A1. Title and Approval Sheet

Quality Assurance Project Plan for Tip of the Mitt Volunteer Stream Monitoring Programs

Date: 2-16-2021
Version # 4
Organization: Tip of the Mitt Watershed Council

Program and QAPP manager: Caroline Keson
Title: Monitoring Programs Coordinator

Signature: 

MiCorps Staff Use

MiCorps Reviewer: _____

Signature of reviewer Date

Signature upon approval. QAPP is valid for two years after date signed.

A.2 Contents

A3. Distribution List

Tamara Lipsey, EGLE, Water Division
Paul Steen, Huron River Watershed Council, MiCorps VSMP Manager
Caroline Keson, Tip of the Mitt Watershed Council
Eli Baker, Tip of the Mitt Watershed Council

A4. Project Organization

1. Management Responsibilities –

A. Caroline Keson , Monitoring Programs Coordinator, Tip of the Mitt Watershed Council, 426 Bay St, Petoskey, MI, 231-347-1181, caroline@watershedcouncil.org. Caroline is the primary project manager and quality assurance manager for the volunteer stream monitoring project. Caroline is the project liaison with ultimate authority for this project. Her responsibilities include:

- Update QAPP every two years and adhere to the Quality Assurance Project Plan.
- Promote volunteer stream monitoring activities and solicit volunteers and stream access permissions from local community.
- Research and purchase necessary equipment for performing stream monitoring activities.
- Coordinate and conduct volunteer stream monitoring training sessions.
- Coordinate volunteer stream monitoring field data collection sessions.
- Coordinate and implement macroinvertebrate indoor sorting and identification sessions.
- Catalogue and store collected specimens.
- Database development, data entry, and data analysis.
- Write reports and update web-page with latest information on an annual basis to share with volunteers and the general public.
- Provision of products and deliverables to MiCorps. All data collected will be sent electronically to the MiCorps database manager on an annual basis.
- Project evaluation.

B. Eli Baker, Water Resources Education Coordinator

- Assist with updates to the QAPP
- Promote Watershed Academy (WA) monitoring activities and stream access permission from local community
- Promote WA stream monitoring activities and solicit volunteers and stream access permissions from local community.
- Research and purchase necessary equipment for performing WA stream monitoring activities.
- Coordinate and conduct WA stream monitoring training sessions.
- Coordinate WA stream monitoring field data collection sessions.

- Coordinate and implement macroinvertebrate sorting and identification sessions.

2. ***Field Responsibilities*** – Field sampling will be performed by volunteers. Team leaders and collectors will receive training in field data collection methods by Tip of the Mitt Watershed Council staff.
    A. Leaders will organize and coordinate stream monitoring efforts by individual teams. In the field, leaders will complete data sheets, collect water samples, measure stream water temperature, take depth measurements, and communicate with the collector to ensure thorough biological sampling of the site. In addition, leaders will provide instruction and guidance to team pickers. After field days, leaders will be responsible for returning equipment, biological samples, water samples and data sheets to Watershed Council staff.
    B. Collectors will sample all in-stream habitats that exist at the site and provide sample contents to pickers for processing.
    C. Pickers will pick macroinvertebrate specimens from sample contents provided by the Collector, presort the macroinvertebrates, and preserve up to 100 specimens per site in alcohol for later identification.
3. ***Laboratory Responsibilities*** – Caroline Keson, Monitoring Programs Coordinator, Tip of the Mitt Watershed Council, 426 Bay St., Petoskey, MI, (231) 347-1181, caroline@watershedcouncil.org will be responsible for calibrating and maintaining the Watershed Council YSI Model 33 Conductivity meter, which will be used to measure conductivity.
4. ***Corrective Action*** – Caroline Keson, Monitoring Programs Coordinator, Tip of the Mitt Watershed Council, 426 Bay St., Petoskey, MI, (231) 347-1181, caroline@watershedcouncil.org will be responsible for initiating, developing, approving, implementing, and reporting corrective actions.

A5. Problem Definition/Background

According to US Census Bureau statistics the number of inhabitants in the northern counties of the Lower Peninsula more than doubled between 1970 and 2020. Population pressure is expected to increase at even greater rates, resulting in urban area expansion and consequent negative impacts on surface water quality. Water quality data from various Watershed Council monitoring initiatives has revealed water quality impacts from invasive species and nonpoint source pollution throughout Antrim, Charlevoix, Cheboygan and Emmet Counties.

Although volunteers have monitored lake water quality in the northern Lower Peninsula for several decades, streams had been largely neglected until 2005. A growing number of lake associations expressed interest in monitoring stream water quality to determine the effects of tributaries draining into their lakes, which prompted the Watershed Council to establish the Tip of the Mitt Volunteer Stream Monitoring program. In 2005, volunteers began monitoring streams to collect baseline water quality data, determine the current health of the streams and begin monitoring changes that may result from human influence.

Originally three watersheds were targeted, but the program has expanded to include 70 sites on 21 different stream systems. Some of these sites include ones monitored school children in the Watershed Council's Watershed Academy. The Watershed Academy was developed in 2015 in response to requests to engage school aged volunteers within the Watershed Council's service area. The Watershed Academy is a stream monitoring program that allows high school students to learn about and monitor a stream in their community. The students are trained to monitor the stream using the same protocols and processes as the Watershed Council's Volunteer Stream Monitoring Program and the data collected by Watershed Academy teams can be utilized in the same manner as other stream quality data. Fourteen streams are monitored by the participating schools each spring and fall.

Three of the Watershed Council's monitoring sites have known populations of the federally and state-endangered Hungerford's crawling water beetle (*Brychius hungerfordi*). The sites are the Black River at Barber Bridge, the Boyne River at Thumb Lake Rd., and Mullett Creek at Straits Highway (M-27). While the presence of the beetle was known at the Black River and Boyne River prior to Watershed Council stream efforts, Water Council volunteers were responsible for collecting the beetle in Mullet Creek in May 2009. This was not discovered until Watershed Council staff and volunteers inspected collections with Haliplidae in 2020, following an accidental collection of the beetle by volunteers at the Black River/Barber Bridge. The beetle was added to the List of Endangered and Threatened Wildlife and Plants on April 6, 1994. Its populations are very small and located in a few isolated locations in Michigan and Ontario, Canada. Beaver dams may be part of the beetle's habitat. Stream dredging,

channelization, bank stabilization, and impoundment may harm the beetle's habitat as well as removing beaver dams.

Tip of the Mitt Watershed Council has a long history of providing aquatic resource information and education to government officials and the local community. Having access to such information generates greater interest in the resource from the public and results in increased awareness and understanding of the environmental and economic values of aquatic ecosystems. Government officials, planners and others are more effective at protecting aquatic resources when water quality data are available to aid in the decision-making process during activities such as master planning and zoning. Water resource professionals and the general public are more successful in promoting stewardship of aquatic resources by using stream water quality data during educational activities.

Results from the program are summarized and presented in annual reports that are sent to Watershed Council members, lake/stream associations, local governments, and other organizations/agencies. Problem areas discovered by volunteer monitoring efforts are investigated, collaboratively with local, state, federal and Tribal aquatic resource professionals. Results are also used to describe effects of best management practices related to nonpoint source pollution such as the installation of greenbelts and improvements in road/stream crossings.

A6. Project Description

The goal of the Tip of the Mitt Volunteer Stream Monitoring program is to protect and improve the water quality of the streams of the northern Lower Peninsula of Michigan. Specific objectives of the program include: collect baseline data, characterize stream ecosystems, identify specific water quality problems, determine water quality trends, evaluate best management practices, and inform and educate the public regarding water quality issues and aquatic ecology. As with the Volunteer Lake Monitoring Program, which has been sponsored and coordinated by the Tip of the Mitt Watershed Council for the last 35 years, volunteer stream monitoring activities will continue to be supported by the Watershed Council into the future.

The key to accomplishing the stated goal is fostering stewardship of aquatic resources through community involvement and education. As more people become involved in monitoring activities and receive water quality education, particularly concerning information regarding the health of local streams, the more likely they are to take care of their streams and become involved in community decision making that could impact water quality. The information gleaned from monitoring activities, such as water quality trends, is shared with and utilized by local governments and citizens for educational and resource management purposes.

This monitoring program focuses on biological monitoring as a tool to assess stream water quality and ecosystem integrity. Aquatic macroinvertebrates are collected and identified to determine diversity in the benthic community and the presence of pollution-

sensitive macroinvertebrate families, the results of which are used to gauge the health of the stream reach. In addition to biological monitoring, volunteers collect water samples to measure conductivity, which is a good indicator of impacts to the stream ecosystem caused by urban and agricultural activity within a watershed. Volunteers also record stream water temperature to note variation within a stream system, identify areas that suffer from thermal pollution, and detect changes over time.

The service area for the Tip of the Mitt Watershed Council includes the counties of Antrim, Charlevoix, Cheboygan, and Emmet as well as portions of major watersheds within these four counties that extend into adjacent counties. Based upon input from local residents, lake/stream associations, and findings from Watershed Council monitoring, streams from five major watersheds are included in the monitoring program.

