QUALITY ASSURANCE PROJECT PLAN

Quality Assurance Project Plan (QAPP) for the
Menomonee River Area of Concern (AOC) Fish Passage Project Milwaukee, WI

Prepared for:
U.S. Environmental Protection Agency GLNPO
17G
77 West Jackson Boulevard Review
Chicago, IL 60604

Grantee: United States Environmental Protection Agency (US EPA)
Funding Opportunity Number: EPA-R5-GL2010-1
Focus area: Habitat and Wildlife Protection and Restoration
Program: Habitat Restoration in Great Lakes Area of Concern

Contract/WA/Grant No./Project Identifier
Project Proposal ID: EPAGLNPO-2010-H-2-1088-1043
Grant #: GL00E00590-0

QAPP Prepared for:
Tom Chapman, P.E.
Milwaukee Metropolitan Sewerage District (MMSD)
260 West Seeboth Street
Milwaukee, WI 53204

QAPP Prepared by:
Bradley Eggold, Supervisor Southern Lake Michigan Fisheries Work Unit
Wisconsin Department of Natural Resources (WDNR)
UW-Milwaukee Great Lakes Water Institute
600 East Greenfield Avenue
Milwaukee, WI 523204

October 19, 2011

SECTION A – PROJECT MANAGEMENT

A.1 Title of Plan and Approval

**Quality Assurance Project Plan (QAPP) for the
Menomonee River Area of Concern (AOC) Fish Passage Project Milwaukee, WI**

**Prepared for the Milwaukee Metropolitan Sewerage District (MMSD)
by the Wisconsin Department of Natural Resources (WDNR)**

Tom Chapman, P.E., Milwaukee Metropolitan Sewerage District
Project Manager

Tom Chapman Date: 10/25/11

Karen Sands, AICP, Milwaukee Metropolitan Sewerage District
Quality Assurance Manager

Karen Sands Date: 10/24/11

Bradley Eggold, Wisconsin Department of Natural Resources
Project Manager and Supervisor Southern Lake Michigan Fisheries Work Unit

Bradley T Eggold Date: 10/24/11

Will Wawrzyn, Wisconsin Department of Natural Resources
Senior Fisheries Biologist, Southern Lake Michigan Fisheries Work Unit

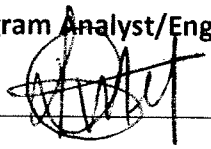
Will Wawrzyn Date: 10/24/11

Donalea Dinsmore, Wisconsin Department of Natural Resources
Quality Assurance Coordinator, Office of the Great Lakes

Donalea Dinsmore Date: 10/24/11

USEPA Approvals:

Rajen Patel, Program Analyst/Engineer, USEPA - Great Lakes National Program Office



Date: 10-25-11

Louis Blume, Quality Assurance Manager, USEPA - Great Lakes National Program Office

Duane Zeaton for Louis Blume **Date:** 10/25/2011

A.2 Table of Contents

SECTION A – PROJECT MANAGEMENT 2
A.1 Title of Plan and Approval 2
A.2 Table of Contents 4
A.3 Distribution List 6
A.4 Project/Task Organization 7
A.5 Problem Definition/Background 8
A.6 Project/Task Description 10
A.7 Quality Objectives & Criteria 13
A.8 Special Training/Certification 17
A.9 Documents and Records 18
SECTION B – DATA GENERATION & ACQUISITION 20
B.1 Sampling Pr^{oc}ess Design (Experimental Design) 20
B.2 Sampling Methods 24
B.3 Sampling Handling & Custody 27
B.4 Analytical Methods 27
B.5 Quality Control 27
B.6 Instrument/Equipment Testing, Inspection, and Maintenance 30
B.7 Instrument/Equipment Calibration and Frequency 31
B.8 Inspection/Acceptance of Supplies & Consumables 32
B.9 Data Acquisition Requirements for Non-Direct Measurements 32
B.10 Data Management 32
SECTION C – ASSESSMENT AND OVERSIGHT 36
C.1 Assessments and Response Actions 36
C.2 Reports to Management 37
SECTION D – DATA VALIDATION AND USABILITY 38
D.1 Data Review, Verification, and Validation 38
D.2 Verification and Validation Methods 38
D.3 Reconciliation with User Requirements 38

List of Tables

Table A.1 Roles & Responsibilities
Table B.1 Classification of Measured Parameters
Table B.5 Quality Control Activities for Measurement Techniques

List of Figures

Figure A.1 Organization Chart
Figure A.6 Menomonee R. Concrete Removal and Approximate Fish Sample Reaches

List of Appendices

Appendix 1. Occurrence and Relative Abundance of Fish Species in the Milwaukee Estuary and Menomonee River Watershed based on Fish Collection Records since 1987 - Downstream versus Upstream of the Proposed MMSD Fish Passage Barrier Removal Project.
Appendix 2. Fish Collection Voucher Label
Appendix 3. Thermistor and Field Thermometer Accuracy Check
Appendix 4. Thermistor Deployment and Retrieval Form
Appendix 5. Fisheries Station Summary and Sample Collection Forms
Appendix 6. Photograph Documentation Log

A.3 Distribution List

Tom Chapman, P.E., Project Manager
Milwaukee Metropolitan Sewerage District
260 West Seeboth Street
Milwaukee, WI 53204
TChapman@mmsd.com

Karen Sands, AICP, Project Quality Assurance Manager
Milwaukee Metropolitan Sewerage District
260 West Seeboth Street
Milwaukee, WI 53204
KSands@mmsd.com

Rajen Patel, P.E., Project Manager
USEPA - Great Lakes National Program Office, 17G
77 West Jackson Boulevard Review
Chicago, IL 60604
Patel.Rajen@epamail.gov

Louis Blume, QA Manager
USEPA - Great Lakes National Program Office, 17J
77 West Jackson Boulevard
Chicago, IL 60604
Blume.Louis@epamail.gov

Bradley Eggold, Project Manager
Supervisor, Southern Lake Michigan Fisheries Work Unit
Wisconsin Department of Natural Resources
600 East Greenfield Avenue
Milwaukee, WI 53204
bradley.eggold@wisconsin.gov

Will Wawrzyn, Senior Fisheries Biologist
Southern Lake Michigan Fisheries Work Unit
Wisconsin Department of Natural Resources
600 E. Greenfield Ave.
Milwaukee, WI 53204
william.wawrzyn@wisconsn.gov

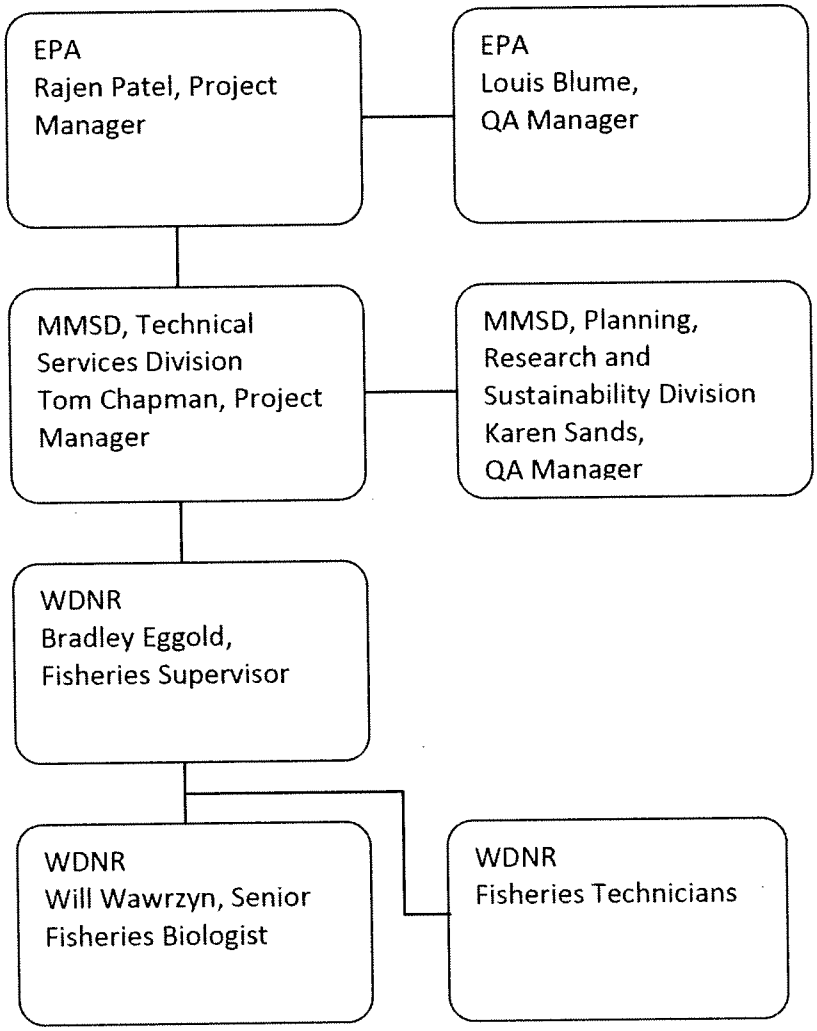
A.4 Project/Task Organization

Table A.1 Roles & Responsibilities

Individual(s) Assigned	Responsible for:	Authorized to:
Tom Chapman P.E., Project Manager Watercourse Section Manager Milwaukee Metropolitan Sewerage District 260 West Seeboth Street Milwaukee, WI 53204 Ofc (414) 225-2154 TChapman@mmsd.com	Oversee development of all MMSD work plans including construction and Quality Assurance Project Plans. Prepare progress reports to GLNPO. Perform project management tasks and manage MMSD construction oversight staff. Oversee and approve work products.	Manage work and approve invoices.
Karen Sands AICP, Quality Assurance Manager Manager of Sustainability Milwaukee Metropolitan Sewerage District 260 West Seeboth Street Milwaukee, WI 53204 Ofc (414) 225-2123 KSands@mmsd.com	Provide technical review and comment on work products.	Review and approve work products including QAPP.
Bradley Eggold, Project Manager Wisconsin Department of Natural Resources (WDNR) Supervisor, Southern Lake Michigan Fisheries Work Unit 600 E. Greenfield Ave. Milwaukee, WI 53204 Ofc (414) 382-7921 bradley.eggold@wisconsin.gov	Review and approve fish passage assessment work plan. Perform project management tasks & supervise WDNR fisheries field staff. Review and approve bi-annual progress and final fish passage reports to MMSD Project Manager & GLNPO.	Review and approve monitoring and reporting tasks.

