are areas that have significant hatches of the “Michigan caddis”, which is actually a mayfly (Genus *Hexagenia*) and not a caddis fly

(Genus *Tricoptera*). Excellent hatches of *Hexagenia l.* are found around Cameron Bridge and below Rainbow Jim's landing. In addition, they are found in lesser numbers throughout the area from Cameron Bridge to the Hodenpyl Dam backwaters, downstream of the planning area.

No comprehensive invertebrate studies have been done in the Manistee River watershed. Invertebrates often are sensitive indicators of habitat problems that are affecting fish and other aquatic life. Three macroinvertebrate studies have been conducted in the watershed, by Michigan Department of Environmental Quality (DEQ). In 1985, DEQ Surface Water Quality Division (SWQD) sampled macroinvertebrates above and below Flowing Well Trout Farm on the North Branch of the Manistee River. They found similar benthic communities above and below this private fish hatchery.

No species of mussels are currently listed for this area in the Michigan Natural Features Inventory (Table 4). However, no definitive studies have been conducted in the watershed and a complete inventory of the mussel species present would be beneficial.

7. PEST SPECIES

Pest species are defined here as those species that have been introduced, either accidentally or intentionally, or are exceptionally damaging to economic values, and that pose a significant threat to native species or their habitat. Most species do not pose any threat unless they are present in high densities.

The only fish pest species that is abundant in the Upper Manistee River, its impoundments, tributaries, or natural lakes is the chestnut lamprey. This parasite is abundant in the mainstream from Co. Road 612 to Sharon Bridge and is very abundant in the mainstream downstream of Sharon Bridge. While chestnut lamprey do cause mortalities to trout, the mortality is not significant.

A pest species of mollusk, the zebra mussel, has invaded the Tippy Dam pond and river downstream.

Rusty crayfish are in the Manistee River system. The "Rusty" is an exotic species, probably introduced by bait dealers and anglers. It is an extremely aggressive crayfish, even known to attack swimmers' toes, and has often replaced native species where introduced.

There are two known pest plant species in the Manistee River system, purple loosestrife and Eurasian milfoil. Eurasian milfoil is present in several of the lakes in the watershed.

Several terrestrial pest species are present, among them gypsy moth, forest tent caterpillar, spruce budworm, and jackpine budworm. None are present in high enough densities to be a problem except the gypsy moth, which can cause severe tree mortality in forested areas. The gypsy moth itself does not kill the tree, but lowers its resistance to other diseases and parasites, especially in oaks on poorer sites.

Other natural features, animals and plants that occur in the Manistee River area are listed in Table 4.

G. *HYDROLOGY AND CHANNEL MORPHOLOGY*

1. ANNUAL STREAM FLOWS

Draining an area of 590 square miles, the Upper Manistee River has average discharge rates at the following United States Geological Survey (USGS) Manistee gauge stations: Mancelona Bridge (Otsego County)-18 cfs; County Road 612 (Crawford County)-116 cfs; CCC Bridge (Kalkaska County)-256 cfs; Sharon (Kalkaska County)-336 cfs; and Sherman (Wexford County)-838 cfs.

2. FLOW STABILITY

Seasonal flow stability can be critical to support balanced and diverse fish communities. It is also a determining factor in ecological and evolutionary processes in streams and has been positively correlated to fish abundance, growth, survival, and reproduction.

The Manistee River mainstream and the Au Sable River are said to have the most stable seasonal flows of any streams in the country. The extreme stability of the mainstream of the Manistee River is a reflection of the geology and soils in the watershed.

River systems such as the Upper Manistee also have very stable daily flows due to the soil types and buffering wetlands present in the watershed. Human-induced factors such as dam operations and some lake-level control structure operations can cause significant daily flow fluctuations. These daily fluctuations can destabilize banks, create abnormally large moving sediment bedloads, disrupt habitat, strand organisms, and interfere with recreational uses of the river. Aquatic production and diversity are profoundly reduced by such daily fluctuations.

One active lake level control structure in the watershed is located on Lake Margrethe. This structure is operated seasonally by the Crawford County Road Commission. When water in the lake is above the target level, flows are rapidly increased to bring the lake level down and when the lake water level is below the target level, flows are reduced.

3. CHANNEL GRADIENT

River gradient is one of the main controlling influences on the river channel. Steeper gradients allow faster water flows with accompanying changes in depth, width, channel meandering, and sediment transport.