A7. Data Quality Objectives

Precision/Accuracy: Streams monitored in this program are assessed by examining aquatic macroinvertebrate community diversity. Quality control during field data collection, to guarantee precision and accuracy, is accomplished by the Program Manager or other trained staff who accompany teams to observe their collection techniques and note any divergence from protocols. The Program Manager also performs independent side-by-side collection (duplicate sample) at one of the two sites monitored by the volunteer team. New volunteers and sites where it is difficult to collect (e.g. poor habitat, deep water, etc.) will be prioritized for side-by-side sampling. The Program Manager alternates between teams during each sampling event. Considering the number of teams now included in the program, quality control for field data collection is carried out approximately once every five years for each team. As the program expands, the Program Manager or other trained staff accompanies new teams during their first macroinvertebrate sampling event and collects duplicate samples.

For sites with known Hungerford's crawling water beetles, staff with permits from the USFWS and MDNR must be present during macroinvertebrate collection (Appendix A). Techniques reviewed in the field include [1] collecting style (must be thorough and vigorous), [2] habitat diversity (must include all habitats and be thorough in each one), [3] picking style (must be pick thoroughly through all materials collected and pick all sizes and types) [4] variety and quantity of organisms (must ensure that diversity and abundance at site is represented in sample), and [5] the transfer of collected macroinvertebrates from the net to the sample jars (specimens must be properly handled and jars correctly labeled). Side-by-side sampling results (by program manager) are compared with volunteer team results to determine if there is a strong divergence between diversity measures. If diversity scores vary strongly (using an 80% threshold), then follow-up is carried out wherein program manager reviews methods with team members and encourages attendance at future training sessions.

The accuracy of specimen identification is dependent upon the abilities of the experts aiding in the indoor identification session. Identifications made by experts that have not received course work or training in family level aquatic macroinvertebrate identification

or better, are reviewed by the Program Manager or by other qualified aquatic macroinvertebrate taxonomists. At least 10% of the samples processed by experts in question will be reviewed to verify results. If more than 10% of specimens were misidentified, then all the samples processed by that expert will be reviewed.

A given site's total diversity (# of families) will be compared to the composite (median) results from the past three years and should be within two standard deviations of the median. Sample results that exceed these standards should be then noted as "outliers" and examined to determine if the results are likely due to sampling error or a true environmental variation. If sampling error is determined the data point should be removed from the data record and resampled if within a two-week time frame from the original sample. Volunteer teams that generate more than one outlier should be observed by the Program Expert at the next sampling event and be considered for an upcoming side by side.

If no sampling error can be determined and the site has a diversity less than two standard deviations from the median, the site will be resampled by the Program Manager to double-check the diversity numbers and to look for any signs of habitat and water quality degradation.

Regarding physical water quality data collection, accuracy and precision are accounted for by following procedures similar to those established for macroinvertebrate data. The Program Manager accompanying the team measures the stream's conductivity and water temperature at the site using a YSI Kor EXO I, YSI Model 33, or Hydrolab MiniSonde® (calibrated via procedure outlined in the manual prior to sampling event). Results by teams are compared to expert results. Conductivity measurements between team and expert should not vary by more than 50 microSiemens and temperature should not vary by more than 2 degrees Celsius. If results are outside limits of comparability, data collection techniques will be reviewed with leader. Furthermore, measuring equipment will be calibrated and checked to ensure that it is functioning correctly as detailed in section B5 of this plan. This protocol will help determine the source of error if unacceptable disparity in readings occurs again.

Completeness: Following a QA/QC review of all collected and analyzed data, data completeness will be 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 95%. 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 for the program are selected following the methodology described in section B1. As indicated, all available habitats are sampled and documented to assure that the site is representative of other stream segments in the subwatershed. Resulting data from the monitoring program are used to summarize the biological conditions of the contributing subwatershed, as an initial screening mechanism. Since

there are not enough resources available to allow the program to cover the entire watershed, some subwatersheds may not initially be represented. Additional subwatershed sites are added as resources and volunteers allow.

Comparability: To ensure comparability, all volunteers participating in the program will follow the same sampling methods and use the same units of reporting. The methods are based on MiCorps standards, which will increase comparability with other MiCorps programs. Periodic reviews of sampling events by the Program Manager will ensure adherence to these standard methods.

A8. Special Training/Certifications

The Program Manager coordinates trainings and ensures that all program personnel and volunteers are properly trained. Trainings can include Volunteer Stream Monitoring Grantee Training or a combination of education and experience.

Volunteer team Leaders and Collectors are trained by the Program Manager in basic stream monitoring methods prior to field day collections. The training covers program goals and objectives, biological and physical data collection methods, filling out field data sheets, safety issues, and quality assurance practices. A database is maintained by Tip of the Mitt Watershed Council that lists all volunteers that have received training as well as the date of the training. Leaders and Collectors, as well as other volunteers, are encouraged to attend a training at least every three years to refresh their knowledge of program components and to learn about any changes incorporated into the program. Training refreshers are also accomplished through side-by-side monitoring with the Program Manager.

Macroinvertebrate collection at streams with known Hungerford's Crawling Water Beetles must have someone with a USFWS Federal Fish and Wildlife Recovery Permit in attendance. Below is a list of local people with permits:

Caroline Keson, Tip of the Mitt Watershed Council
Eli Baker, Tip of the Mitt Watershed Council
Lauren Dey, Little Traverse Bay Bands of Odawa Indians
Josh Leisen, Huron Pines
Bert Ebbers, Great Lakes Ecosystems
Bob van de Koppel, retired University of Michigan Biological Station professor

A9. Documentation and Records

All data, including information recorded on field datasheets, conductivity measurements, and aquatic macroinvertebrate data are entered into and managed in Microsoft Excel workbooks. Paper datasheets are scanned in as electronic files, and then are filed and stored at the TOMWC office. Electronic data are stored on a server and backed up daily, with rotating back-up media

stored off premises. Computer passwords provide data security. Data will be stored indefinitely at the Watershed Council office. Raw datasheets are kept for a minimum of ten years.

B1. Study Design (Experimental Design) & Methods

Monitoring Sites

Monitoring sites were chosen to assess water quality in areas of concerns and to monitor longitudinal variation in stream systems. Watershed Council staff visited potential monitoring sites on target streams and assessed the sites in terms of habitat diversity present, accessibility, safety, and likelihood of impairment. Watershed Academy sites are often located close to schools for short travel times. Sites that are on private property, unsafe, or flooded are not monitored or retired on a case-by-case basis. A map of sites can be found in Appendix B and a list of sites and information about each can be found in Appendix C.

Methods

Volunteers monitor stream water quality by collecting physical and biological data two times per year, during the months of May and September (Table 2). Physical monitoring includes water temperature and conductivity (Appendix D). Biological monitoring consists of collecting a representative sample of the benthic community (Appendix E).

Water temperature is measured by volunteers using hand-held thermometers to note longitudinal variations in the stream system and impacts on the macroinvertebrate community. Temperature data provide valuable insight into stream systems that contain impoundments and help gauge thermal impacts from streams that flow through urban areas. Water samples collected by volunteers are used to measure conductivity. Conductivity measurements have been demonstrated to be a good surrogate indicator of human activity in a watershed and are therefore pertinent for streams that flow through or near urban areas.

Table 2. *Annual events schedule for volunteer stream monitoring program.*

Event	Date	Participants
Fall Training	September (2nd week)	Leaders, Collectors, Pickers
Fall Field Window	September 15-30	Leaders, Collectors, Pickers
Fall Indoor ID	October--December	Experts
Spring Training	May (2nd week)	Leaders, Collectors, Pickers
Spring Field Day	May 15-31	Leaders, Collectors, Pickers
Spring Indoor ID	June--August	Experts

Table 3. *Annual events schedule for Watershed Academy program*

Event	Date	Participants
Fall Training	September (2nd to 4th week)	Leaders, Students
Fall Field Day	October (1st to 3rd week)	Leaders, Students
Fall Indoor ID	October (4th week)	Experts
Spring Training	April (2nd to 4th week)	Leaders, Students

Spring Field Day	May (1st to 3rd week)	Leaders, Students
Spring Indoor ID	May (4th week)	Experts

The biological evaluation of stream water quality consists of a complete sample of the different groups present rather than a random sub-sample because it is based upon community diversity. 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. During field data collection efforts, volunteers attempt to collect specimens from the benthic community from all habitats present at the site. Macroinvertebrates collected from the benthic community are identified to the family level and tallied to calculate diversity indices. Diversity scores are used to rate the health of the stream ecosystem and provide a basis for trend analyses. Results from this program are compared with other data sets available through EGLE and other agencies/organizations for the site in question and compared with locations in the same river system included in this program.

B2. Study Methods

The Watershed Council will contact existing volunteers and promote the recruitment of additional volunteers approximately one month prior to each sampling event. For each sampling event, monitoring by volunteers will be completed within the same two week period each year. If a site is temporarily inaccessible, due to factors such as prolonged high water, the monitoring time may be extended for two additional weeks. If the issue concerning inaccessibility is continued beyond the extended dates, then monitoring data will be collected during that time and the change will be noted in quality control report. If a team is unable to monitor their site during the specified time, the Team Leader will contact the Project Manager as soon as possible and no later than the end of the first week in the sampling window in order for the Manager to arrange for another team to complete the monitoring. If no team is available, the Project Manager will be responsible to see that the site is monitored unless sufficient redundancy has been included in the monitoring schedule that additional data is not needed.