Will Wawrzyn, Senior Fisheries Biologist (WDNR) Southern Lake Michigan Fisheries Work Unit 600 E. Greenfield Ave. Milwaukee, WI 53204 Ofc (414) 382-7924 william.wawrzyn@wisconsin.gov	Draft fish passage assessment work plan and submit to WDNR supervisor. Implement fish passage field assessment, data management and analysis. Prepare and submit draft bi-annual and fish passage report to WDNR supervisor.	Draft fish passage monitoring work plan, complete field assessment, manage and analyze data, draft reports.

Figure A.1 Organization Chart



A.5 Problem Definition/Background

The Milwaukee Metropolitan Sewerage District (MMSD) proposes to construct the Menomonee River Area of Concern Fish Passage Project in the City of Milwaukee, Wisconsin. The Menomonee River is a tributary to the Milwaukee River and Estuary, which are connected to Lake Michigan through the Milwaukee Harbor. The project is located in the Milwaukee Estuary Area of Concern. The Milwaukee Estuary was designated an Area of Concern in the mid 1980s in part because of the historical modifications to wetlands and river habitats that occurred due to dredging, straightening, filling, and lining with bulkheads and concrete for purposes of commercial navigation, development, and flood management. Modifications to the Milwaukee Estuary and Menomonee River bed and banks have created poor habitat and man-made barriers for Lake Michigan, the Estuary, and riverine fish and other aquatic species traveling to their historical spawning and rearing habitats. Historical accounts noted large migrations of fish from Lake Michigan and the Milwaukee Estuary upstream along the Menomonee River prior to the construction of a dam located at present day Hawley Road and upstream of the current barrier; *"What a place it was below the dam of that old mill, in the early spring, for fish; pike, pickerel (*walleye*), muscalonge (*muskellunge*) and suckers used to come up there by the million, and were taken out by the cart load by the settlers living near there; a sight that will never be witnessed again in Milwaukee."* (Buck, 1881).

The project will eliminate a barrier to migratory fish in the Milwaukee Estuary Area of Concern, enabling potamodromous fish passage to historical spawning and rearing habitat including 27 km of the Menomonee River, 32 km of tributary streams, and over 405 ha of wetland habitat; and enhance local habitat along the former footprint of the concrete river channel.

The proposed project will remove concrete from the bed and banks of the Menomonee River for a distance of 300 m and replace it with a series of engineered pools and riffles with a rock substrate. The existing 300 m concrete-lined reach has a steep gradient with resulting poor habitat and high velocities and shear stresses, conditions that have severed the connections for Menomonee River watershed fish and other aquatic life from the Milwaukee Estuary and Lake Michigan since the mid-1960s. The Milwaukee Metropolitan Sewerage District, in collaboration with local municipalities, previously restored 365 m of concrete streambed to natural conditions and eliminated a 1.5 m drop structure directly upstream of the project area. This proposed project would remove the final downstream fish passage barrier between Lake Michigan, the Estuary, and the free-flowing and wetland habitats in the Menomonee River watershed.

The existing concrete lined river channel is a barrier to potamodromous fish indigenous to Lake Michigan, the Milwaukee Estuary and lower reaches of the Menomonee River. These indigenous fish do not possess swimming abilities that would enable them to migrate through the concrete invert.

The Wisconsin Department of Natural Resources (WDNR) fisheries management program staff is assisting the MMSD to assess the effects of removing this barrier to fish passage. *The objective of this monitoring project is to document the effectiveness of removing a 300 m long reach of concrete channel from the bed*

of the Menomonee River for enabling potamodromous fish from Lake Michigan and the Milwaukee Estuary passage to historical spawning and rearing habitat.

Briefly, the following quantitative and qualitative results would provide evidence that removal and rehabilitation of the concrete river channel enables fish to pass upstream of the former barrier:

Quantitative

1. Fish collected and marked downstream of the former fish barrier and are re-captured upstream of the former barrier. More specifically, a 5% re-capture rate of the estimated species-specific population present downstream of the former barrier.

Qualitative

2. The presence of fish species previously known to be distributed downstream of the former concrete fish barrier and absent upstream of the former barrier, and are ultimately collected from river reaches upstream of the former barrier.
3. Downstream collection and marking of poor swim performing Northern pike that are re-captured upstream of the former concrete fish barrier would suggest the project would pass other targeted fishes.

A.6 Project/Task Description

Design, Permitting, Construction, and Assessment Schedule

- Complete Final Design and Permitting: September 2011
- Contractor Award: March 2012
- Notice to Proceed Issued: April 2012
- Substantial Completion: September 2012
- Fish Passage Field Assessment: March-June 2013
- Fish Passage Bi-annual Report: December 2013
- Fish Passage Assessment Final Report: June 2014

Measurements to be Made and Data to Obtain

Fish collection methods will include electrofishing and passive netting techniques. One sample reach each will be monitored upstream and downstream of the former fish passage barrier (Figure A.6). The sample reach downstream of the former barrier will be sampled on five separate dates during the peak fish migrating and spawning period (March-June 2013). The sample reach upstream of the former barrier will be sampled more frequently, up to 10 separate sample dates, to account for the potential lower sample efficiency of passive fishing gear.

All fish >254mm (>10-inches) in total length captured **downstream** and **upstream** of the former barrier will be identified, counted, and measured for total length to the nearest 1mm; inspected for spawning

condition (gonads as green, ripe or spent), sex; and inspected for external health conditions (deformities, eroded fins, lesions and tumors). Fish <254mm (<10-inches) will not be captured or marked because smaller specimens are more fragile and may not survive the strain of handling and marking, and because it can be inferred that these smaller fish are immature and less likely to undergo spawning migrations. Up to 3,000 fish ≥254mm in total length will receive a one-time sequentially numbered floy tag. All fish >254mm in total length captured **downstream** of the former barrier will also receive a unique left ventral (LV) fin clip. The combination of fin clips and floy tags provide adequate information on the effectiveness of the project to enable fish passage. The unique number provided by each floy tag will provide more detail on the movement of individual fish regardless of being captured upstream or downstream of the former barrier, over a longer period of time, and provide more options for population estimates.

All captured fish will be inspected for previously applied fin clips and floy tags. All previous fin clipped and floy tagged specimens will be identified to species and noted as a "re-capture". The type of fin clip will also be noted and the floy tag number recorded. All captured and re-captured fish will be released in the reach they were captured. All subsequent fish sample events will not be scheduled earlier than 24-hours after the previous sample event.

Water temperature and increasing river discharges are useful and easily measured queues for initiating spring spawning migration behavior, and planning sample schedules. Instantaneous water temperatures will be obtained prior to and immediately after completing each sample reach. Water temperature will be logged continuously at 1-hour intervals using submersible electronic temperature loggers. Logging thermistors will be located at the furthest upstream and downstream sample reach. Real-time river discharge and stage recorded at 15-minute intervals will be obtained from the United States Geological Survey Menomonee River gage station (Station 04087120) located 3 km upstream of the project site.

Figure A.6 Menomonee R. Concrete Removal and Approximate Fish Sample Reaches

Special Personnel or Equipment Requirements
WDNR will provide all specialized equipment and trained personnel for all field analyses and reporting activities. The WDNR will provide all the equipment needed to complete field assessments for this project including but not limited to specialized active electrofishing and passive netting fish collecting gear, fish measuring and marking gear, GPS, digital camera, thermistors for measuring continuous and instantaneous water temperature, and personal outerwear and safety gear. All of the equipment is readily available through the local WDNR fisheries program and offices. WDNR are trained in the operation, calibration and maintenance of this equipment. Volunteers, only under direct supervision by WDNR personnel, may assist in the setting and retrieval of nets and fishes.

Monitoring Schedule
Post-construction fish monitoring will commence between March-April 2013 and be completed between May-June 2013, approximately 6-months after in-stream construction is substantially completed.

Logging thermistors will be deployed and retrieved on or about February 15 and September 1, 2013, respectively.