The average gradient of the Upper Manistee River mainstream is four feet per mile. Naturally, some portions of the river are steeper than average while others are more gradual. These different gradient areas create different types of channel, and hence different kinds of habitat for fish and other aquatic life. Typical channel patterns in relation to gradient are listed below. In these descriptions, hydraulic diversity refers to the variety of water velocities and depths found in the river. The best river habitat offers such variety to support various life functions of various species.

Gradient Class	Channel Characteristics
0.0 - 2.9 feet/mile	Mostly run habitat with low hydraulic diversity
3.0 - 4.9 feet/mile	Some riffles with modest hydraulic diversity
5.0 - 9.9 feet/mile	Riffle-pool sequences with good hydraulic diversity
10.0 - 69.9 feet/mile	Well established, regular riffle-pool sequences with excellent hydraulic diversity
70.0 - 149.9 feet/mile	Chute and pool habitats with fair hydraulic diversity
> 150 feet/mile	Falls and rapids with poor hydraulic diversity.

4. STREAM CHARACTERISTICS BY SEGMENT

Discharge rates, gradient and other characteristics of various segments of the river channel are as follows:

Headwaters to M-72

From its source to the confluence of Frenchman's Creek, the Manistee River follows a shallow, winding, woody-cover filled course. River discharge at Mancelona Bridge is 17.6 cfs and the gradient is 5.9 ft/mi. This section is characterized by areas of shallow water and a channel with abundant vegetation and woody debris.

From Frenchman's Creek to the M-72 Bridge, the flow and depth increase and the channel has less woody debris. River discharge at County Road 612 is 116 cfs and gradient is 2.1 ft/mi.

M-72 to Wexford/Missaukee County Line

Between the M-72 Bridge and Sharon the channel widens and in most areas is practically lacking the large woody debris that provides trout cover and insect habitat. River discharge at CCC Bridge is 256 cfs. Gradient ranges from 2.2 to 9.8 ft/mi. in this stretch. This section has many short, relatively shallow, fast riffles.

The North Branch of the Manistee River enters the mainstream at Sharon, resulting in a larger, deeper channel. River discharge at Sharon is 336 cfs.

North Branch of the Manistee River

The North Branch follows a slow, winding course through open marshlands, with beaver dams, dense overhanging vegetation, and partly submerged woody debris. The North Branch has a discharge rate of 26.4 cfs.

H. *VEGETATION, SOILS AND LAND USE PATTERNS*

The historical vegetative cover of the watershed was predominantly pine forest and hardwood forest, with wetlands intermixed. The current landscape is predominantly coniferous, deciduous, or wetland forest (54 percent), agricultural land (39.03 percent) and a few urban areas (3.29 percent). Common tree species in areas with loamy soils include northern white cedar, balsam fir, red maple, and basswood. In the higher, sandy areas, red pine, jack pine and oak dominate.

Current land use patterns in the watershed are approximately as follows:

Urban and suburban	3.29%
Agricultural	39.03%
Range land	1.71%
Coniferous forest	12.18%
Deciduous forest	29.28%
Wetlands (forested & non-forested)	12.83%
Lakes and streams	1.68%

While thirty-nine percent of the area is listed as agricultural land, little of this is tilled cropland. The majority is pasture, fruit orchards, or Christmas tree plantations.

The majority of the soils in the watershed, especially along the mainstream, are deep sands of the Kalkaska-Rubicon-Grayling series, which are very well drained, rapidly permeable soils.

Soils of the watershed include the following (percentages are approximate):

Clayey	7.9%
Loamy/organic/sand/gravel/sandy	41.4%
Sandy	19.4%
Wet/clayey/loamy/sandy/organic	29.6%
Inland lakes and streams	1.7%

I. *LAND OWNERSHIP*

The State of Michigan MDNR has extensive land ownership in the Upper Manistee River corridor. Table 6 reflects the land ownership by county within 400 feet on either side of the mainstream and tributaries. A total of 52.2 percent of the corridor lands are in public ownership. In 1994, a significant transfer of riparian and other lands from Consumers Energy to the MDNR resulted from a settlement between the two parties related to the operations of the Consumers Energy Ludington Pumped Storage Facility. Consumers Energy land ownership is now primarily project lands associated with Tippy and Hodenpyl Dams downstream of the planning area.