Team leaders will be given a binder with directions and history about their site, datasheets, and procedural information about monitoring.

B3. Sample Handling and Custody

At the sample site, volunteers write relevant information on a label, including stream name, location, date, and number of containers used to collect specimens, which is placed inside every container used at the site. The field datasheet includes a section to record the number of containers used at the site. Containers used for collecting water samples have the stream name and site location written with indelible marker on label tape that is affixed to the container. The team leader is responsible for putting labels in containers, securely closing the containers, and returning all containers and equipment to the Program Manager. Upon delivery to the Program Manager, all containers are checked for labels. All containers from an individual site are secured together with a rubber band and placed together in a bag that includes a site label. In addition,

datasheets are checked for completeness and to verify that the correct number of containers from the sample site is indicated on the data sheet.

Samples are stored in the Watershed Council office until the expert ID session. Conductivity is measured for water samples within a calendar year. Team leaders turn field datasheets into the Program Manager, information is entered into a database, and then, datasheets are scanned and electronic and hard copies are filed and stored at the Watershed Council office for a minimum of 10 years.

During subsequent "expert-only" identification sessions, experts work on one site at a time, identifying all organisms from that site, before packing specimens in a container for long-term storage. All specimens from an individual site are stored in glass containers with Polyseal lining to ensure safe, long-term storage. Labels made of heavy-gauge paper are inserted into containers to provide relevant information, such as stream name, sample site location, and date collected. The containers are checked periodically for alcohol content and refilled as necessary. In the event that the container or lid is found to be faulty, all contents and label are transferred to a new container that is filled with alcohol. Preserved samples are securely stored for a minimum of five years at the Tip of the Mitt Watershed Council office for future reference.

B4. Analytical Methods

Aquatic macroinvertebrates collected by volunteers during sampling events are identified to the family level or lowest taxonomic level possible. Although reference literature for taxonomic identification is dependent upon the preference of the expert, copies of *Aquatic Insects of North America* by R. W. Merritt and K. W. Cummins, *Aquatic Insects of Wisconsin* by W. L. Hilsenhoff, and *Guide to Aquatic Invertebrates of the Upper Midwest* by R.W. Bouchard, Jr. are available during indoor identification sessions. Volunteer experts record specimen identifications from an individual site on a datasheet that includes a list of aquatic macroinvertebrate order and family names most commonly found in Northern Michigan streams (Appendix F). Stereo microscopes with up to 65x magnification are also available during indoor identification sessions to aid the experts. If unable to process all samples during the identification sessions, Tip of the Mitt Watershed Council staff will complete the identification process.

Three biotic diversity indices are used to rate the water quality of each stream, make comparisons between streams and perform trend analyses within the same stream over time. Diversity indices to be used include: Total Taxa, EPT, and a Hilsenhoff Sensitivity Index. The Total Taxa index is the total number of families found at a sample site during one sample event. The EPT index is the total number of families belonging to the Ephemeroptera, Plecoptera, and Trichoptera orders found at a sample site during one sample event. A system developed by William L. Hilsenhoff to rate the sensitivity of aquatic macroinvertebrates is used to total the number of sensitive families (those receiving ratings of 0, 1, & 2 by Hilsenhoff). All biotic diversity index scores are calculated on the aquatic macroinvertebrate identification datasheet and all information from the datasheet is entered into a Microsoft Excel® workbook.

Annual stream monitoring reports will include an average score (spring and fall data) for each site and stream alongside the site and stream's historical average score, which includes all Watershed Council data for that site and stream.

B5. Quality Control

Equipment Quality Control

1. YSI EXO Handheld or Hydrolab Surveyor® unit must be checked and charged if necessary before each event.
2. Calibration solution standards must be checked to ensure that they are not expired and that there is sufficient volume to perform calibrations.
3. YSI Kor EXO I or Hydrolab MiniSonde® must be calibrated before each field event according to the standard calibration procedures from the, using a two point calibration with standard solutions. If either piece of equipment will not calibrate correctly or if experiencing any other technical problems, the unit must be sent into company for service. If the either piece of equipment is not ready for use during the sampling event, the Watershed Council will use a backup YSI conductivity meter that has been calibrated according to specifications. Equipment and calibration solutions will be securely stored in the laboratory of the Watershed Council office.
4. Thermometers must be inspected physically for damage prior to use. In addition, thermometers will be checked to verify that they are functioning correctly, by emersion into both boiling and ice water. If the thermometer is damage or not working correctly, it will be disposed of properly and replaced with a new unit.
5. D-frame nets must be inspected for damage and repaired or replaced as necessary.
6. Containers for water sample collection must be checked for damage and cleanliness and cleaned or replaced as necessary.
7. All equipment must be cleaned, dried and stored securely after sampling events.

Field Procedures Quality Control:

1. Replicate water samples must be collected during side-by-side field data collection when a new volunteer team starts monitoring and then every 3-5 years thereafter. A program manager or qualified expert will accompany the team and collect a replicate water sample to verify accuracy of conductivity measurements.
2. Replicate water temperature data must be collected during side-by-side field data collection when a new volunteer team starts monitoring and then every 3-5 years thereafter. A program manager or qualified expert will accompany the team and collect replicate water temperature data to verify accuracy.
3. Replicate benthic macroinvertebrate sampling must be performed during side-by-side field data collection when a new volunteer team starts monitoring and then every 3-5 years thereafter. A program manager or qualified expert will accompany the team and collect benthic macroinvertebrate data to compare diversity indices with those of the team and thus, verify quality control in collection techniques and thoroughness.

Indoor Sorting and Identification Quality Control

1. All containers with macroinvertebrate specimens must be checked by a program manager upon receipt from the volunteer team to assure that they contain labels and are secured together with a rubber band and site label, and placed together in one bag.
2. Field datasheets used by volunteers must be checked for completeness and to verify that the correct number of containers from the sample site is indicated on the form.
3. Prior to identification, datasheets and containers must be checked to ensure that all containers, and only containers from that collection are present prior to emptying them into a white pan for sorting.
4. During the indoor session, if any specimens are separated from the pan during sorting and identification, a site label must accompany them.
5. All samples must be checked and verified by a qualified expert.
6. Following identification, all specimens from the sample site in question must be stored in 70% ethanol in an air-tight container and a label included in the container that includes all relevant information (e.g., stream name, sample site location, and sample event date.).

Data Analysis Quality Control

1. Field datasheets must be reviewed for errors upon receipt by a program manager to minimize errors before entry into a database and subsequent analysis.
2. Calculations for diversity indices must be verified by a program manager to minimize errors before entry into a database and subsequent analysis.
3. Data entered into the computer must be reviewed by comparing hard copy print outs of database with field data sheets.
4. Data analysis methods must be reviewed on a five year basis by qualified professionals.

A quality control check list was developed for use by project managers (Appendix G).

B6. Instrument/Equipment Testing, Inspection, and Maintenance

D-frame nets are inspected before each sampling event to ensure that they are intact. If the nets have come loose from the frame, they are fixed, and if holes or tears are found in the netting, nets are replaced prior to use. Containers for collecting water samples are also be inspected before each event and cleaned or replaced as necessary.

The YSI Model 30 Conductivity Meter is calibrated prior to use and calibration records are kept in the Watershed Council's lab. If service is needed, the Watershed Council will work with the companies of origin.

Thermometers are inspected physically for damage and compared to other thermometers and/or the Hydrolab to verify that they are functioning correctly, prior to the sampling event. If equipment has been damaged or is malfunctioning, replacement thermometers are purchased by the Tip of the Mitt Watershed Council.

Decontamination

The following decontamination methods will be employed to prevent the spread of aquatic invasive species. In particular, efforts will be made to prevent the spread of New Zealand mudsnail which has been found close (Boardman River), but not inside, the Watershed Council's service area. The New Zealand mudsnail is of special interest because it is often spread on waders, which are used frequently in stream monitoring. The mudsnail can survive drying for longer than other invasives.

Watershed Academy
A field day for Watershed Academy involves going to one stream site at one stream or river. Watershed Council staff is always present. All non-breathable waders and gear will be sprayed with a 10% bleach solution upon returning to the Watershed Council office. Waders will be rinsed with fresh water and set out to dry. When possible, they will dry for 5 days before reusing. If neither the 5 day dry period nor the 10% bleach solution is possible, waders will be frozen for 48 hours before reuse. The Watershed Council has a lot of waders and will make an effort to use different sets of waders from site-to-site.

Volunteer Stream Monitoring
A field day for volunteer stream monitoring sometimes involves more than one site and sometimes more than one stream (but always in the same watershed). In between sites, volunteers will spray down all waders and gear with a 10% bleach solution and let dry for 10 minutes. Waders and gear will again be sprayed with a 10% bleach solution when returned to the office. When possible, they will dry for 5 days before reusing. If neither the 5 day dry period nor the 10% bleach solution is possiblee, waders will be frozen for 48 hours before reuse.

B7. Instrument/Equipment Calibration and Frequency

Conductivity is measured in the lab using a YSI Model 33 Conductivity meter that is properly calibrated prior to use. In the field a YSI Kor EXO1 model will be used.