Deliverable Products
A bi-annual and final project report will be drafted by Will Wawrzyn, WDNR, reviewed and approved by Brad Eggold, WDNR, and forwarded to Tom Chapman, the MMSD Project Manager and Rajen Patel, USEPA Program Analyst/Engineer at 6-months (December 2013) and 1-year (June 2014) following the last field sample date,.

A.7 Quality Objectives & Criteria

Project Objectives and Limits
The objective of this monitoring project is to document the effectiveness of removing a 300 m long reach of concrete channel from the bed of the Menomonee River for enabling potamodromous fish passage to historical spawning and rearing habitat..

There are a number of factors that limit a more rigorous study design and the need to include both qualitative and quantitative Quality Objectives and Criteria (QOC):

- An optimum quantifiable design would include a pre-impact (pre-barrier removal) assessment to serve as a temporal control to the post-barrier removal condition. Identical sample efforts among all reaches relative to the number of samples, frequency and methods for measurements, and a like-reach not receiving the treatment (i.e., barrier removal) would be available to serve as a control and included in the design and effort. The WDNR does not have sufficient budget for time and materials to conduct an optimum sample effort. The study design will be inferred from spatial patterns only.

- Estimates of species-specific fish populations are not normally required for documenting fish passage effectiveness. There are no quantitative data from previous fishery assessments that provide accurate estimate of species-specific fish populations or required sample size during spring spawning migrations in the Milwaukee Estuary or the Menomonee River upstream or downstream of the existing barrier. Since 1987, fishery assessments in the Estuary and throughout the Menomonee River watershed were semi-quantitative by design (Appendix 1). Sample protocol included standardized equipment and sample reach length. These data do provide valuable information regarding species diversity, species relative abundance, and species presence and absence; and will provide a basis for proposing qualitative DQOs regarding fish assemblages upstream and downstream of the existing barrier including.

- The ability to collect comparable quantitative fish assemblage data among sites can be limited by uncontrollable environmental factors. This is especially the case when conducting spring fish assessments in highly urbanized streams where connected imperviousness contribute to rapidly changing, extreme and frequent changes in river discharge and stage. Both of the proposed sample reaches may not be sampled safely or effectively during high spring flows using towed wadable electrofishing gear; and the reach upstream of the barrier may not be easily accessed or sampled safely using boat and towed electrofishing gear. Therefore, post-barrier removal monitoring in early 2013 may be severely limited and may require using a combination of active (boat and towed electrofishing) and passive (net) fishing gear with different sample efficiencies.

The study design includes quantifiable and qualitative measures to assess the effectiveness of barrier removal for enabling fish passage.

Quantitative

1. Fish captured and marked downstream of the former fish barrier and re-captured upstream of the barrier following removal of the barrier. More specifically, a 5% re-capture rate of the estimated species-specific population present downstream of the former barrier would conclude that barrier removal and channel restoration was effective at providing fish passage.

Qualitative

2. The capture and marking of the most common fish species known to be present downstream of the existing barrier and are absent upstream of the barrier, and are ultimately captured upstream following removal of the barrier would conclude that barrier removal and channel restoration enabled fish to swim beyond the former barrier. In particular, capture of the following fishes upstream of the current barrier would provide evidence that removal of the barrier and restored river channel was effective at enabling fish passage: Four species of redhorse including Golden, Shorthead, Silver and Greater redhorses; spring-run strain of Rainbow trout and Gizzard shad. Other species if eventually captured upstream of the former barrier that would confirm fish passage include Walleye, Smallmouth bass, Channel catfish, and Yellow bullhead, Spotfin shiner and Emerald shiner. However, these species are only present in limited numbers downstream of the barrier so the probability of capturing them at any of the sample reaches is low. Mature Spotfin shiner and Emerald shiner are less than the 254mm length fish targeted for capture and

would not be trapped in the larger mesh-sized net fishing gear deployed at the upstream reach.

3. Downstream capture and marking of poor swim performing Northern pike that are re-captured upstream of the former concrete fish barrier would suggest the completed project would enable passage of other species having similar swimming abilities.

Recreational or sport fish populations downstream of the barrier are small based on semi-quantitative fisheries assessments and creel surveys. The WDNR does not have the time or resources to repeat recreational fishing creel surveys that would confirm changes in recreational sport fishing effort and successes following removal of the fish passage barrier.

This QAPP describes the organization and instructions for field monitoring, data management and reporting activities that will be followed for this project. Establishing performance criteria will ensure that these activities will be documented and completed at a high level of performance in order to meet the project's objectives. Central to establishing performance criteria will be the use of WDNR's standardized fish monitoring and data management protocols. To insure critical and direct monitoring data is of the highest quality and reproducible over time, the following criteria will be adhered to:

Completeness (Critical)

1. The study design, monitoring protocol and data management elements will be reviewed by all members of the project organization prior to implementation. Members will be afforded the opportunity to ask clarifying questions and suggest modifications to the project elements.
2. All data will be recorded onto water proof and standardized paper field forms. The names of field sampling crew members, data recorder and field supervisor will be included on all forms.
3. All completed field forms and data will be reviewed for legibility, accuracy and completeness prior to leaving the sample site.
4. The data recorder will serve as the quality check for all field measurements including fish species identification, absence/presence of pre-existing fin clips and/or floy tags, fish total length measurement, correctly applied fin clip and floy tag, observed floy tag number, and specimen spawning and health condition. All data will be reviewed, discrepancies will be resolved on-site, and data declared complete prior to leaving each sample site. Final measures will be correct >99% of the time.

Accuracy and Precision (Critical)

1. Standard field forms and definitions are included for all field equipment, variables, units of measure and recording of data.
2. All fish >254mm will be measured in the field to the nearest 1mm.
3. All fish >254mm will be identified in the field to the lowest taxonomic level, usually species using taxonomic keys adopted for Wisconsin and Great Lakes fish. Fish samples that cannot be identified in the field will be preserved as voucher specimens and examined in the laboratory. Field forms will be updated to include the results of the voucher specimen correct identification.
4. All fish >254mm will receive the appropriate unique fin clip and floy tag. Each floy tag includes a

unique identification number that cannot be duplicated.

5. In order to minimize potential injury or mortality to fish during handling and processing, the design will follow a dual observer/recorder protocol. Direct dual observer/recorder protocols for field measurements and markings of fish including specimen total length; species identification; fin clip and insertion of a unique external floy tag identification number; and spawning and health condition will insure that all discrepancies will be resolved on site; and these measures will be correct 99% of the time. Indirectly, duplicate capture, total length measurements, and noting of unique fin clips and tags to the same specimens will be made when fish are re-captured during subsequent sample events. Some measures to fish may be expected to change over time, most notably spawning condition and external health characteristics as fish progress through the spawning phase.
6. Fish passage effectiveness is partly gauged by fish collected and marked downstream of the former fish barrier and are re-captured upstream of the former barrier. The Data Quality Objective (DQO) proposes a 5% re-capture rate of the species-specific population estimates downstream of the former barrier. Population estimates will use the Schnabel Population Model, Cormack-Jolly-Seber Population Model, or other appropriate animal based population model depending upon the life history characteristics of the particular species and the degreed to which the population is "closed". The model includes estimates for standard error, and 95% upper and lower confidence intervals (see Section B.5).
7. All data will be entered into the existing centralized WDNR/USGS Fish and Habitat Database using standardized data entry forms and fields. All data residing on servers is routinely backed up.
8. All electronically entered data will be proofed prior to being flagged in the database as "proofed and complete."

Accuracy and Precision (Informational)

1. The accuracy of the GPS will be checked by geolocating a known local geo-referenced benchmark. Before each use of the GPS, the data recorder is responsible for verifying GPS settings are locked and set. Prior to use perform battery check; verify settings that the Wide Area Augmentation System (WAAS) is enabled; the map datum is set to WGS 84; location format set to display decimal.degrees; True north; 24-hr time reporting, correct date and time; Central Time Zone; auto set for Daylight Savings Time.
2. The USGS is the national authoritative source for gauging stream flow. The USGS follows strict quality control guidelines before enabling access to real-time flow data and prior to publishing. No quality check or audit of their data is necessary.
3. Instantaneous and continuously logged water thermistors are accurate within $\pm 0.5^{\circ}C$. Handheld field thermometers will be checked against the ABS certified thermometer at prior to and at the end of the fish assessment period. The logging thermistor will be checked against the ABS certified thermometer prior to programming ("launching") from the desktop PC, and following retrieval and data download. Temperature differences in excess of $\pm 0.5^{\circ}C$ between field thermistors and the ABS thermometer will be cause for rejecting the data.

Representativeness

1. Fish sample reaches will be selected to represent the full range of spawning habitats and fish

assemblage in the Milwaukee Estuary, the lower Menomonee River, river reaches downstream and upstream of the proposed barrier removal reach.

2. A large number of sample events (5 downstream and 10 upstream of the former barrier) and specimens will be collected and marked to account for a full range of species-specific seasonal fish migrations and sample efficiencies

Duplicate Measurements

Critical measurements include direct measurements or marks made to capture fish including total length, fin clips and inserting floy tags. To avoid excessive handling and potential harm or mortality to the specimens no duplicate measures or marks will be made.