A major land use in the Upper Manistee watershed is the Hanson Military Reserve, a training area for National Guard Units nationwide. This area on the east side of the mainstream extends from M-72 downstream to CCC Bridge. Little military land actually abuts the Manistee River mainstream, but most of the Portage Creek stream frontage is within the reserve.

J. *RECREATIONAL USES*

Fishing and canoeing are two of the most popular recreational uses on the Upper Manistee River system. These two activities also generate user conflicts in some areas at certain times of the year.

1. CANOEING

Most of the Upper Manistee River mainstream is canoeable. Headwater segments and tributaries are not generally suitable for canoeing due to brush, logjams, and beaver dams.

Although the Manistee River near Deward is large enough for canoeing, canoeing is most popular from Cameron Bridge to Sharon. An additional area of high canoe use is from Smithville to U.S. 131 Bridge downstream of the planning area. Several canoe liveries are located in the Upper Manistee River area.

Canoe trip lengths and conditions for various segments of the system are as follows (much of this information is taken from "Canoeing Michigan Rivers" by Jerry Dennis and Craig Date, 1986 Friede Publications):

MANISTEE RIVER

Deward to M-72 - 14.5 miles, approximately 5 ½ to 7 hours

The river averages 30-50 feet wide and one to three feet deep in this section, with occasional deadfalls present, and with "spreads" areas of braided channels located between Cameron Bridge and County Road 612 and between County Road 612 and M-72. Access is at unmarked trails in the Deward area, Cameron Bridge, County Road 612, the Upper Manistee River State Forest Campground and the State Forest Campground at M-72. The upper sections can be challenging to novice canoeists due to deadfalls, sweepers and a moderate current. Most of the residential development in this area is downstream of County Road 612.

M-72 to CCC Bridge – 14 miles, approximately 4-5 hours

The river averages 40-80 feet wide and one to four feet deep with occasional deeper holes. Access is limited in this stretch due to the great amount of private land and no road/stream crossings. Denser development in the form of cottages is seen near the upper and lower sections of this stretch. Current is slow to moderate in this area, with an occasional "sweeper" to keep paddlers alert.

CCC Bridge to Lower Sharon Bridge – 9.5 miles, approximately 2 ½ to 3 ½ hours

The upper and lower thirds of this section provide an excellent float, with less development and a swifter current in this section than in the previous section. The river still averages 40-80 feet, but with more volume and therefore deeper holes. Again, easy access is limited to the start and end points of this section. The swifter current, high forested banks in some areas and less noticeable development make this one of the nicer sections of the river for canoeing.

Lower Sharon Bridge to M-66 – 9.5 miles, approximately 2 ½ to 3 ½ hours

Below Sharon the river increases in size due to the influence of the North Branch of the Manistee, and slows and widens somewhat, averaging 60-90 feet with some pools up to 10 feet deep. Much of the river corridor consists of floodplain/wetland areas.

M-66 to Old US -131 State Forest Campground (downstream of the planning area), 25 miles, approximately 6-8 hours

A very scenic stretch of river, this section has a fairly swift current and a few riffle areas in the first few miles. However, the current soon slows and the river becomes deeper and slower, and more turbid after a rain due to the heavier clay content of the surrounding soils. The latter part of this trip also features high, forested banks with relatively little development, lending a feeling of remoteness to the section. There are a few intermediate access points on this stretch at county road crossings.

2. FISHING

Trout fishing is extremely popular throughout the river system, including the smallest of tributaries (also see "**Present Fish Communities**"). At this writing, the section from M-72 to C.C.C. Bridge on the Upper Manistee River mainstream is subject to special regulations that specify "flies-only" fishing with a year-round fishing season, except that the brook and brown trout possession season runs from the last Saturday in April through October 31st. The fishing season for the remainder of the mainstream is from the last Saturday in April until September 30, with all tackle allowed. Tributary seasons are also from April to September, with slightly smaller minimum size limits for most trout. See the current Michigan DNR Inland Trout and Salmon Guide for details.

Upper portions of the Upper Manistee River mainstream and major tributaries, and all of the lesser tributaries, are wadeable. Most contain brook and brown trout.

3. OTHER RECREATIONAL ACTIVITIES

Hunting for a variety of game is popular in the watershed. Game mammals such as white-tailed deer, squirrels, snowshoe hares and cottontail rabbits are abundant in many areas. Game birds present include ruffed grouse, woodcock, a large wild turkey population and many varieties of waterfowl.