B8. Inspection/Acceptance for Supplies and Consumables

A list of monitoring supplies and consumables is available in Appendix H. Supplies will be maintained by program managers and stored at the Watershed Council office.

B9. Non-direct Measurements

Data from the Michigan Environment, Great Lakes, and Energy (EGLE) streams database may or may not be used to make comparisons between sites, with the same site, or for trend analysis. Information about stream data collected by EGLE can be found at

the following website: http://www.michigan.gov/deq/0,1607,7-135-3313_3686_3728---,00.html. Data from other agencies or organizations, such as the Little Traverse Bay Band of Odawa Indians, may be used for the same purposes. All data generated outside the Tip of the Mitt Volunteer Stream Monitoring program are only used if field methods are similar and specimens have been identified to the same taxonomic level (usually family). Data may also be used to quality assure data .

B10. Data Management

Tip of the Mitt Watershed Council staff ensure that field datasheets are turned in with collected specimens when brought in by volunteers from the field. Following the indoor session, information from both field datasheets and specimen identification datasheets is put into a comprehensive stream water quality Microsoft Access® database, designed and created by Watershed Council staff. Either program managers or a single trained volunteer inputs the data into the database. All inputted data are verified with raw data from datasheets.

Once a year, all new data are exported to a compatible format and sent to MiCorps for inclusion in the MiCorps data exchange. Digital data are stored on the Watershed Council server, which is backed up daily, a copy of which is taken home each week day by a designated staff person. Hard-copy data sheets are stored at the Watershed Council office for a period of at least ten years. If the program were to be discontinued, the Watershed Council would consult with MiCorps staff regarding the fate of stored data.

C1. Assessments and Response Actions

Volunteer team leaders trained by Tip of the Mitt Watershed Council or MiCorps monitor to ensure that quality assurance protocols are followed and report any issues possibly affecting data quality. Program managers accompany groups in the field to perform side-by-side sampling and verify the quality of work by the volunteer team. Details of this process and assessment of data quality are outline in section A7. Response to quality control problems is also included in section A7.

If deviation from the QAPP is noted at any point in the sampling or data management process, the affected samples are flagged in the database and are not used for stream assessment or comparisons. Re-sampling is conducted if feasible, given that the deviation is noted soon after occurrence and volunteers are available. Otherwise, a gap must be left in the monitoring record and the cause noted. All corrective actions are documented and communicated to MiCorps.

C2. Reporting

Watershed Council staff will publish yearly reports to share results of the program with volunteers, lake and stream associations, and the general public. Data and reports are made available on Watershedcouncil.org.

Quality control reports will be generated as quality control issues occur and stored on the Watershed Council's server. They will also be sent to MiCorps. Quality control reports will provide information regarding and 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.

D1. 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. A program manager or a single trained volunteer reviews data before it is stored in a computer or file cabinet. After data has been compiled and entered into a computer file, they are verified with raw data from field and identification datasheets. Volunteer experts conduct identification with the aid of dissecting microscopes (with a maximum enlargement of 65x), consultation with dichotomous keys (*Guide to Aquatic Insects of the Upper Midwest*, Bouchard, *Aquatic Insects of Wisconsin*, Hilsenhoff and *Aquatic Insects of North America*, Merritt and Cummins), and the use of a reference collection on-hand at the Watershed Council office. Identification results from volunteer experts are confirmed by experienced aquatic entomologists.

Experts who assist in macroinvertebrate identification quality control include:

1. Caroline Keson, Tip of the Mitt Watershed Council, B.S. in Environmental Studies, 11 years of experience in macroinvertebrate identification
2. Eli Baker, Tip of the Mitt Watershed Council B.A. in Elementary Education, 5 years of experience in macroinvertebrate identification
3. Kathy Germain, Volunteer, retired Biology Professor at North Central Michigan College with coursework in aquatic macroinvertebrate taxonomy.
4. Mike Winnell, M.S. University of Michigan, 40 years' experience in aquatic macroinvertebrate identification with Freshwater Benthic Services, Inc.
5. Doug Fuller, Volunteer, retired Director of Stewardship at Little Traverse Conservancy, former Director of Monitoring and Research at Tip of the Mitt Watershed Council

D2. Reconciliation with Data Quality Objectives

Data quality objectives are reviewed on an annual basis to ensure that objectives are met. Any data quality problems are reported to program managers and MiCorps for assessment and corrective actions. In addition, data quality issues are recorded as a separate item in the database and provided to all data users. Specific response to and reconciliation of problems that occur in data quality are outlined in section A7.

NATIVE ENDANGERED SPECIES RECOVERY
ENDANGERED WILDLIFE

Permit Number: TE75495D-0

Effective: 07/09/2020 Expires: 12/31/2025

Issuing Office:

Department of the Interior
U.S. FISH & WILDLIFE SERVICE
Endangered Species Permit Office
5600 American Boulevard, West, Suite 990
Bloomington, MN 55437-1458
permitsR3ES@fws.gov

Chief - Endangered Species

Permittee:

TIP OF THE MITT WATERSHED COUNCIL
426 BAY ST.
PETOSKEY, MI 49770
U.S.A.

Name and Title of Principal Officer:
CAROLINE M. KESON - MONITORING PROGRAMS COORDINATOR

Authority: Statutes and Regulations: 16 USC 1539(a); 50 CFR 17.22, 50 CFR 13.

Location where authorized activity may be conducted:
Michigan

Reporting requirements:
ANNUAL REPORT DUE: 01/31
See permit conditions for reporting requirements

Authorizations and Conditions:

A. General Conditions set out in Subpart B of 50 CFR 13, and specific Conditions contained in Federal regulations cited above, are hereby made a part of this permit. All activities authorized herein must be carried out in accord with and for the purposes described in the application submitted. Continued validity, or renewal of this permit is subject to complete and timely compliance with all applicable Conditions, including the filing of all required information and reports.

B. The validity of this permit is also conditioned upon strict observance of all applicable foreign, state, local, tribal, or other Federal law.

C. Valid for use by those identified in the List of Authorized Individuals.

C.1. Authorized Individuals:

Only individuals identified on the attached List of Authorized Individuals (LAI) are authorized to conduct activities pursuant to this permit. The LAI, printed on U.S. Fish and Wildlife Service (USFWS) letterhead, and signed and dated by the Regional Minnesota permit issuing office or a Regional Minnesota office state Field Supervisor, may identify special Conditions or circumstances under which individuals can conduct authorized activities and it must be retained with these Conditions and Authorizations. Each named individual shall be responsible for compliance with the Authorizations and Conditions of this permit.

Trained assistants not named on the attached LAI may work on permitted activities under the direct and on-site supervision of the individuals named on the LAI as authorized. "On-site supervision" is defined as having the Permittee at a distance close enough to enable immediate assistance to a supervised individual, as needed, while

the supervised individual conducts an authorized activity. Trained assistants may not work independently at a site.

Permittee/Principal Officer shall replace outdated LAIs and attach the subsequent current updated version of the LAI to this recovery permit upon receipt. **This permit will be considered invalid without a current attached LAI.**

C.2. To request changes to the LAI, the Permittee/Principal Officer shall submit written requests to the USFWS Regional Minnesota office Recovery Permit Coordinator identified in Condition L.1. The request shall be submitted at least 30 days prior to the desired effective date. The request should indicate the desired effective date, must include the $50 application processing fee unless fee exempt (see 50 CFR 13.11(d)), must be signed and dated by the Permittee/Principal Officer, and include the following information:

a. The name of each individual (first name, middle initial, last name) to be added to the LAI and indicate the species he/she will be working with and the activities he/she will be conducting;

b. The resume/qualifications of each person, including specific information on previous professional experience working with the species/activity affected by the request. Information should include: the approximate number of hours of focused activity with each species in occupied habitat; approximate numbers of each species the applicant has worked with at each site (e.g., the number of bats, identified by species at a specific site); specific activities conducted; names, dates, and location of areas surveyed; and experience with similar species;

c. Reference letters for each individual containing: the name, title, organization, email address, and telephone number of a minimum of two references who can verify experience of the individual with the species; and

d. The names of any individuals to be deleted from the LAI.

Note: This procedure is **only** for personnel changes to the LAI. For requests to renew/amend this permit, a complete application and appropriate application processing fee must be submitted to the Regional Minnesota office Recovery Permit Coordinator. The application Form 3-200-59 may be obtained at: https://www.fws.gov/endangered/permits/how-to-apply.html.

D. Acceptance of this permit serves as evidence that the Permittee and its authorized agents understand and agree to abide by the terms of this permit and all sections of Title 50 Code of Federal Regulations, Parts 13 and 17, pertinent to issued permits (https://www.fws.gov/permits/ltr/ltr.html). Section 11 of the Endangered Species Act of 1973, as amended, provides for civil and criminal penalties for failure to comply with permit Conditions.