A.8 Special Training/Certification

Fish Sampling, Measurements and Marking

Fisheries assessments will be completed by WDNR Fisheries personnel trained in the standard operating procedures for collecting fish samples using standardized active (electrofishing) and passive (netting) equipment. All unauthorized staff using electrofishing equipment or who observe electrofishing from DNR vessels are required to complete an Electrofishing Orientation Training course each year; and all WDNR staff are required to complete specific training every 5-years. This course familiarizes operators and observers on all phases of the equipment, its operation, safety procedures, and the fundamentals of electricity. WDNR materials used for electrofishing training are available upon request. Similarly, all field staff are trained to obtain accurate measurements for total length; and to correctly identify and apply the correct taxonomic fin clip, and to correctly insert and read floy tags.

Fish Specimen Identification

Fisheries staff are trained and have extensive professional experience to correctly identify all fishes present in Wisconsin and boundary waters including Lake Michigan >26mm (1-inch) to the lowest taxonomic level, usually species, using fish taxonomic keys for Wisconsin Inland and Great Lake waters (Becker, 1983 and Lyons, 2005). Questionable specimens are preserved for laboratory identification. Laboratory voucher specimens are maintained in the WDNR Southern Lake Michigan Work Unit facility to aid species identification.

GPS

All WDNR staff are knowledgeable in the operation of the GPS in order to geolocate accurate "point" field positions using the Garmin GPS model 76. Critical features are pre-set and "locked" to avoid erroneous locations, date and time stamps including enabling WAAS, map datum as WGS 84, location format displayed as decimal.degrees, 24-hr time reporting format, Central Time Zone, and automatic set for daylight savings time.

Safety and First Aid

Staff are trained and certified annually by the Red Cross or American Heart Association for cardiopulmonary resuscitation (CPR), automated external defibrillator (AED) and first aid.

A.9 Documents and Records

QAPP Control, Distribution and Updates

The final approved QAPP will be retained by Tom Chapman, P.E., Project Manager for the MMSD in Milwaukee, Wisconsin office. A copy of the original approved QAPP will be distributed to individuals identified in Section *A.3 Distribution List* of this document. In the event that Project Managers identified in Section *A.4 Project/Task Organization* wish to modify or append to the QAPP and supporting protocols, the Project Manager will forward the request to other Project Managers for their review and consideration. Acceptance, acceptance with conditions or denial of proposed revisions will ultimately be the responsibility of Rajen Patel, USEPA Project Manager. Approved modifications or addendums to the QAPP and supporting protocols will be made to the final approved QAPP and distributed to other Project Managers. The updated QAPP cover page will clearly identify the appropriate date and version. Field forms and resulting database entries will include the operating date and version for the revised QAPP.

Reports, Data and Field Records

Interim Progress and Final Project Report

Construction will be substantially completed by September 2012 and the subsequent post-construction fishery assessment will commence on or about spring of March 2013. An interim progress and final project report will be completed 6-months and 1-year following completion of the initial fish survey date, or approximately December 2013 and June 2014, respectively.

Interim and final report formats will include chapters on "Field Sampling Issues/Problems Encountered" and "Recommendations" to aid in resolving and managing future fish assessment issues and problems recognizing that the construction and monitoring phase of this project will provide important transferable information for similar project within and outside the Great Lakes Basin. Interim and final reports will be prepared using MS WORD and Excel software applications.

Data Report

An interim data quality assessment report will be prepared for MMSD and USEPA Project Managers 6-months following completion of the initial fish survey date, or approximately December 2013. The report will summarizes internal WDNR data quality assessments and performance evaluations; any completed field sample audits by WDNR or others; the overall project status; database entry and database review for completeness and accuracy; significant quality assurance problems; major departures from the work plan and study design; and recommended solutions (see section C.2 Reports to Management).

All direct and non-direct collected data classified as critical or informational collected over the course of the study, including but not limited to fish collection forms, thermistor and field thermometer accuracy check and deployment forms, logged thermistor water temperature data files, USGS river discharge data downloads, photograph and photograph logs, and equipment logs will be scanned as Acrobat .PDF images. This information will be included as an addendum to the final report or issued as a separate

report as directed by the USEPA Project Manager.

Photograph Documentation

The project will be documented with enlarged high quality (3200x2400) digital photographs. Photographs will be uploaded using proprietary camera manufacturer software to .JPG format. All photographs will be documented on a standard form or field book. Each photograph will be documented and described to include: Photographer, camera make and model, date and time, photo identification number, location, orientation, and description. Photographs will be uploaded to a local desktop PC. Each uploaded photograph includes an alphanumeric file name, date and time stamp when it was taken. The file name will be copied onto the photograph form or field book.

SECTION B – DATA GENERATION & ACQUISITION

B.1 Sampling Process Design (Experimental Design)

Sampling network design & rationale for design

The sampling design proposes to gage the effectiveness of removing and rehabilitating the concrete-lined river channel to enable potamodromous fish from Lake Michigan, the Milwaukee Estuary and lower Menomonee River. Process and design is predicated on the following assumptions:

The time and location for removing the barrier is known. Under ideal conditions, the study design would include a pre-impact (pre-barrier removal) assessment to serve as a temporal control to the post-barrier removal condition. Identical sample efforts among all reaches relative to the number of samples, frequency and methods for measurements, and a like-reach not receiving the treatment (i.e., barrier removal) would be available to serve as a control and included in the design and effort. The WDNR does not have sufficient budget for time and materials to conduct such a thorough sample effort. As a result, no pre-impact monitoring sampling will occur and the study must be inferred from spatial patterns only.

Quantitative DQO

There are no quantitative data to accurately estimate species-specific fish populations or required sample size during spring spawning migrations in the Milwaukee Estuary or the Menomonee River upstream or downstream of the existing barrier. Such data would be most useful for estimating the level of effort to complete the study. The design will maximize the effort to capture, mark and re-capture as many specimens as possible. Fish populations downstream of the barrier can be estimated using mark and re-capture techniques and appropriate animal population models. The quantitative DQO proposes a 5% re-capture rate of the species-specific population estimates downstream of the former barrier. Population estimates will use the Schnabel Population Model, Cormack-Jolly-Seber Population Model, or other appropriate animal based population model depending upon the life history characteristics of the particular species and the degree to which the population is "closed". The population model will be robust enough in that it is not biased by marking; re-capture events that occur on multiple sample events; or sampling that occurs at unequal time intervals.

Qualitative DQO

Estimates of species-specific fish populations are not always required for documenting fish passage effectiveness. Since 1987, fishery assessments in the Estuary and throughout the Menomonee River watershed were semi-quantitative by design. Sample protocol included standardized equipment and sample reach length. These data do provide valuable information regarding species diversity, species relative abundance, and in particular species presence and absence. The clear boundary and differences between the presence and absence of some species is a testament to the effectiveness of the barrier limiting or preventing fish passage. The presence/absence of fish species upstream versus downstream of the barrier will provide a basis for proposing a qualitative DQO (Appendix 1). The capture and marking of the most common fish species known to be present downstream of the existing barrier and are absent upstream of the barrier, and are ultimately captured upstream following removal of the barrier would

conclude that barrier removal and channel restoration enabled fish to swim beyond the former barrier. In particular, capture of the following fishes upstream of the current barrier would provide evidence that removal of the barrier and restored river channel was effective at enabling fish passage: Four species of redhorse including Golden Shorthead, Silver and Greater redhorses; spring-run strain of Rainbow trout and Gizzard shad. Other species captured upstream of the former barrier that would confirm fish passage include Walleye, Smallmouth bass, Channel catfish, and Yellow bullhead, Spotfin shiner and Emerald shiner. However, while these species are only present downstream of the barrier they are uncommon so the probability of capturing them at any of the sample reaches is low. Mature Spotfin shiner and Emerald shiner are less than the 254mm length fish targeted for capture and would not be trapped in the larger mesh-sized net fishing gear deployed at the upstream reach.

The concrete channel is a complete barrier to the upstream movement of all indigenous potamodromous fishes. Not all species are present in similar numbers or exhibit similar or known migratory behavior. Downstream capture and marking of poor swim performing Northern pike that are re-captured upstream of the former concrete fish barrier would suggest the completed project would pass other large bodied and mature targeted fish (>254mm) and smaller (<254mm) fishes. Similar to other species described above, Northern pike populations downstream of the barrier are low so that there is a lower probability that they may be captured.

Sample locations and sample frequency

As described earlier, the ability to capture fish using the same gear and effort may not be feasible between sites due to uncontrollable environmental factors. This is especially the case when conducting spring fish assessments in a highly urbanized stream where urban land use and connected imperviousness contribute to rapidly changing, extreme and frequent changes in river discharges. Both of the proposed sample reaches may not be sampled safely using towed wadable electrofishing gear; and the reach upstream of the barrier may not provide adequate access and maneuverability to be sampled safely using boat electrofishing gear. These conditions requires using a combination of active (powered boat or towed electrofishing) and passive (net) fishing gear. All of these gear have different sample efficiencies independent of environmental conditions. To account for these field conditions differences in sample gear and site conditions, a high number of mark and re-capture sample events are proposed to be completed in order to collect an adequate number of specimens. Up to five sample events are proposed for the reach downstream of the barrier where boat electrofishing can be effectively used; and up to 10 sample events are proposed for the reach upstream of the barrier where a combination of active (electrofishing gears) and passive (netting) gears will be utilized. The combination of sample site conditions, mixed sampling gears, and presumed lower sample efficiencies accounts for the greater number of sample events at the upstream reach compared to the downstream reach. However, post-barrier removal monitoring in early 2013 may be severely limited due to uncontrollable environmental factors.