Other popular recreational activities include camping, picnicking, trapping, ORV trail riding, cross country skiing, hiking, horseback riding, bird watching and simply observing the river and its associated flora and fauna. Segments of the North Country National Scenic Trail are located in the watershed, some coinciding with the existing Shore to Shore Trail. Numerous snowmobile trails exist in the watershed.

There are numerous campgrounds and public access points throughout the river system. These are listed in Table 7.

K. ***DAMS AND BARRIERS***

There are currently 13 known dams in the Upper Manistee River watershed, regulated under authority of Michigan's Dam Safety Part 315 of 1994 PA 451 (Table 8). Ninety percent of these have a head of five feet or less. None have a head greater than 20 feet. The storage capacity of most of these dams is very small, in the 0-10 acre-feet range.

Three relatively small dams four to six feet high were constructed by the MDNR Wildlife Division to create floodings for wildlife habitat. All of these, including Goose Creek Impoundment, Cannon Creek Flooding No. 1, and Cannon Creek Flooding No. 2 are on designated trout streams.

L. *MINERAL EXTRACTION*

The watershed has experienced a great deal of oil and gas activity since the 1930's. Earlier exploration and extraction activities focused on recovering oil from formations in the eastern and southern areas of the watershed. The Niagaran Reef that is present throughout the northern portion of the watershed was first developed in the late 1960's. Since 1987, there has been increased activity related to Antrim gas development, tapping relatively shallow gas reserves throughout the watershed. The potential for widespread continued Antrim gas development exits in all areas of the watershed. Gravel extraction activities are also present in the watershed.

M. *WATER QUALITY*

Overall surface water quality in the Upper Manistee River basin is excellent. Water quality parameters under normal conditions meet the criteria for total body contact recreation, and aquatic life. This is due in large part to the deep permeable soils of the watershed which allow precipitation to rapidly be absorbed. This leads to groundwater flows being the dominant contributor to river flow. Limited development has also helped preserve water quality.

One National Pollution Discharge Elimination System (NPDES) permit for surface water discharge of effluent (the Flowing Well Trout Farm) exists for the basin.

The Michigan Environmental Response Act, Act 307 of 1982, as amended, provides for identification, risk assessment and evaluation of sites of environmental contamination. Twenty-four such sites have been identified in the Upper Manistee River Basin (Table 9).

With good water quality in the watershed, fish populations in the river system have not been subject to any specific fish consumption advisories. All of the waters of the Upper Manistee watershed are classed as designated trout streams.

N. *SPECIAL JURISDICTIONS*

Numerous Federal and State laws and county, township and municipal ordinances affect the river and riparian zones. Some Federal laws and many State statutes affecting the river and its adjoining lands are administrated by the Michigan Department of Environmental Quality (MDEQ), Land and Water Management Division (LWMD) (Table 10).

1. NAVIGABILITY

Navigable Waters as Public Waters

The definition of legal navigability of Michigan streams (i.e. "public waters") is part of an ongoing controversy. Public and private rights related to water have historically been determined by the courts. A navigable water has been defined as any water which in its natural state is capable of and has been used for the purposes of commerce, travel and trade by the customary and ordinary modes of navigation. The floating of logs during the lumbering era was held to be an act of commerce. Consequently, any lake or stream used for this purpose would be considered navigable. Thus, the "log floatation test" has largely become the method of determining the "navigability" of a stream in Michigan, and therefore whether that stream is a public water.

On a navigable stream, the public has the right to float the stream, wade on the submerged soil and to fish in the stream. This right does not extend to trespass upon the private lands of abutting landowners, except that a wading angler may enter upon the upland to avoid a hazard or other impediment obstructing passage within the stream. The public should also feel secure in making a portage around any dam or other obstruction. The banks of a public stream are subject to the public easement only so far as they are necessary to exercise the right of passage and navigation. There have been periodic legislative efforts in Michigan to refine the definition of a navigable water.

Whether a stream is determined to be navigable has no bearing on whether it may be designated a Natural River. Also, designation of a stream as a Natural River has no bearing on its status as a navigable water.

None of the Upper Manistee River system has been declared non-navigable by the courts.