A request for permit renewal using Application Form 3-200-59 and the $100 application processing fee must be received **at least 30 days prior to the expiration date** of this permit to continue conducting authorized activities under the expired permit while your application is being processed (subject to compliance with 50 CFR, Parts 13.21 and 13.22: https://www.ecfr.gov/cgi-bin/text-idx?c=ecfr&sid=a1d34199d1ab36c8b78ecd06a7fa5180&tpl=/ecfrbrowse/Title50/50cfr13_main_02.tpl). When these requirements are not met, this permit becomes invalid on the expiration date. *Unless otherwise instructed within the Authorizations and Conditions*, **annual reports** are due by January 31 following each year your permit is in effect and shall be submitted to all offices identified in the permit Conditions, as appropriate. The following website link provides the permit application Form 3-200-59 and the mailing address to the Bloomington, MN - U.S. Fish and Wildlife Service, Endangered Species Office: https://www.fws.gov/endangered/permits/how-to-apply.html.

E. Permittee is authorized to take (capture, handle, temporarily hold, handle, and release, relocate) Hungerford's crawling water beetle (*Brychius hungerfordi*) for scientific research aimed at recovery of the species: presence/absence surveys, studies to document habitat use, population monitoring, monitoring health or disease, and evaluating potential impacts of activities to manage or modify habitat. This permit does **not** authorize the collection of voucher specimens.

F. Activities are authorized throughout Michigan as outlined in Condition G.

G. Permittee shall notify the U.S. Fish and Wildlife Service (USFWS) Field Supervisor in the State of Michigan at least 15 days prior to conducting any activities (See Condition L.2.). Your request for this site-specific approval must be in writing and must indicate:

G.1. Species for which proposed activities are being conducted.

G.2. Location of proposed activities, including project site (legal description and lat/long), county, and state.

G.3. A complete description of activities (i.e., proposed project plan, including purpose and need, surveys, methods, etc. If the purpose includes relocation, a copy of the specific study proposal must be included.

G.4. Dates when the project is proposed to take place.

G.5. Evidence that Permittee has received any required contracts to complete the activities.

G.6. Whether all annual reporting requirements have been fulfilled.

You may proceed with only the activities described in your written concurrence letter, upon receipt from the applicable USFWS Field Supervisor. ***Your concurrence letter must be carried with this permit to authorize site-specific activities*.**

H. Permittee shall adhere to the following Conditions involving capture and handling of Hungerford's crawling water beetle (HCWB):

H.1. Permittee may conduct surveys for Hungerford's crawling water beetles by using aquatic D nets and sweeping the water, photographing individuals, and immediately releasing the individuals unharmed at the capture site.

a. Hungerford's crawling water beetles captured in the net shall be immediately identified visually in a white enamel pan containing only stream water and immediately released into the stream at the capture site.

b. Care shall be taken to avoid crushing of Hungerford's crawling water beetles.

c. When collecting information on size and gender, individuals shall be released as quickly as possible after appropriate measurements are taken.

H.2. Capture and relocation shall be authorized under this permit only upon prior written approval from the USFWS Field Supervisor in accordance with the following Conditions:

a. Relocation sites will be identified in advance and should be the nearest suitable habitat that is outside of the area of disturbance. In selecting a suitable relocation site, look for presence of algae (*Dichotomosiphon*, *Chara*), overwintering sites, and suitable substrate. Generally, these sites will be within 0.5 mile of the capture site (upstream or downstream) of the collection site.

b. For transportation purposes, Permittee may temporarily hold specimens in small plastic centrifuge tubes (e.g., 50 mL Falcon tubes), or a pail/bucket with a secure lid, filled with stream water. Carefully secure the lid after ensuring no beetles are near the top of the container, and place in shade until collection efforts are complete. Use care to avoid crushing beetles with the lid and ensure containers are stable during transport.

c. Within four (4) hours, unless otherwise approved by the USFWS, collected HCWB shall be transported to the relocation site and permanently released.

d. Prior to release, Permittee must make an accurate count of the number of HCWB individuals being relocated. Photographs should be taken for identification/verification purposes.

e. Reporting for relocation: Within 30 days of collection and release, submit a report with the number of individuals, GPS data, and photographs.

f. Other than approved relocations, no HCWB may be permanently removed from survey sites.

I. Upon determination that Hungerford's crawling water beetle is present at previously undocumented sites, Permittee shall notify the following USFWS Offices within 48 hours: the USFWS Regional Minnesota office Recovery Permit Coordinator

(Condition L.) and the Michigan Field Office (Condition M.).

J. A maximum of three (3) individuals are anticipated to be accidentally injury or killed as a result of authorized activities. In the event that this number is exceeded, all activities must immediately cease. The Permittee must immediately provide a written report any Hungerford's crawling water beetle mortality or serious injury to the USFWS Michigan Field Office (Condition M.1.) Written notification must also be made within 48 hours to the USFWS Regional Minnesota office Recovery Permit Coordinator (Condition L.1.). The Permittee's statement must document the cause of the injury or mortality, and identify all remedial measures employed by the Permittee to eliminate future mortality or injury events. Based on consultation between the USFWS offices, decisions will be made regarding remedial measures that will be implemented and whether and/or when any of the authorized activities may continue. The Species Recovery Lead Office will provide a decision within five (5) business days concerning the disposition of any injured or dead specimen. Permitted activities may resume upon receipt of written approval from the Species Recovery Lead Office.

Any accidentally killed specimen(s) shall be preserved according to standard museum practices, mounted, properly identified and indexed [Include date, complete scientific and common names, and location (site name, township, range, and section).] and sent to:

Insect Division Collection Manager
Museum of Zoology, Insect Division
University of Michigan
1109 Geddes Avenue
Ann Arbor, Michigan 48109-1079
(734/764-0476; fax 734/763-4080)

K. An annual report of all activities conducted under the authority of this permit is due by January 31 following each year this permit is in effect. In addition, copies of all publications and reports resulting from work conducted under this permit must be submitted as they become available. Failure to furnish any reports required by this permit is cause for permit revocation and/or denial of future permit applications. At a minimum, your report shall include:

K.1. A discussion of field procedures and data collection methods;

K.2. The date, time, geographic locations (including projection information using UTM, latitude-longitude, section descriptors, or accurately plotted on USGS maps) of all specimens encountered, as well as all data collected on the individuals (such as measurements, age, sex, and weight);

K.3. Locations surveyed where no specimens were encountered;

K.4. Habitat conditions at all sites surveyed;

K.5. GPS data, photographs, and the number of individuals relocated;

K.6. A complete description of any injuries and/or mortalities to listed species, the dates of occurrence, any circumstances surrounding the incidents, and a description of any steps taken to reduce the likelihood that such injuries and/or mortalities will occur in the future;

K.7. Identification of any salvaged specimens, locations where salvaged, and their disposition;

K.8. Legible photocopies of all field data sheets; and

K.9. Copies of all site specific authorization letters required under Condition G.

IF NO ACTIVITIES OCCURRED OVER THE COURSE OF THE YEAR, INDICATION OF SUCH SHALL BE SUBMITTED AS AN ANNUAL REPORT.

L. **Copies of your reports shall be sent to the offices listed below.** Your transmittal letter (or email) must cite your Federal permit number. Electronic copies shall be submitted in MS Word, Portable Document Format, Rich Text Format, or other

file format that is compatible with the receiving office (**thumb drives/flash drives cannot be accepted**).

L.1. Regional Recovery Permit Coordinator
U.S. Fish and Wildlife Service
Ecological Services - Endangered Species
5600 American Blvd. W., Suite 990
Bloomington, Minnesota 55437-1458
(612/713-5343; fax 612/713-5292)
permitsR3ES@fws.gov

L.2. Field Supervisor
U.S. Fish and Wildlife Service
Michigan Field Office
2651 Coolidge Road, Suite 101
East Lansing, Michigan 48823
(517/351-2555; fax 517/351-1443)