Classification of each measurement parameter as critical or for informational purposes only

Table B.1 Classification of Measured Parameters

Parameter	Measuring Device	Classification
Electrofishing effectiveness	Adjust power output rheostat for optimum electrical output. Monitor and record digital meter voltage and amperage output at power box.	Critical for determining optimum sample effectiveness.
Electrofishing and net fishing start and end date and time	Record sample date, start and end time using digital pre-set chronogram wrist watch.	Critical for estimating catch per unit effort and providing more precise estimates of fish species relative abundance.
Fish identification and fish count	Appropriate fish identification keys for Wisconsin and Great Lakes fishes; Collect and preserve voucher specimens for laboratory identification; Personnel training and experience.	Critical for qualitatively assessing the effectiveness in enabling fish passage for all fish species.
Fish marking	One-time left ventral fin clip and floy tag for all specimens collected downstream of former barrier. One-time floy tag for all specimens collected downstream and upstream of former barrier; Personnel training and experience.	Critical for assessing fish passage effectiveness for assessing fish passage effectiveness, and species specific adult population estimates.
Total fish length (mm)	Fish measuring board in 1cm and 1mm increments; Personnel training and experience.	Critical for selecting specimens for marking. Acceptable accuracy $\pm$10mm. Informational as an indirect measure of species age and physical stature to successfully ascend former barrier reach.
Fish spawning condition	Gentle external pressure to abdomen and gonads; Personnel training.	Informational for determining fish population sex ratios, for approximating duration of spawning migration

		and emigration, and anticipating sample schedule.
Sample reach location start and end, and locating thermistor deployments.	Garmin® model GPS 76 locked pre-sets include: WAAS enabled <35m, 95% typical; Map datum WGS 84; Location format decimal degrees (hddd,ddddd); True north; 24-hr time reporting, date and time set, and Central Time Zone; Auto for Daylight Savings Time.	Informational for re-locating the approximate begin-end of sample reach. ±15m is acceptable tolerance for displaying sample sites onto GIS and re-locating approximate sample site. Informational for locating deployed thermistor. ±15m is acceptable tolerance acceptable tolerance for displaying sample sites onto GIS and re-locating approximate sample site.
Continuous water temperature	Logging thermistor by ONSET Computer Corp.®	Informational for documenting the peak and duration of fish migrations. These data will be assembled after the fish sampling effort is completed. When correlated with stream flow and peak species specific migrations, provide useable life history information.
Instantaneous water temperature	Hand-held alcohol thermometer.	Informational for approximating the timing of fish migrations and scheduling fish collection surveys.
Discharge	Internet access to USGS real-time gauging station for assessing fishability, safety and queue for fish migrations.	Informational for approximating the timing of fish migrations and scheduling fish collection surveys.

B.2 Sampling Methods

Fish Sample Locations, Frequency and Schedule

A total of two river sample reaches will be established; one reach upstream and one reach downstream of the concrete river channel and fish passage barrier. The reach downstream of the former fish barrier will be sampled up to five times and the reach upstream of the former fish barrier will be sampled up to 10 times beginning in March-April 2013 and ending in May-June 2013 to coincide with peak fish spawning runs. Greater sample frequencies at the upstream sample reach is needed to account for potential reduced sample effectiveness using passive net gear as opposed to more effective sampling using electrofishing gear.

The initial sampling event will coincide with spring river ice-out, snow melt, increasing discharge and increasing water temperature. These and other environmental events trigger the earliest and peak fish spawning migrations for potamodromous and adfluvial and spring-spawning fish species indigenous to Lake Michigan, the Milwaukee Estuary and the lower Menomonee River. Ultimately, the final sampling schedule will be finalized to coincide with peak spawning periods for fish species possessing strong spawning migration behavior described earlier. Northern pike are the earliest staging and ascending fish species, followed closely by White sucker, and Walleye. Northern pike and Walleye are relatively rarer than indigenous members of the sucker family. Within the study area, members of the sucker family are the most common large-bodied fishes. They include the white sucker, and four species of Redhorses spp., ranked by relative abundance, the Golden redhorse, Shorthead redhorse, Greater redhorse, and Silver redhorse. The Greater redhorse is listed as a state Threatened species. Northern pike, Walleye and suckers exhibit strong natal spawning migrations.

Fish Sampling Procedures

Fish will be sampled using active and passive techniques. Active fish sampling methods will use electrofishing while passive methods will emphasize netting. Electrofishing equipment will include an outboard powered boat and mini-boom and multiple manually towed electrofishing units. All electrofishing will be completed by WDNR staff trained and certified in the safe operation of electrofishing gear. No block nets will be used during fish sampling efforts. The length of each electrofished sample reach will be a minimum of 35-times the mean stream width based on 10 equally spaced stream width measurements to the nearest 0.1 m. The sample reach conditions upstream of the former barrier are dynamic relative to hydraulic conditions and safe accessibility. These conditions limit the type of gear that can be used and its effectiveness. Therefore, the emphasis is to capture and mark as many of the targeted species and size (>254mm) as possible downstream of the former barrier to increase probability of re-capturing fish upstream of the former barrier.

Mini-Boom Sampling Technique

Fish community sampling techniques will be largely dependent on river flow and depth conditions. Standard equipment is a boat-mounted, pulsed-DC electrofishing unit. Typically a 5m long aluminum boat powered by a 15-25hp outboard motor, with the boat hull serving as the cathode. The anode is a

single 4m boom with a "Wisconsin ring" from which 16 cylindrical, 17mm-diameter stainless steel droppers are suspended. In normal operation, about 125mm of each dropper is in contact with the water. A gas-powered generator rated at ~3500 W provides adequate electricity. The control box converts AC to DC and allows standardization of the pulse rate at 60 Hz and a 25% duty cycle. Depending upon water chemistry, sampling can typically be done at ~3000 W output from the control box.

Sampling is generally conducted in a downstream direction to better enable boat control and netting effectiveness in strong currents. While sampling, a single person uses a 17mm-mesh (stretch) dip net and is effective at capturing all fish specimens >254mm and presumably mature fish exhibiting spawning migration behavior, and capable of safely accepting fin clips and floy tags.

Towed Electrofishing Techniques

A DC-powered towed electrofishing units may be used to collect fish as part of the project. This towed electrofishing units will be used when safe wadable stream conditions exist, typically water depths less than 0.75 m and velocities less than 1.2 m/sec. Each of the two units will be operated using a three anode configuration operating at greater than 150-volts and between 6 and 8 amps. Each anode assembly will be operated by a single individual and hand held dip net with a 5mm-mesh (stretch) dip net. Sampling is conducted in an upstream direction sampling all available cover types and habitats.

Netting Techniques

Sampling fish with passive netting configurations can be especially effective during spring migration periods. Nets can fish effectively especially in quiescent lakes or backwaters, or sluggish flowing rivers. Nets may not be appropriate in moderately steep and fast flowing waters such as the Menomonee River under high spring flow conditions and transporting large amounts of debris. High river velocities and debris can sweep away or damage nets, or make fishing ineffective. A decision to use nets, net types and configurations will be based on river conditions and effectiveness of electrofishing techniques.

Fish Measurements and Markings

All fish >254mm (>10-inches) in total length captured <u>downstream</u> and <u>upstream</u> of the former barrier will be identified to species level, counted, and measured for total length to the nearest 1mm. Fish <254mm will not be captured or marked because smaller specimens are more fragile and may not survive the strain of handling and clipping. All captured fish will be inspected for spawning condition (gonads as green, ripe or spent), sex, and external health conditions (as deformities, eroded fins, lesions and tumors). Mortalities caused by fishing and handling will be noted as a mortality.

Up to 3,000 fish <u>≥</u>254mm in total length will receive a one-time sequentially numbered floy tag and all fish captured <u>downstream</u> of the former barrier will also receive a unique left ventral (LV) fin clip. Fin clips and floy tags applied to fish captured downstream of the former barrier and re-captured upstream of the barrier would confirm those specimens were capable of swimming beyond the former barrier and restored river channel. The unique number provided by each floy tag will provide more detail on the movement of individual fish regardless of being captured upstream or downstream of the former barrier over a longer period of time, and provide more options for estimating fish populations.

All captured fish will be inspected for previously applied fin clips and floy tags. All previous LV fin clipped and floy tagged specimens will be identified to species, the type of fin clip noted, the floy tag number recorded, and noted as a "re-capture". All subsequent fish sample events will not be scheduled earlier than 24-hours after the previous sample event.

All sampled specimens will be released to the reach they were collected from after processing unless a sample is needed to confirm species identifications. Voucher specimens will be preserved in a stock solution of 37% formaldehyde diluted with a 10:1 ratio of river water. All voucher jars will be labeled noting sample date, waterbody and associated WIBC code, sample reach identification number, number of preserved specimens and collector's name.