2. COUNTY DRAINS

County Drain Commissioners have authority to establish designated drain systems under the Michigan Drain Code (PA 40, 1956). This allows for construction or maintenance of drains, creeks, rivers, and watercourses and their branches for flood control and water management. A designated drain may be cleaned out, straightened, widened, deepened, extended, consolidated, relocated, tiled, and connected to improve flow of water. Designated drains constructed prior to January 1, 1973 are exempt from the provisions of the Inland Lakes and Streams Part and the Wetlands Protection Part of 1994 PA 451.

The only known designated county drain in the watershed, the Ham Creek Drain, is located in Bloomfield Township, Missaukee County. The relatively few drains in the Manistee River system indicate little development, limited agricultural areas, and mostly sandy soils.

Drain Commissioners are also responsible for the maintenance and operation of lake-level control structures, including the structure on Lake Margrethe in Crawford County, the headwaters of Portage Creek.

3. FEDERAL WILD AND SCENIC RIVERS

The U.S. Forest Service has studied the entire Mansitee River system for possible inclusion in the Federal Wild and Scenic Rivers Act. At this time, no portions of the Upper Mansitee river have been designated as Federal wild and Scenic rivers. Portions of the Lower Manistee River and Bear Creek in Manistee County and the Pine River in Wexford and Manistee counties were designated as Federal Wild and Scenic rivers under provisions of the Federal Michigan Scenic Rivers Act of 1991 (PL 102-249).

O. ***CITIZEN INVOLVEMENT***

Many citizens groups take an active role in protecting and managing the Upper Manistee River watershed. Such groups often act in partnership with MDNR, USFS and other government agencies to work toward the improvement of the river system. Such groups include the Michigan Council of Trout Unlimited, Michigan River Guides Association, Upper Manistee River Association, Manistee River Association, George Mason Chapter of TU and the Michigan Chapter

of Fly Fishing Federation. The non-profit Huron Pines Resource Conservation and Development Council have been instrumental in forming partnerships with many of these groups in the form of restoration committees dedicated to stabilizing eroding streambanks and improving inadequate road/stream crossings.

Many citizens took an active role in helping MDNR develop this Natural River management plan as part of the Upper Manistee River Citizens Advisory Group. Group members represented a wide range of interests such as property owners, local government, local and State-wide citizen and sporting groups, local business and interested citizens from the local area and outside the area. The knowledge and commitment of group members over a three-year planning process was invaluable in the development of recommendations for stream segments to be designated and use and development standards for both public and private lands along those segments.

APPENDIX 2:
HABITAT ASSESSMENT and
DATA SHEETS

STREAM HABITAT ASSESSMENT

I. Stream, Team, Location Information

Site ID:_____ Date:_____ Time:_____

Site Name:_____ Lat/Long _____

Names of Team members:_____

II. Stream and Riparian Habitat

A. General Information *Circle one or more answers as appropriate*							Notes and Observations: Give further explanation when needed.
1	Average Stream Width (ft)	< 10	10-25	25-50	>50		
2	Average Stream Depth (ft)	<1	1-3	>3	>5		
3	Has this stream been channelized? (Stream shape constrained through human activity- look for signs of dredging, armored banks, straightened channels)	Yes, currently	Yes, sometime in the past	No	Don't know		
4	Estimate of current stream flow	Dry or Intermittent	Stagnant	Low	Medium	High	
5	Highest water mark (in feet above the current level)	<1	1-3	3-5	5-10	>10	
6	Which of these habitat types are present?	Riffles	Pools	Large woody debris	Large rocks	Undercut bank	
		Overhanging vegetation	Rooted Aquatic Plants	Other:	Other:	Other:	
7	Estimate of turbidity	Clear	Slightly Turbid (can partially see to bottom)		Turbid (cannot see to bottom)		
8	Is there a sheen or oil slick visible on the surface of the water?	No	Yes				
9	If yes to #8, does the sheen break up into pieceswhen poked with a stick?	Yes (sheen is most likely natural)		No (sheen could be artifical)			
10	Is there foam present on the surface of the water?	No	Yes				
11	Does the foam smell soapy and look white and pillow like or look gritty with dirt mixed in?	Soapy (foam could be artifical)		Gritty (foam is most likely natural)			
The following are optional measurements not currently funded by MiCorps							
8	Water Temperature						
9	Dissolved Oxygen						
10	pH						
11	Water Velocity						

MiCorps Site ID#:_____ Date:_____

II. Stream and Riparian Habitat (continued)

B. Streambed Substrate

Estimate percent of stream bed composed of the following substrate.