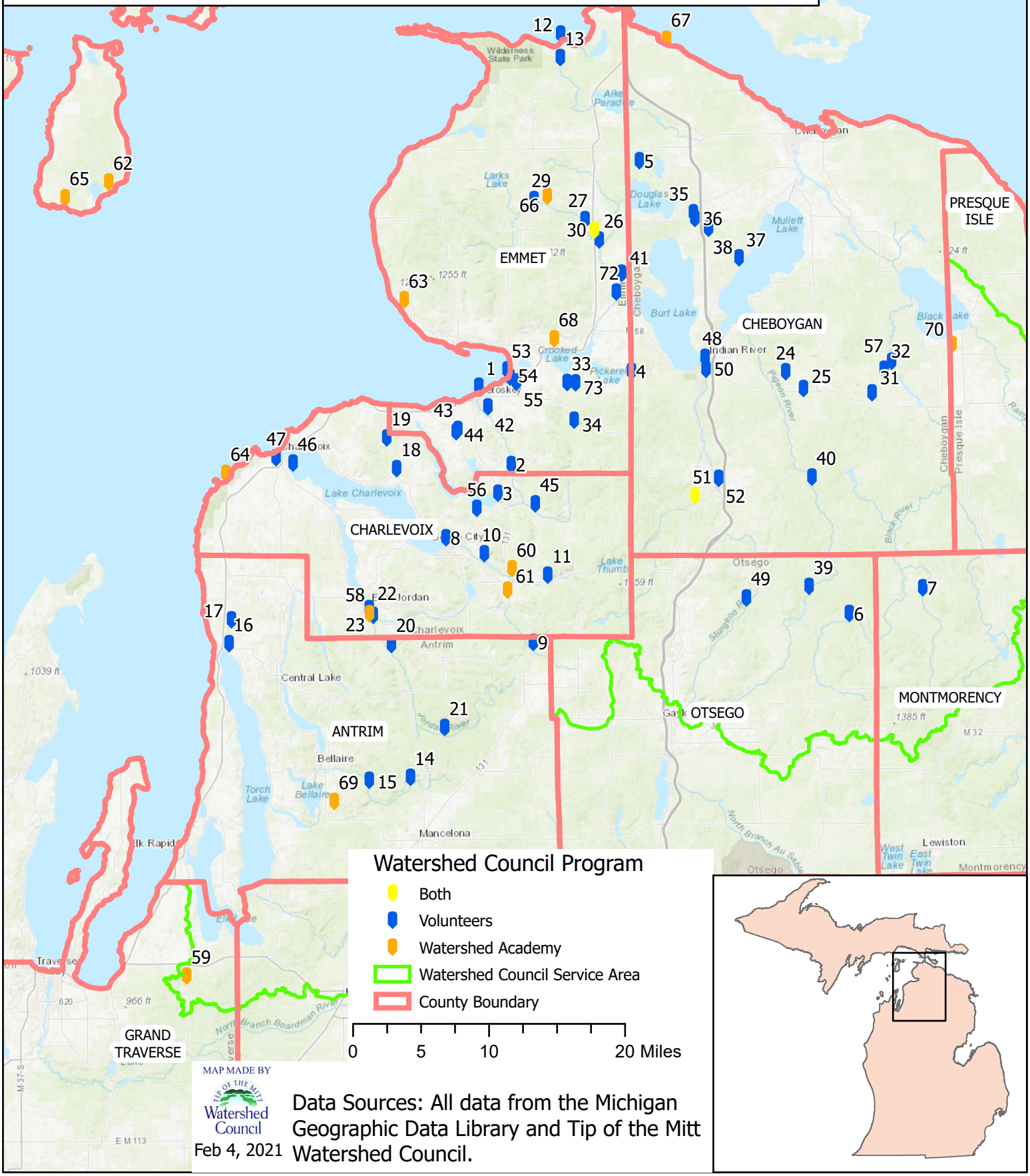
M. Additionally, reports and publications shall be submitted to:

M.1. Carrie Tansy
U.S. Fish and Wildlife Service
Michigan Field Office
2651 Coolidge Road, Suite 101
East Lansing, Michigan 48823
(517/351-2555; fax 517/351-1443)

M.2. Dan Kennedy
Endangered Species Coordinator
Michigan Department of Natural Resources
Wildlife Division
P.O. Box 30444
Lansing, Michigan 48909-7444
(517/284-6194; fax 517/373-6705)

cc: FWS, TE Coordinator: Michigan
DNR/DOC, TE Coordinator: Michigan
END

Tip of the Mitt Watershed Council Stream Monitoring Locations February 2021



Appendix C

MiCorpsID	Stream_Name	Site_Location	Watershed	First_Yr_Monitored	Last_Yr_Monitored	Lat	Long	Program	HCWB Present
VSM_Bear1	Bear River	Mineral Well Park	Little Traverse Bay	2005	2019	45.375060	-84.9607064446677	VSM	
VSM_Bear2	Bear River	Bear River Rd	Little Traverse Bay	2005	2019	45.291227	-84.913319494015	VSM	
VSM_Bear3	Bear River	Melrose Township Park	Little Traverse Bay	2005	2019	45.260906	-84.9339242898602	VSM	
VSM_Berry1	Berry Creek	Banwell Rd	Cheboygan River	2019	2019	45.388825	-84.7297232808149	VSM	
VSM_Bessey1	Bessey Creek	Ingleside Rd	Cheboygan River	2017	2019	45.612752	-84.712643531011	VSM	
VSM_Black1	Black River	Tin Shanty Bridge	Cheboygan River	2018	2019	45.126744	-84.4076460009288	VSM	
VSM_Black2	Black River	Barber Bridge	Cheboygan River	2018	2019	45.152505	-84.2964093873418	VSM	Yes
VSM_Boyne1	Boyne River	Old City Park	Lake Charlevoix	2005	2019	45.214151	-85.0131835270434	VSM	
VSM_Boyne2	Boyne River	Dobleski Rd	Lake Charlevoix	2005	2019	45.101490	-84.883773036027	VSM	
VSM_Boyne3	Boyne River	Dam Rd	Lake Charlevoix	2005	2019	45.196659	-84.9556732669943	VSM	
VSM_Boyne4	Boyne River	North Branch Nature Preserve	Lake Charlevoix	2005	2019	45.172918	-84.8606335845887	VSM	Yes
VSM_Carp1	Carp River	Pointe Dr	Lake Michigan	2013	2015	45.748922	-84.8293542830024	VSM	
VSM_Carp2	Carp River	Oliver Rd	Lake Michigan	2013	2015	45.723897	-84.8303860214256	VSM	
VSM_Cedar1	Cedar River	Cedar River Rd	Elk River	2017	2018	44.959453	-85.0708352765266	VSM	
VSM_Cedar2	Cedar River	Schuss Mountain Rd	Elk River	2017	2018	44.956835	-85.1327058760218	VSM	
VSM_Eastport1	Eastport Creek	M88	Elk River	2005	2019	45.103718	-85.3413761745183	VSM	
VSM_Eastport2	Eastport Creek	Farrell Rd	Elk River	2005	2019	45.129076	-85.3375110289659	VSM	
VSM_Horton1	Horton Creek	Boyne City Rd	Lake Charlevoix	2005	2019	45.288372	-85.086389173508	VSM	
VSM_Horton2	Horton Creek	Church Rd	Lake Charlevoix	2005	2019	45.321238	-85.1007446925433	VSM	
VSM_Jordan1	Jordan River	Webster Bridge Rd	Lake Charlevoix	2007	2018	45.101236	-85.0971638528926	VSM	
VSM_Jordan2	Jordan River	Pinny Bridge	Lake Charlevoix	2011	2018	45.012158	-85.0185598870859	VSM	
VSM_Jordan3	Jordan River	Fair Rd	Lake Charlevoix	2007	2017	45.139666	-85.1299236000334	VSM	
VSM_Jordan4	Jordan River	Rogers Rd	Lake Charlevoix	2011	2017	45.132520	-85.1239479811517	VSM	
VSM_Kimberly1	Kimberly Creek	Quarry Rd	Cheboygan River	2005	2019	45.385383	-84.4966042151098	VSM	
VSM_Kimberly2	Kimberly Creek	Montgomery Rd	Cheboygan River	2005	2017	45.367137	-84.4702734828608	VSM	
VSM_Maple1	Maple River	Woodland Rd	Cheboygan River	2011	2017	45.529071	-84.7753744343986	VSM	Yes
VSM_Maple2	Maple River	Robinson Rd	Cheboygan River	2011	2019	45.550945	-84.7964899391803	VSM	
VSM_Maple3	Maple River	Pleasantview Rd	Cheboygan River	2011	2015	45.573053	-84.8733429681176	VSM	
VSM_Maple4	Maple River	US31	Cheboygan River	2018	2019	45.539792	-84.7822562426945	Both	
VSM_Milligan1	Milligan Creek	M68	Cheboygan River	2008	2019	45.361178	-84.3667973738976	VSM	
VSM_Milligan2	Milligan Creek	Waveland Rd	Cheboygan River	2008	2019	45.386054	-84.347818033253	VSM	
VSM_Minnehaha1	Minnehaha Creek	Pickerel Lake Rd	Cheboygan River	2017	2019	45.377738	-84.8272618735541	VSM	
VSM_Minnehaha2	Minnehaha Creek	Maxwell Rd	Cheboygan River	2017	2019	45.337521	-84.8174559246628	VSM	
VSM_Mullett1	Mullett Creek	Indian Trail	Cheboygan River	2005	2019	45.556372	-84.6320864145465	VSM	
VSM_Mullett2	Mullett Creek	Crump Rd	Cheboygan River	2005	2019	45.550360	-84.6300197549217	VSM	
VSM_Mullett3	Mullett Creek	M27	Cheboygan River	2005	2019	45.507565	-84.5640529354564	VSM	Yes
VSM_Mullett4	Mullett Creek	S. Extension Rd	Cheboygan River	2005	2019	45.539675	-84.6095468927369	VSM	
VSM_Pigeon1	Pigeon River	Sturgeon Valley Rd	Cheboygan River	2010	2019	45.156347	-84.4674252329757	VSM	
VSM_Pigeon2	Pigeon River	Webb Rd	Cheboygan River	2010	2019	45.272734	-84.4599746608887	VSM	
VSM_Maple5	Maple River	Brutus Rd	Cheboygan River	2011	2016	45.493304	-84.742258576591	VSM	
VSM_Russian1	Russian Creek	North Central Michigan College	Little Traverse Bay	2007	2018	45.353011	-84.9474486715579	VSM	
VSM_Schoofs1	Schoof's Creek	Fields Preserve	Little Traverse Bay	2015	2019	45.329355	-84.9931651800712	VSM	
VSM_Schoofs2	Schoof's Creek	Williams Rd	Little Traverse Bay	2015	2018	45.326942	-84.9958243802	VSM	
VSM_Springbrook1	Springbrook Creek	Spring Brook Rd N	Little Traverse Bay	2007	2019	45.248995	-84.877876909541	VSM	
VSM_Stover1	Stover Creek	Ferry Rd	Lake Charlevoix	2004	2019	45.295448	-85.2426011723714	VSM	
VSM_Stover2	Stover Creek	Brookside Cemetery	Lake Charlevoix	2004	2019	45.301282	-85.2681499644884	VSM	
VSM_Sturgeon1	Sturgeon River	M68, Indian River	Cheboygan River	2009	2016	45.402307	-84.6181456027181	VSM	
VSM_Sturgeon2	Sturgeon River	Sturgeon Valley Rd	Cheboygan River	2009	2019	45.145226	-84.5621528603387	VSM	
VSM_Sturgeon3	Sturgeon River	Fisher Woods Rd	Cheboygan River	2009	2016	45.389549	-84.6170074572732	VSM	
VSM_Sturgeon4	Sturgeon River	Old 27 Park/Beagles Monument Park	Cheboygan River	2009	2019	45.255287	-84.6366125285111	Both	
VSM_Sturgeon5	Sturgeon River	Wolverine, E. Main St	Cheboygan River	2009	2018	45.273130	-84.6006954252446	VSM	
VSM_Tannery1	Tannery Creek	Mouth, Bike Path	Little Traverse Bay	2007	2019	45.392131	-84.9177596436163	VSM	
VSM_Tannery2	Tannery Creek	Country Club Rd	Little Traverse Bay	2007	2017	45.384343	-84.9133100622721	VSM	
VSM_Tannery3	Tannery Creek	Boyer Rd	Little Traverse Bay	2007	2015	45.379057	-84.9038208696571	VSM	
VSM_Fineout1	Fineout Creek	M75	Little Traverse Bay	2015	2019	45.245072	-84.9661066247332	VSM	
VSM_Black3	Black River	Kleber Dam	Cheboygan River	2018	2019	45.394343	-84.3362651738247	VSM	
VSM_Birney1	Birney Creek	Rogers Road, Rogers Family Homestead Preserve	Lake Charlevoix	2015	2019	45.13421	-85.129621	WA	
VSM_Bissell1	Bissell Creek	Moore Road, Elk Rapids HS Property	Elk River	2016	2019	44.750122	-85.408749	WA	
VSM_Boyne5	Boyne River	South Branch-US131	Lake Charlevoix	2015	2019	45.18022	-84.914083	WA	
VSM_Boyne6	Boyne River	North Branch-US131	Lake Charlevoix	2015	2019	45.1575	-84.921413	WA	
VSM_Cables1	Cable's Creek	Beach Road, Beaver Island	Lake Michigan	2017	2019	45.59622	-85.518306	WA	
VSM_FiveMile1	Five Mile Creek	Five Mile Creek Nature Preserve	Lake Michigan	2015	2019	45.468193	-85.071919	WA	
VSM_Inwood1	Inwood Creek	Fisherman's Island State Park	Lake Michigan		2019	45.285152	-85.344045	WA	
VSM_IronOre1	Iron Ore Creek	East Side Drive, Beaver Island	Lake Michigan	2017	2019	45.57975	-85.58456	WA	
VSM_Maple6	Maple River	Ely Bridge Road	Cheboygan River	2015	2019	45.57646	-84.853208	WA	
VSM_Mill1	Mill Creek	Mill Creek Discovery Park	Lake Huron	2016	2019	45.741639	-84.668472	WA	
VSM_Oden1	Oden Creek	Oden Creek Fish Hatchery	Cheboygan River	2016	2019	45.42457	-84.84583	WA	
VSM_Shanty1	Shanty Creek	Creekside Drive, Shanty Creek Resorts	Elk River	2016	2019	44.934694	-85.185472	WA	
VSM_Stoney1	Stoney Creek	North Allis Highway	Cheboygan River	2016	2019	45.410976	-84.244252	WA	
VSM_Stover3	Stover Creek	Belvedere Golf Club	Lake Michigan	N/A	N/A	ND	ND	WA	
VSM_Snider1	Unnamed	Snider Rd.	Cheboygan River	2019	2019	45.473265	-84.750784	VSM	