Water Temperature and Discharge Measurements

Water temperature and rising river discharges are one of the most important and measureable queues for initiating and timing fish spawning migrations. Instantaneous water temperatures (nearest 0.5°C) will be obtained prior to and immediately after completing a sample reach using an alcohol based hand-held thermometer. Water temperature (nearest 0.5°C) will be logged continuously at 1-hour intervals using an ONSET Computer, Inc. Water Temp Pro version 2 submersible thermistor. Logging thermistors will be located at the furthest upstream and downstream sample reach and within the former concrete lined river channel. Logging thermistors will be deployed and retrieved on or about February 15 and June 15, 2013, respectively.

Real-time river discharge and stage recorded at 15-minute intervals will be obtained from the United States Geological Service Menomonee River gage station (Station 04087120) located 3 km upstream of the project site.

All field data will be recorded on water-proof paper field forms.

Oversight and Responsibility for Corrective Actions

Will Wawrzyn, Senior Fisheries Biologist is responsible for direct oversight for implementing the study design; thermistor and GPS accuracy checks, operation and deployment; oversight of day to day field sampling activities; operation of electrofishing gear; dual role of field sample observer and recorder for fish identification: measures and marks to fish; maintaining quality control records and photograph logs; data entry, review for completeness and management; draft interim and draft final report; and at the direction of Brad Eggold, WDNR Project Manager is responsible for implementing corrective actions for any significant departures in from study design and field plans.

Technicians will be responsible for assisting with operation of electrofishing equipment and passive fishing net gear and their maintenance; serve as observer for fish identification, measures and marks to fish.

Brad Eggold, WDNR Project Manager is responsible for oversight of WDNR staff; insuring project sample design is implemented; completion of weekly field performance reviews and data quality checks; monthly performance reviews during the data review, database entry, and database review for completeness and

accuracy check phase; review and approval of interim and final reports to Tom Chapman, MMSD Project Manager; maintaining communication. The need for significant departures from the study design and work plans will be reported to Tom Chapman, MMSD Project Manager. Significant departures from study design and work plans will be discussed and approved among all entities responsible for the project including WDNR, MMSD and USEPA.

B.3 Sampling Handling & Custody

All paper field forms will reside in the WDNR Southern Lake Michigan Work Unit files.

Potential field samples for this project include fish voucher specimens. A copy of the fish voucher container label is included in Appendix 2.

B.4 Analytical Methods

Fish Sample Methods and Required Equipment

Fish sampling methods will primarily use active collection methods, specifically outboard powered boat (mini-boom) and manually towed stream shocking units. Effective and efficient fishing is generally gauged by generator output voltage and amperage. Under moderately conductive waters (1,000 u/S), effective electrofishing for mini-boom output is optimum at greater than 150 volts and between 15 and 20 amps. Stream shocker output is effective at outputs of greater than 150 volts and 6 to 8 amps. Fishing effectiveness and efficiency can be significantly reduced under more conductive waters (> 1,500 u/S). Urban stream conductivity, including the Menomonee River, can be seasonally high during the spring as a result of urban stormwater runoff and the use of winter road salt. In the event that electrofishing effectiveness and efficiencies are poor, sampling may be re-scheduled at the discretion of Brad Eggold, WDNR Project Manager.

Water Temperature Methods

Instantaneous water temperatures will be obtained from each sample reach prior to and following completion of the fish sample using a hand-held alcohol thermometer. Logging thermistors will be deployed to measure temperature at 1-hour intervals at three river reaches downstream, within and upstream of the former concrete channel and fish passage barrier. Hand-held thermometer and logging thermistors will be checked against a NBS certified and traceable thermometer. Hand-held thermometers and logging thermistors greater than $\pm 0.5^{\circ}C$ compared to the NBS standard will not be deployed or used. Protocols for accuracy checks are provided in section **B.7 Instrument/Equipment Calibration and Frequency.** The fisheries unit maintains replacement logging thermistors and hand-held thermometers. Will Wawrzyn, WDNR Southern will conduct accuracy checks. When a thermometer or logging thermistor is observed to be out of tolerance, those units will not be deployed and replacement units will be used.

B.5 Quality Control

Table B.5 Quality Control Activities for Measurement Techniques

Sample or Measurement Technique	Method and Criteria	Corrective Action
Electrofishing (Critical)	For effective fishing mini-boom output >150V and 1520A; towed stream shocker > 150V and 6-8A; routine checks electrical continuity; safety. Operation and output is monitored throughout electrofishing sample event.	Replace units in whole or in part. Standard WDNR issued gear. Serviceable by technicians and "off the shelf "replacement parts readily available. Staff certified for optimum operation and safety features on an annual basis.
Fish Mark and Re-Capture using Unique Fin Clap and Sequentially Numbered Floy Tags (Critical)	For all specimens ≥254mm captured downstream of project will receive a left pelvic (LV) clip. Field staff are trained to recognize external fish topography and to apply the correct fin clip, and to recognize regenerated fins and scar tissue formed from previous fin clips. Each floy tag includes a unique and sequential number.	No other alternative fin clips or floy tags will be used
Fish Total Length (mm) (Critical and Informational)	Distance from anterior most projection of head to the farthest tip of the caudal fin when the lobes of the fin are folded together; 1m long measuring board in 1cm and 1mm increments.	Standard measurement for WDNR fisheries surveys. Replace measurement board if ruler becomes worn and non-legible
Fish Species Identification (Critical)	WDNR staff trained to identify fishes > 26mm in total length. Use standard fish taxonomic keys for Wisconsin fishes (Becker, 1983 and Lyons, 2005).	All fish not readily identified in the field will be preserved as voucher specimens for identification the laboratory using dissecting grade microscope. Standard voucher specimen label for project (Appendix 2)
Hand-Held Thermometer for instantaneous water temperature measures (Informational)	Calibration is not feasible. Accuracy is checked against a NBS certified and traceable thermometer prior to	Departure of the hand-held thermometer or logging thermistor against the NBS standard thermometer in

Logging Thermistor for measuring continuous logged water temperature water measures at 1-hr intervals (Informational)	deployment and following retrieval.	excess of $\pm$0.5°C is considered to be out of tolerance. Units will not be deployed and will be replaced (Appendix 3 and 5)
GPS for geo-locating fish sample site location and thermistor deployment sites (Informational)	Check accuracy by geo-locating a known local geo-referenced benchmark.	Accuracy is acceptable $\pm$15m

Procedures to Calculate Quality Control Statistics

The quantitative DQO is: Fish collected and marked downstream of the former fish barrier and are re-captured upstream of the former barrier. More specifically, a 5% recapture rate of the estimated species-specific population downstream of the former barrier.

There are a variety of peer reviewed animal population models that may be used to assess this outcome. The Schnabel Model allows marking and recapture on several occasions. Marking events need not be separated by equal time intervals. The population must remain constant throughout the sampling period, and immigration, reproduction, differential mortality and other factors must not change the ratio of marked to total animals. If these assumptions appear to be violated, other methodology such as the Cormack-Jolly-Seber method will be employed. This technique is often used for organisms that are difficult to capture and can be obtained only in small numbers.

The Schnabel Model estimates calculated for each re-capture date is shown below as:

$N = (\Sigma C_t M_t)/(\Sigma R_t)$

Where: C_t = number captured each time

M_t = number marked before sample t is taken

R_t = number of recaptures

Confidence intervals are calculated following the same procedure except that the reciprocal of N is used because it is more normally distributed.

$S^2 = \Sigma R_t/(\Sigma C_t M_t)^2$

Standard errors are calculated as:

St. err. = sqrt (s^2/N)

and the confidence interval about the mean is:

$1/N \pm t$*st. err

where t is the student t at a = 0.05 and v= mark and re-capture dates (t).

Using the reciprocal for the estimation of the confidence interval produces an unbalanced interval about the Schnabel estimate such that the mean is not at the midpoint between upper and lower limits. This compensates for the fact that the Schnabel Method requires sampling with replacement.

Schnabel method calculations for population estimates.

Date (t)	Marked fish in population (M_t)	Captured (C_t)	ΣC_t	C_tM_t	ΣC_tM_t	Recaptures (R_t)	ΣR_t	N_t
1								
t+1								

Variance and Confidence limits for Schnabel population estimates.

Date (t)	ΣR_t	$(\Sigma C_tM_t)^2$	Variance (1/N)	Standard error	Student t (with n = t)	1/N – Confidence interval	1/N + Confidence interval	N lower Confidence interval	N Co int
1									
t+1									

Statview® statistical software will be used to calculate and report descriptive statistics for fish length, capture, mark and re-capture, and population data; logged temperature and river discharge data.

B.6 Instrument/Equipment Testing, Inspection, and Maintenance

All electrofishing hardware will require routine maintenance. Generator oil is changed out after 40 hours of operation per the manufacturer's recommendations. The 12 volt battery that operates the electrofishing control boxes are routinely checked for voltage, and are charged with an external battery charger as needed. Electrical continuity checks between anodes and control box are checked at the beginning of each sample reach. Electrical output can be observed on all electrofishing equipment during operation. Output as voltage and amperage is recorded for each sample event to insure maximum performance between sample events. Spare generators, spark plugs, service tools, nets, batteries, anodes and droppers, and cables are kept with the electrofishing unit (mini-boom) or service trailer (towed electrofishing unit).