Leave blank if group will take transects and pebble counts (in Section IV).

Substrate type	*Size*	*Percentage*
Boulder	>10" diameter	
Cobble	2.5 - 10" diameter	
Gravel	0.1 - 2.5" diameter	
Sand	coarse grain	
Silt/Detritus/Muck	fine grain/organic matter	
Hardpan/Bedrock	solid clay/rock surface	
Artificial	man-made	
Other (specify)		
Can't see		

You may wish to take photos of unstable or eroded banks for your records. Record date and location.

Comments:

C. Bank stability and erosion.

Summarize the extent of erosion along <u>each bank separately</u> on a scale of 1 through 10, by circling a value below. Left/right banks are identified by looking downstream.

Excellent	Good	Marginal	Poor
Banks Stable. No evidence of erosion or bank failure. Little potential for problems during floods. < 5% of bank affected.	Moderately stable. Small areas of erosion. Slight potential for problems in extreme floods. 5-30% of bank in reach has areas of erosion.	Moderately unstable. Erosional areas occur frequently and are somewhat large. High erosion potential during floods. 30-60% of banks in reach are eroded.	Unstable. Many eroded areas. > 60% banks eroded. Raw areas frequent along straight sections and bends. Bank sloughing obvious.
LEFT BANK 10 - 9	LEFT BANK 8 - 7 - 6	LEFT BANK 5 - 4 - 3	LEFT BANK 2 - 1 - 0
RIGHT BANK 10 - 9	RIGHT BANK 8 - 7 - 6	RIGHT BANK 5 - 4 - 3	RIGHT BANK 2 - 1 - 0

MiCorps Site ID#:_____ Date:_____

II. Stream and Riparian Habitat (continued)

D. Plant Community

What percentage of the stream is covered by overhanging vegetation/tree canopy?

<10% 10-50% 50-90% >90%

Using the given scale, estimate the relative abundance of the following:

Plants in the stream:		*Plants on the bank/riparian zone:*	
Algae on Surfaces of Rocks or Plants, or floating	Filamentous Algae (Streamers)	Shrubs	Trees
Macrophytes (Standing Plants)	**0= Absent 1= Rare 2= Common 3= Abundant**	Herbaceous plants	**0= Absent 1= Rare 2= Common 3= Abundant**
Identified species (optional)		Identified species (optional)	

E. Riparian Zone

The riparian zone is the vegetated area that surrounds the stream. Right/Left banks are identified by looking downstream.

1. Left Bank

Circle those land-use types that you can see from this stream reach.

Wetlands Forest Mowed Grass Park Shrubby/Grassy Field Agriculture
Construction Commercial Industrial Highways Golf Course Other_____

2. Right Bank

Circle those land-use types that you can see from this stream reach.

Wetlands Forest Mowed Grass Park Shrubby/Grassy Field Agriculture
Construction Commercial Industrial Highways Golf Course Other_____

3. Summarize the size and quality of the riparian zone along each bank separately on a scale of 1 through 10, by circling a value below.

Excellent	**Good**	**Marginal**	**Poor**
Width of riparian zone >150 feet, dominated by vegetation, including trees, understory shrubs, or non-woody macrophytes or wetlands; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	Width of riparian zone 75-150 feet; human activities have impacted zone only minimally.	Width of riparian zone 10-75 feet; human activities have impacted zone a great deal.	Width of riparian zone ,10 feet; little or no riparian vegetation due to human activities.
LEFT BANK 10 - 9	LEFT BANK 8 - 7 - 6	LEFT BANK 5 - 4 - 3	LEFT BANK 2 - 1 - 0
RIGHT BANK 10 - 9	RIGHT BANK 8 - 7 - 6	RIGHT BANK 5 - 4 - 3	RIGHT BANK 2 - 1 - 0

MiCorps Site ID#:_____ Date:_____

III. Sources of Degradation

1. Does a team need to come out and collect trash?

2. Based on **what you can see** from this location, what are potential causes and level of severity of any degradation at this stream?