Appendix D

Field physical parameter data collection:

Each team will be provided with clean containers that will be used to collect water samples at each site. The Leader will collect water from the middle of the stream at mid-depth, rinsing container and lid three times with stream water before collecting the final water sample. Water samples will not be frozen because freezing affects conductivity readings. Instead, water will simply be placed in the bucket containing monitoring supplies and then delivered to the Watershed Council office on Indoor Sorting Day. Watershed Council staff will measure conductivity of all water samples using a YSI Model 55 Conductivity Meter that has been calibrated prior to use.

A handheld thermometer will be used by the Leader to measure water temperature. The thermometer will be placed in the middle of the stream and left in the water for a minimum of five minutes before reading. The Leader will record the water temperature to the nearest degree Celsius.

A separate "expert-only" session is coordinated within three months of the field data collection. At this session, volunteer experts with macroinvertebrate taxonomic identification skills identify specimens to the family level. Aquatic macroinvertebrate identifications are checked by the Program Manager as necessary. Family names and the number of specimens belonging to each family are recorded on the ID data sheet (Appendix F). Results at each site are tallied on the ID datasheet to determine index scores. Once identification is complete, all specimens collected at a site are packed into a glass jar with a poly-seal lid and a label with sample site information and sampling date is put inside the jar. If necessary, the Program Manager coordinates additional experts-only sessions to complete sample identification.

Appendix E

Field macroinvertebrate data collection

Upon arriving at the site, the leader and collector will inspect the sampling gear to ensure that it is clean. If there is debris or aquatic life on any of the equipment, water withdrawn from the stream with a clean container will be used to clean the equipment at a distance of not less than 100 feet from any water body. The Leader will instruct and assist other team members in techniques for finding and collecting macroinvertebrates in the sorting pans.

A trained aquatic macroinvertebrate Collector will collect numerous samples at each site with the goal of sampling each habitat type (i.e. riffles, runs, pools, woody debris, etc.) in the stream reach three times. The Collector will also gather rocks, logs, sticks and other debris to collect macroinvertebrates from. Sites on small streams will be sampled for a minimum of 30 minutes while those on large streams will be sampled for at least one hour. D-frame nets will be used to sample all habitat types, the contents of the net will be emptied into shallow white trays, and volunteers will pick aquatic organisms from the tray.

The aquatic macroinvertebrates found by volunteers will be presorted into like groups in cells of an ice-cube or other divided tray. The team member with the greatest knowledge of aquatic macroinvertebrate taxonomy will select a variety of presorted organisms that represents the diversity found at the site and store them in 70% ethanol for later identification. Volunteer teams are encouraged to collect a minimum of 100 specimens, but an emphasis will be placed on collecting a variety of aquatic organisms as opposed to quantity. Haliplidae will not be collected at sites with known Hungerford's Crawling Water Beetle populations, due to the possibility of collecting a Hungerford's Crawling Water Beetle. Haliplidae found at the site will be noted on a datasheet.

The Leader will fill out all sections of the field datasheet. The Collector will provide information to the team Leader in response to questions on the data sheet that review all habitats to be sampled, stream conditions, and any changes in methodology or unusual observations. Potential sources of variability in the stream reach being sampled, such as weather, stream flow, turbidity, and erosion, will be noted on the datasheet. The field data sheet will include sections to record unusual procedures or accidents, such as losing part of the collection by spilling. The Leader will draw a site sketch on the back of the field datasheet that depicts physical features in and around the stream, the locations and types of habitats sampled, where water sample was collected, and other pertinent information (Appendix F).

The Leader and Collector will decide together whether a site needs to have an extended collection time or other variations in procedure. Before leaving the site, the Collector will thoroughly rinse the net to ensure that no organisms are transported to the next site and the Leader will inspect the site to make sure that no equipment or refuse is left behind.

Appendix F

Tip of the Mitt Stream Monitoring Datasheet

Stream Name: _____ **Major Watershed:**_____

Location:_____(Please circle: *Upstream* or *Downstream* of road?)

Date:_____ **Water Sample Collected** Yes No **# of Glass Jars Used:**_____

Collection Start Time:_____(AM/PM) **Collection End Time**:_____(AM/PM)

Monitoring Team {please put number of years with program in parentheses, e.g. "Mary Smith (3)"}:

Name of Person Completing Datasheet:_____

Collector(s):_____

Other Team Members:_____

Stream Conditions: Water temperature: _____ (°C or °F) Air Temperature:_____ (°C or °F)

Is the substrate covered with excessive silt? ____ No ____ Yes (describe: _____)

Substrate Embeddedness in Riffles: ____ 0-25% ____ 25-50% _____ > 50% ____ Unsure

Water turbidity/clarity (circle): Clear Cloudy Muddy Average Water Depth: _____ (ft)

Distance from water surface to top of culvert, bridge, etc (put location and details on sketch): _____(ft)

Weather (today and note rain from last few days):_____

_____

Macroinvertebrate Collection & Invasive Species Monitoring: Sample all habitats found at the site and check the habitats sampled in the left box. Also, remember to check area for invasive species. Preserve approximately 100 specimens or less.