Logging thermistors and hand-held thermometers can not be calibrated. They can however be checked for accuracy compared to a NBS certified and traceable thermometer. Logging thermistors and hand-held thermometers will be checked for accuracy prior to deployment and upon retrieval from the field. Thermistor and field thermometer accuracy is acceptable within $\pm 0.5^{\circ}C$ of the NBS certified and traceable thermometer. Thermistors and field thermometers observed to be out of tolerance (greater than $\pm 0.5^{\circ}C$ of the NBS certified and traceable thermometer) will not be deployed. Replacements will be checked for accuracy and deployed only when they are observed to be within tolerance.

GPS equipment when operating correctly does not need routine maintenance beyond insuring proper battery power and that the unit remains "locked" for default settings (see section B.1).

B.7 Instrument/Equipment Calibration and Frequency

Logging thermistors are classified as direct and informational data only but are proposed to be checked for analytical performance. The logging thermistors are manufactured by ONSET Computer Corporation® Model HOBO U22-001 version 2 performance specifications follow below:

Operation range†: -40° to 70°C (-40° to 158°F) in air; maximum sustained temperature of 50°C (122°F) in water.
Accuracy: 0.2°C over 0° to 50°C (0.36°F over 32° to 122°F)
Resolution: 0.02°C at 25°C (0.04°F at 77°F)
Response time: (90%) 5 minutes in water; 12 minutes in air moving 2 m/sec (typical)
Stability (drift): 0.1°C (0.18°F) per year

Accuracy Check of Thermistor

While the thermistors cannot be calibrated, they can be checked to see if they are recording within their specifications. Testing should be done in a controlled environment. Prior to and following the deployment, the accuracy of each thermistor will be checked consistent with the manufacturer's (ONSET Computer Corporation) recommendations:

1. Place crushed ice in an insulated container that is large enough to hold the thermistor being tested. (It is important to crush the ice to maintain as consistent and uniform a temperature as possible).
2. Fill the container with tap water to just below the level of the ice and stir the mixture around.
3. Submerge and suspend the thermistor being tested and a NBS certified thermometer.
4. Place the entire container in a refrigerator to minimize temperature gradients. Allow enough time for the thermistor to acclimate. The ice will melt slowly, so the actual temperature should settle around 0°C if the ice bath was prepared correctly.
5. The thermistors should be recording data and a certified thermometer should be in the same ice water bath.
6. Remove the thermistors and certified thermometer from the ice bath and allow them to reach room temperature. Record the certified thermometer temperature at predetermined intervals (e.g. 1 hour, 4 hours).
7. Download the thermistors and plot the data on a graph with the certified thermometer data to see if the data is within the acceptable error boundaries specified by the manufacturer.

Record the appropriate observations on the thermistor specific *Thermistor and Field Thermometer Accuracy Check* form in Appendix 3. The thermistors, however, do not allow any adjustment to the calibration. If they do not fall within the acceptable error boundaries, they must not be used.

Field Check of Thermistor

To be completed at time of thermistor deployment and at the time the thermistor is retrieved from the stream. Fill out the *Thermistor Deployment and Retrieval Check* form in Appendix 4. The individuals watch and the thermistor internal clock set by the computer clock at the time of launch may be different. Use this data to compare to the thermistor data once it is downloaded onto the computer to determine if the field thermometer and the thermistor are within an acceptable level of accuracy for purposes of meeting the established monitoring objectives (e.g. $\pm 0.5^{\circ}C$). If thermistor is off by more than the specified accuracy or an acceptable accuracy, do not re-deploy the thermistor and determine the reason for the error, if known.

Certified Thermometer
A certified thermometer is a glass and mercury thermometer that has a document stating the difference between it and a National Bureau of Standards (NBS) thermometer. The thermometer is never removed from the laboratory.

Field Thermometer
Once per year, the field thermometer should be checked against the certified thermometer. All the above results should be recorded in a logbook for that particular field thermometer.

Calibration for GPS unit
The GPS unit will not be calibrated per se. Calibration can only be accomplished by the factory. The GPS unit will be checked for relative accuracy. The GPS unit's accuracy prior to initiating the fish sampling phase and thermistor deployment; and at the end of the sampling phase. The GPS is used for approximating sample locations and thermistor deployment sites. The GPS unit will be checked for accuracy by comparing it to a known local geo-referenced benchmark. Accuracy of +15m is acceptable for purposes of displaying sample site locations onto GIS.

B.8 Inspection/Acceptance of Supplies & Consumables

There are no specialized supplies or consumable materials required for this project.

B.9 Data Acquisition Requirements for Non-Direct Measurements

The USGS stream discharge gauging station data is the only external and non-measured data for this project. These data are for informational purposes and are not critical to the overall project in terms of meeting the projects **Criteria for Measuring Fish Passage Effectiveness (see section B.1 Sampling Process Design Experimental Design)**. The USGS is the national authority on river gauging and follows strict data acquisition, field equipment calibration and verification protocols before enabling real-time access to or prior to publishing their data.

B.10 Data Management

All fish data will be entered and stored in the WDNR/USGS Fish and Habitat Database. The following protocols for data management are contained in the WDNR Fisheries Management Handbook:

Fish Management Handbook
Update – Chapter 11, Sections J - P
October 2009

Data Collection and Analysis Procedures

J. Fisheries Management Database

The fisheries biologists or designated fisheries technicians and their fish team supervisors are ultimately responsible for the long-term maintenance of all records in the Fisheries Management Database within their management area.

Fisheries and habitat data collected from Tier 1 and Tier 2 fisheries management assessment surveys, habitat improvement surveys, stocking and regulation evaluation surveys, tournament permits, stocking permits, fish kill investigations and stocking planning and activities are stored in the Fisheries Management Database http://infotrek.er.usgs.gov/wdnr_bio. Information stored in the Fisheries Management Database is used to generate statewide stocking or fisheries summaries, to evaluate fisheries status and trends, to evaluate the effectiveness of regulation strategies or stocking practices, or in regulatory decision making, permitting and policy decisions.

All DNR employees have read-only access to the Fisheries Management Database. Those who have had training and are required to enter data in the system may also be given read-write access. All other interested parties need to request data from the local biologist, if the request is localized, or from the Database Coordinator.

K. Database Training

Annual training is required to enter data into or retrieve from the Fisheries Management Database. Supervisors are responsible for ensuring that at least one of their permanent staff is proficient and current in their training. Large group training courses are offered in January of each year at a central location. Small group/individual training sessions will be offered at other locations throughout the year as needed.

L. Data Entry

All completed paper Fish Collection Field Forms will be proofed and all missing data fields and recorded data discrepancies will be resolved before leaving the site. All completed and proofed field forms will be filed into a sample-site specific paper file. All paper Fish Collection Field Forms will be proofed again prior to entry into the WDNR/USGS Fish and Habitat Database. The Fish and Habitat Database is resident on USGS servers and is routinely backed up. Output from the database includes text .TXT and MS Excel .XLS formats.

Thermistor logged data will be uploaded to resident PC proprietary ONSET software. Output from

the ONSET software is available in text .TXT and MS Excel worksheet .XLS formats. Data reduction and analysis will utilize MS Excel and STATVIEW software. USGS flow gauging data is available for downloading in text .TXT and MS Excel worksheet .XLS formats.

The integrity of the database and every analysis from it depends on the quality of the data collection and its accurate entry into the system. The Fish Team Supervisor or Supervisor's designee is ultimately responsible for data entry. General instructions for data entry and reporting are available on the web site.

Biologists in the field are responsible for collecting the required metrics and measurements. All mandatory fields must be populated on field sheets to minimize error during data entry. All permanent staff will be notified of updates to data entry forms, reports and requirements and to new modules in the form of a newsletter or e-mail.

If the person entering the data was not involved in the sampling, care must be taken when transferring the field data sheets to ensure that all field forms are correctly interpreted and data are entered correctly into the database. Interpretation of field forms can be confusing and requires some understanding of how fisheries data are typically collected and summarized.

Information stored in the Fisheries Management Database may be accessed and downloaded by anyone within the Water Division as soon as it is entered into the database. Because downloads are possible even if the data entry is not complete, we established a Data Entry Survey Status Code to indicate the status of data entry for anyone downloading information from the database. Except for the default status of "Data Entry Not Complete", the status codes need to be manually updated in the survey data entry form. The following Date Entry Survey Status Codes exist in the database:

Data entry not complete: All survey records have a status code of "Data entry not complete" as the default to prevent someone from downloading and using records that are incomplete and in the process of being entered.

Data entry complete: The person entering data has finished entering all information for that survey.

Data entry complete and proofed: Data entry is final and the Fisheries Biologist or Fish Team Supervisor's Designee has reviewed the data entry.

M. Data Proofing

Updating the "Data Entry Status Code" in the Survey Data Entry form from "Complete" to "Proofed" should only be done by the Fisheries Biologist or Fish Team Supervisor's Designee who will be responsible for the survey records after review.

This person should review the raw data from an export or directly in the data entry form. In addition, the automated summary reports should be reviewed

Before the Data Entry Status Code is updated to "Data entry complete and proofed", the Fisheries Biologist or Fish Team Supervisor's Designee should ask and answer several questions.