(Severity: S – slight; M – moderate; H – high) (Indicate all that apply)							
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)	S	M	H
Highway/Road/Bridge Maintenance and Runoff	S	M	H	Resource Extraction (Mining)	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/Recreational Boating (water releases)	S	M	H
Bank and Shoreline Erosion/ Modification/Destruction	S	M	H	• Marinas/Recreational Boating (bank or shoreline erosion)	S	M	H
Flow Regulation/ Modification (Hydrology)	S	M	H	Debris in Water	S	M	H
Invasive Species	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	S	M	H	Source(s) Unknown	S	M	H

Additional comments:

Michigan Clean Water Corps

MiCorps Site ID#:_____ Date:_____

IV. Optional quantitative measurements

A. Transects and Pebble Counts

To take quantitative stream habitat measurements, conduct 10 transects of your stream reach. Required equipment: tape measure long enough to stretch across the stream, and graduated rod or stick to measure water depth. Data sheet is on the next page.

Directions:
1) Determine stream width.
2) Use the rod to measure depth (D) and substrate (S) at more than 10 but less than 20 regular intervals along the entire transect. (For streams less than 10 feet wide, measure every ½ foot, for streams about 10 feet wide, measure every foot, etc.)
3) At every depth measurement, identify the single piece of substrate that the rod lands on. If it is a mix of substrates, randomly pick one of them, and the next time you find a similar grouping, pick the other(s).
4). For every measurement, enter the reading on the tape measure, the depth, and the substrate on the data sheet on the next page.

Data use: The depth and tape measure reading can be used to produce stream cross-section profiles. The pebble count can be used to give a more accurate percentage breakdown of the stream substrate than simply making an eyeball estimate (see Section II-B).

B. Bank Height

Vertical banks higher than 3 feet are usually unstable, while banks less than 1 foot, especially with overhang, provide good habitat for fish. While doing the transects, measure bank heights and record the angle of the bank (right, acute, or obtuse) as indicated on the data sheet. Left/right banks are identified by looking downstream.

Data use: Calculate the percentage of banks with right, obtuse, and acute angles. Right angles indicate higher erosive potential, while acute angles improve the habitat structure of a stream.

V. Final Check

This data sheet was checked for completeness by: _____

Name of person who entered data into data exchange: _____

Date of data entry:_____

VI. Credits

This habitat assessment was created for the MiCorps Volunteer Stream Monitoring Program from a combination of habitat assessments from the Huron River Watershed Council, the Friends of the Rouge River, and the Michigan Department of Environmental Quality. Version 1.0, June 2009. Version 2.0, November 2020.

MiCorps Site ID#:_____ Date:_____

Michigan Clean Water Corps

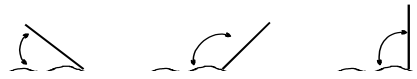
STREAM TRANSECT DATASHEET

B: Boulder -- more than 10”
C: Cobble -- 2.5 - 10”
G: Gravel – 0.1 – 2.5”
S: Sand -- fine particles, gritty
F: Fines: Silt/Detritus/Muck
H: Hardpan/Bedrock
A: Artificial
O: Other (specify)

T= Reading on tape
D = Depth
S = Substrate

	EXAMPLE			Transect #			Transect #			Transect#		
Stream Width	13.3 feet											
	T	**D**	**S**	**T**	**D**	**S**	**T**	**D**	**S**	**T**	**D**	**S**
Beginning Water's Edge:	1.5											
1	2.5	0.4	G									
2	3.5	0.4	G									
3	4.5	0.4	G									
4	5.5	0.2	C									
5	6.5	0	S									
6	7.5	0.6	S									
7	8.5	0.7	G									
8	9.5	0.7	G									
9	10.5	0.6	C									
10	11.5	0.7	B									
11	12.5	0.4	G									
12	13.5	0.3	F									
13	14.5	0.2	F									
14												
15												
16												
17												
18												
19												
Ending Water's Edge:	14.8											
Bank Side	**L**	**R**		**L**	**R**		**L**	**R**		**L**	**R**	
Bank Height	1.7 feet	0.5 feet										
Does the bank have an undercut?	N	Y										
If so, how wide is it?		1 ft										
Bank Angles: Sketch												

Sketch examples:



Undercut (Acute) Obtuse Right

MiCorps Site ID#:_____

Stream Macroinvertebrate Datasheet

Site Name: _____

Date:_____ Collection Start Time:_____(AM/PM)

Major Watershed:_____ HUC Code (if known):_____

Latitude:_____ Longitude:_____

Names of Team members: _____

Stream Conditions:

Average water depth:_____feet

Notable weather conditions of the last week:_____

Are there any current site conditions that may impede normal macroinvertebrate sampling? (weather, flooding, poor visibility, etc?)