☐ Riffles	☐ Aquatic Plants	☐ Undercut banks
☐ Runs	☐ Leaf Packs	☐ Overhanging Vegetation
☐ Pools	☐ Stream Margins	☐ Root Wads
☐ Cobbles	☐ Submerged Wood	☐ Other (describe_____)

Did you see, but **not** collect, any **live crayfish**? (___ Yes ___ No), or **large clams**? (___ Yes ___ No)?

Other wildlife & fish? (___ Yes ___ No) Describe:_____

_____

Please look for invasive species before you leave the site. Did you see any? (____ Yes____ No) Please describe and take pictures:_____

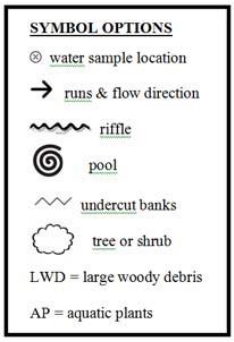
*Datasheet checked for completeness by:*_____ *Date:*_____

*Data entered into TOMWC database by:*_____ *Date:*_____

Stream Name:_____Location:_____

SITE SKETCH

Please make a sketch showing the length and shape of the stream reach that was sampled by your volunteer group. Remember to include where water sample was collected, approximate locations of habitat types (riffles, runs, pools, woody debris, etc.), approximate distances of stream length sampled and stream width, water level measurement, flow direction, and north arrow.



Other comments (were there any changes in methodology or unusual observations?):_____

_____

_____

_____

_____

_____

_____

*Datasheet checked for completeness by:*_____ *Date:*_____

*Data entered into TOMWC database by:*_____ *Date:*_____

Appendix G

Macroinvertebrate Identification Datasheet

Volunteer Stream Monitoring Program

Tip of the Mitt Watershed Council

Stream Name:_____ **Date Collected:**_____

Site location:_____ **Site ID:**_____

Volunteers sorting:_____

_____

Expert identifier:_____ **Checked by:**_____

Order	Family	Sensitive	Count	TOTAL
Amphipoda	Gammaridae	NO		
Amphipoda	Hyallelidaee	NO		
Coleoptera	Dryopidae	NO		
Coleoptera	Dytiscidae	NO		
Coleoptera	Elmidae	NO		
Coleoptera	Gyrinidae	NO		
Coleoptera	Haliplidae	NO		
Coleoptera	Hydrophilidae	NO		
Coleoptera	Psephenidae	NO		
Collembola	*(Springtails)*	NO		
Decapoda	Cambaridae	NO		
Diptera	Athericidae	YES		
Diptera	Ceratopogonidae	NO		
Diptera	Chironomidae	NO		
Diptera	Dixidae	YES		
Diptera	Empididae	NO		
Diptera	Simuliidae	NO		
Diptera	Stratiomyidae	NO		
Diptera	Tabanidae	NO		
Diptera	Tipulidae	NO		
Ephemeroptera	Baetidae	NO		
Ephemeroptera	Baetiscidae	NO		
Ephemeroptera	Caenidae	NO		
Ephemeroptera	Ephemeridae	NO		
Ephemeroptera	Ephemerellidae	YES		
Ephemeroptera	Heptageniidae	NO		
Ephemeroptera	Isonychiidae	YES		
Ephemeroptera	Leptohyphidae	NO		
Ephemeroptera	Leptophlebiidae	YES		
Ephemeroptera	Metrotopodidae	YES		
Ephemeroptera	Siphloneuridae	NO		
Gastropoda	Ancylidae	NO		
Gastropoda	Lymnaeidae	NO		
Gastropoda	Physidae	NO		
Gastropoda	Planorbidae	NO		
Gastropoda	Pleuroceridae	NO		
Gastropoda	Valvatidae	NO		
Gastropoda	Viviparidae	NO		
Heteroptera	Belostomatidae	NO		
Heteroptera	Corixidae	NO		
Heteroptera	Gerridae	NO		

Order	Family	Sensitive	Count	TOTAL
Heteroptera	Mesoveliidae	NO		
Heteroptera	Notonectidae	NO		
Heteroptera	Pleidae	NO		
Heteroptera	Veliidae	NO		
Hirudinea	*(Leeches)*	NO		
Hydracarina	*(Mites)*	NO		
Isopoda	Asellidae	NO		
Lepidoptera	Pyralidae	NO		
Megaloptera	Corydalidae	YES		
Megaloptera	Sialidae	NO		
Nematomorpha	*(Horsehair worms)*	NO		
Odonata	Aeshnidae	NO		
Odonata	Calopterygidae	NO		
Odonata	Coenagrionidae	NO		
Odonata	Cordulegastridae	NO		
Odonata	Corduliidae	NO		
Odonata	Gomphidae	YES		
Odonata	Lestidae	NO		
Odonata	Libellulidae	NO		
Oligochaeta	*(Aquatic worms)*	NO		
Pelecypoda	Dreissenidae	NO		
Pelecypoda	Sphaeridae	NO		
Plecoptera	Capniidae	YES		
Plecoptera	Leuctridae	YES		
Plecoptera	Nemouridae	YES		
Plecoptera	Perlidae	YES		
Plecoptera	Perlodidae	YES		
Plecoptera	Pteronarcyidae	YES		
Plecoptera	Taeniopterygidae	YES		
Trichoptera	Brachycentridae	YES		
Trichoptera	Glossosomatidae	YES		
Trichoptera	Helicopsychidae	NO		
Trichoptera	Hydropsychidae	NO		
Trichoptera	Lepidostomatidae	YES		
Trichoptera	Leptoceridae	NO		
Trichoptera	Limnephilidae	NO		
Trichoptera	Molannidae	NO		
Trichoptera	Philopotamidae	NO		
Trichoptera	Phryganeidae	NO		
Trichoptera	Polycentropodidae	NO		
Trichoptera	Psychomyiidae	YES		
Trichoptera	Rhyacophilidae	YES		
Trichoptera	Uenoidea	NO		
Turbellaria	*(Flat worms)*	NO		
			Total Families:	
			EPT Families:	
			Sensitive Families:	

Appendix H

Equipment

Field sampling gear includes D-frame nets, sorting trays, waders, and a bucket that contains glass jars full of ethanol and with poly-seal lids, a plastic sample bottle, a thermometer, at least three forceps, at minimum of two eye-droppers, two or more ice-cube trays, a measuring tape, a meter stick, and pencils. All equipment is stored in the Tip of the Mitt Watershed Council office and made available for pick-up by volunteers prior to sampling events. After field sampling, equipment is returned directly to the Watershed Council office or to staff during the indoor sorting session. Equipment is maintained by Watershed Council staff.

List of Equipment Needed:

2 Ounce (oz) Flint (Clear) Glass AC Jar, 38-400 (288/Case)
38-400 Black Phenolic (Bakelite) Bold Ribbed Cap with Polyseal (Cone) Liner
Aquatic invasive species card packet
Bottle, Polyethylene, Widemouthed, 500 mL
Buckets
Celsius Red Alcohol Thermometers, -20° to +110°C, Total Immersion, Yellow
Clipboards
Ethanol, 95%, Lab Grade, 20 L
Fiberoptic light
Forceps
Ice cube trays
Larval tray - sorting
McCafferty ID Books
Measuring tape
Medicine Dropper, Plastic, 1-mL Nipple, 3 1/2 in, Pk 12
Meter Stick, Wood
Pencils
Petri dish, glass
Petri dishes - disposable
Rite-in-the-Rain paper
Sorting trays
Sorting Trays (12 well)
Stereo microscope
Teasing needles
Transparent rulers
Unitary Wash Bottle, Widemouthed, 250 mL
Unitary Wash Bottle, Widemouthed, 500 mL
Waders, lug sole and felt sole
Water bottles

Appendix I

Quality control check list.

Tip of the Mitt Volunteer Stream Monitoring Program Quality Control Check List

Date: _____ Name of program manager: _____

Prior to sampling event:

1. Charge Hydrolab unit [ ]
2. Check calibration solutions (expiration and quantity) [ ]
3. Calibrate Hydrolab MiniSonde [ ]
4. Check thermometers for damage & accuracy [ ]
5. Check nets for damage and repair/replace if necessary [ ]
6. Check water sample containers for damage & cleanliness [ ]

During sampling event:

7. Review and guide volunteer leading procedures [ ]
8. Review and guide volunteer collecting techniques [ ]
9. Review and guide volunteer picking techniques [ ]
10. Collect replicate water sample for conductivity analysis [ ]
11. Collect replicate water temperature measurements [ ]
12. Collect replicate macroinvertebrate sample [ ]

After sampling event:

13. Ensure that containers have labels inside [ ]
14. Secure containers with rubber band and label [ ]
15. Review field data sheet for errors and completeness [ ]
16. Review data sheet for correct number of containers [ ]
17. Clean, dry and store equipment [ ]

Indoor sorting and identification:

18. Ensure all (and only) jars from site are present [ ]
19. Ensure site labels accompany and specimens removed [ ]
20. Ensure that all samples are reviewed by an expert [ ]
21. Store samples (with labels) in ethanol [ ]

Data review and analysis:

22. Review field records for errors prior to data entry [ ]
23. Repeat all diversity calculations prior to data entry [ ]
24. Compare database records with hard copies [ ]