Habitat Types: Check the habitats that were sampled. Include as many as possible.

____Riffles
____Rocks
____Aquatic Plants
____Runs
____Backwater areas
____Leaf Packs
____Pools
____Undercut banks/Overhanging Vegetation
____Submerged Wood

Did you see any crayfish? #:_____, Clams/mussels? #_____

remember to include them in the assessment on the other side!

Do not take crayfish, fish, clams, and mussels from the water.

Collection Finish Time: _____(AM/PM) Picking Finish Time:_____(AM/PM)

Identifications made/supervised by:_____

Rate your confidence in these identifications: Quite confident 5 4 3 2 1 Not very confident

Datasheet checked for completeness by:_____ Datasheet version 11/13/2020

Data entered into MiCorps database by:_____ Date:_____

MiCorps Site ID#:_____

Michigan Clean Water Corps

IDENTIFICATION AND ASSESSMENT

*** Do NOT count empty shells, pupae, or terrestrial macroinvertebrates****
****Taxa are listed from most pollution sensitive to most pollution tolerant****

Count	Common Name	Scientific Taxa	Sensitivity Rating (0-10)	Count x Sensitivity
	Hellgrammite (Dobsonfly)	Megaloptera, Corydalidae	0.0	
	Clubtail Dragonfly	Odonata, Gomphidae	1.0	
	Sensitive True Flies (water snipe fly,net-winged midge, dixid midge)	Athericidae, Blephariceridae, Dixidae,	1.0	
	Stonefly	Plecoptera	1.3	
	Caddisfly	Trichoptera	3.2	
	Mayfly	Ephemeroptera	3.5	
	Alderfly	Megaloptera, Sialidae	4.0	
	Scud	Amphipoda	4.0	
	Dragonfly	Odonata	4.0	
	Beetle	Coleoptera	5.1	
	Somewhat Sensitive True Flies	Dipterans (those not listed elsewhere)	6.0	
	Crayfish	Decapoda	6.0	
	Bivalves/Snails	Pelecypoda, Gastropoda	6.9	
	True Bug	Hemiptera	7.7	
	Damselfly	Odonata	7.7	
	Sowbug	Isopoda	8.0	
	Tolerant True Fly (mosquito, rat-tailed maggot, soldier fly)	Culicidae, Syrphidae, Stratiomyidae	8.7	
	Leech	Hirudinae	10.0	
	Aquatic Worm	Oligochaeta	10.0	

	Total Abundance

Sum of (Count x Sensitivity):	

First: If your total abundance is
Less than 30 → Automatically give it a WQR of 10 (Very Poor rating)
Less than 60 → Automatically give it a WQR of 7 (Poor rating)

Water Quality Rating			Degree of Organic Pollution
0.0-3.50	excellent		Pollution unlikely
3.51-4.50	very good		Slight pollution possible
4.51-5.50	good		Some pollution possible
5.51-6.50	fair		Fairly substantial pollution likely
6.51-7.50	fairly poor		Substantial pollution likely
7.51-8.50	poor		Very substantial pollution likely
8.51-10.0	very poor		Severe pollution likely

Water Quality Rating =

Sum of (Count x Sensitivity)
Divided By
Total Abundance

= _____

Datasheet checked for completeness by:_____ Datasheet version 11/13/2020
Data entered into MiCorps database by:_____ Date:_____

APPENDIX 3:
WATERSHED MAP AND SAMPLING LOCATIONS

Watershed Location

Missaukee County

Stream Sampling Sites

To Sample

MISCD-UMAN01

(44.47083, -85.28666)
Hopkins Creek off Lucas Rd

MISCD-UMAN02

(44.48924, -85.25798)
Ham Creek of Lanning Rd

MISCD-US-MUS02

(44.28579, -85.33007)
Clam River in Cadillac Pathways

MISCD-US-MUS03

(44.30666, -85.20194)
Mosquito Creek at MSU Research Farm

MISCD-UC-MUS04

(44.20055, -85.05277)
Clam River off 8-mile Rd

MISCD-UC-MUS05

(44.33675, -84.8864)
Muskegon River at Ben Jeffs Park

MISCD-UC-MUS-06

(44.26058, -84.96434)
Butterfield Creek at Ransom House