1. Does the database accurately reflect the records on the field data sheets? If not, then there might be a typing error in data entry (i.e., is it really a 60 inch bluegill, or should it be a 6.0 inch bluegill?).
2. Is the summary of information from the database's automated reports an accurate reflection of the field data sheet? If not, then there might be an error in how the field data sheet information was organized and entered into the database.
3. Is the summary of information in the database an accurate reflection of the fish population in the lake or stream? The data entry and summary reports may be correct, but something about the sampling event may be confounding the summary results (i.e., a sudden storm or suspected equipment malfunction). Any suspected problems should be documented in the Survey Description area of the Survey Data entry form.

N. Data Entry Error Checking Procedures

Error checking procedures are run nightly for all data. Raw data and summaries are also exported and examined for data structure interpretation and other errors that cannot be caught during the error checking procedure. Data entry and data structure interpretation errors will be flagged and visible in reports and in the data entry form. All corrections will be made by the responsible biologist, the data entry person or with the help from the database team at the Central Office.

O. Data Reporting

The Fisheries Management Database produces standard summary reports and raw data reports. The summary reports and calculations are based on standard protocols. These protocols and metadata associated with the reports are located on the Fisheries Management Database web site.

P. **Data Use**

Not all fisheries sampling information may be used for all purposes. If fisheries data are readily accessible to Water Division staff and eventually the public, care must be taken to prevent misuse and misinterpretation by the unfamiliar user. Metadata is being developed to describe general database structure, field protocols and sampling techniques, assumptions behind sampling techniques, and decision rules to assess the validity of assumptions for each survey. Data Use Codes are based on assumptions for particular sampling techniques. For example, targeted surveys (i.e., Walleye fall young-of-year electrofishing) should not be used if the objective is to determine species presence and absence. Data Use Codes are being developed for all survey techniques in the Fisheries Management Database and will be expanded to include all modules.

SECTION C – ASSESSMENT AND OVERSIGHT

C.1 Assessments and Response Actions

Frequency, Type and Authority for Assessments

Potential departures from the work and sampling plan may include uncontrollable environmental factors (i.e., long-term floods and unsafe sampling conditions), and controllable factors including equipment failure and albeit unlikely, failure of responsible personal to perform. Brad Eggold, WDNR Project Manager will complete field performance reviews and data quality checks at the end of each week during the field sampling period, or more frequent as appropriate. The review and data checks will consist of Brad Eggold, WDNR Project Manager conducting an interview with Will Wawrzyn, Senior Fisheries Biologist and other field staff as appropriate regarding the outcome of the sample events. Interview items include summary of catch effectiveness, stream conditions, equipment deployment and performance, problems encountered and actions taken or needed to be taken to resolve them, and any safety issues that occurred. Field fish collection sheets, field equipment and photograph log books will be reviewed for completeness relative to the MQOs. Brad Eggold is responsible for identifying personal, usually Will Wawrzyn, is responsible for corrective action to guarantee project quality is maintained.

Corrective Actions and Responsibility for Corrective Actions

Short-term revisions (i.e., day-to-day) to scheduled sample events due to inclement weather conditions or high river discharge event would not be expected to significantly impact project data quality, quantity, results and conclusions. Under these circumstances, there is no need to formally contact other members of the project group. Longer-term revisions (i.e., recurring as a result of watershed wide flood events) could significantly impact project data quality, quantity, results and conclusions. Under these circumstances, a more formal notification and modification to the projects study design, fish sampling numbers and sample protocols would be warranted. The decision to significantly modify project sample frequency, number of sample event, sample protocol and techniques would be made by Brad Eggold, WDNR Project Manager following consultation with Tom Chapman, MMSD Project Manager and Rajen Patel, USEPA Project Manager.

If weekly field performance reviews and data quality reviews; or monthly performance reviews and data quality assessments indicate significant departures from work plans and study designs or significant quality assurance problems, Brad Eggold will report those findings to the Tom Chapman, MMSD Project Manager and Rajen Patel, USEPA Project Manager if the work plan and study design could potentially be compromised. All departures from the project design and work plan will be summarized in the project's interim and final reports.

Field Audits

Brad Eggold, WDNR Project Manager will accompany the field sample team on a minimum of one sample event over the course of the field assessment. Representatives of the external project team Tom Chapman, MMSD and Rajen Patel, USEPA, or their agents may participate recognizing participation on certain activities may be limited by WDNR's standard operating procedures related to safety (i.e.,

electrofishing).

C.2 Reports to Management

Internal WDNR data quality assessments will be completed at the end of each week during the fish sampling phase of the project, and on a monthly basis during the data review, data entry into the FH Database, and database review for completeness and accuracy.

An interim data quality assessment report will be prepared for MMSD and USEPA Project Managers 6-months following completion of the initial fish survey date, or approximately December 2013. The report will summarizes the overall project status; performance evaluations and field sample audits; data quality assessments; database entry and database review for completeness and accuracy; significant quality assurance problems; major departures from the work plan and study design; and recommended solutions. The report will be drafted by Will Wawrzyn, WDNR; reviewed and approved by Brad Eggold, WDNR Project Manager and forwarded to Tom Chapman, MMSD and Rajen Patel, USEPA for their review and comments.

WDNR will notify Tom Chapman, MMSD and Rajen Patel, USEPA at any time the approved study design and work plan require significant adjustments or departures to the sample design and work plan that could affect the outcome and conclusions of the study.

A final project report will be completed approximately 1-year following completion of the initial fish survey date, or approximately June 2014.

SECTION D – DATA VALIDATION AND USABILITY

D.1 Data Review, Verification, and Validation

WDNR protocols for fish collection data review; verification and validation are presented in section **B.10 Data Management. WDNR guidelines for review, verification and validation of data classified as critical and direct include:**

D.2 Verification and Validation Methods

WDNR protocols for fish collection data verification and validation methods are presented in section **B.10 Data Management.**

Standard field forms are located as follows:
Appendix 2. Fish Collection Voucher Label
Appendix 3. Thermistor and Field Thermometer Accuracy Check
Appendix 4. Thermistor Deployment and Retrieval Form
Appendix 5. Fisheries Station Summary and Sample Collection Forms
Appendix 6. Photograph Documentation Log

Fish and supporting data flagged as proofed and complete is public record. Those data are readily available to the public upon request in paper or electronic format. Similarly, project reports will also be available to the public in both paper and electronic formats. Consistent with state policy and law, a small fee may be required for paper reproductions.

No data is proposed to be transformed for statistical analyses.

Protocol for data review, verification and validation were previously described in the following sections:
A.7 Completeness, Accuracy and Precision
A.8 Special Training/Certification
A.9 Documents and Records
B.1 Sampling Process Design and Table B.1
B.5 Quality Control
B.10 Data Management

D.3 Reconciliation with User Requirements

The proposed study design and work plan quantitative and qualitative DQOs to evaluate the effectiveness of removing a barrier and rehabilitating a reach of stream to enable potamodromous fish from Lake

Michigan and the Milwaukee Estuary passage to historical spawning and nursery habitat to fish movement. The DQOs include the following quantitative and qualitative DQO measures:

Quantitative

1. Fish captured and marked downstream of the former fish barrier and are re-captured upstream of the barrier following removal of the barrier. More specifically, a 5% re-capture rate of the estimated species-specific population present downstream of the former barrier would conclude that barrier removal and channel restoration was effective at providing fish passage.

Qualitative

2. The capture and marking of the most common fish species known to be present downstream of the existing barrier and are absent upstream of the barrier, and are ultimately captured upstream following removal of the barrier would conclude that barrier removal and channel restoration enabled fish to swim beyond the former barrier.
3. Downstream capture and marking of poor swim performing Northern pike that are re-captured upstream of the former concrete fish barrier would suggest the completed project would enable passage of other species having similar swimming abilities.

MQOs classified as critical and direct measurements include fish capture; fish identification; fish catch per unit effort of time (CPUE); length measurement; and marking and recapture. Potential departures from the study design and sampling plan may include uncontrollable environmental factors (i.e., long-term floods and unsafe sampling conditions), and controllable factors including equipment failure, and albeit unlikely, failure of responsible personal to perform. Brad Eggold, WDNR Project Manager will complete field performance reviews and data quality checks at the end of each week during the field sampling period, or more frequent as appropriate. Monthly performance reviews and data quality checks will be completed during the data review, entry and final review for data entry completeness and accuracy. If these reviews and data quality checks indicate significant departures from work plans and study designs, or significant quality assurance problems, Brad Eggold will report those findings to the Tom Chapman, MMSD Project Manager and Rajen Patel, USEPA Project Manager for consideration of corrective measures.

Informational direct and indirect measures include instantaneous and continuously logged water temperature; geolocation for stream sample reach; and USGS river discharge.

References

Becker, George. 1983. Fishes of Wisconsin. University of Wisconsin Press, Madison, WI.

Buck, James S. 1881. History of Milwaukee 1840-1846, Volume 2. Symks, Swain & Co., Book and Job Printers.

Lyons, John. 2005. Wisconsin Fish Identification System: Software for Identifying Fishes of Wisconsin. ver. 1.0 http://www.wiscfish.org/fishid/wFrmAbout.aspx

Schnabel, Z.E. 1938. The estimation of total fish populations of a lake. American Mathematical Monthly 45:348-352.

Appendix 1. Occurrence and Relative Abundance of Fish Species in the Milwaukee Estuary and Menomonee River Watershed based on Fish Collection Records since 1987 - Downstream versus Upstream of the Proposed MMSD Fish Passage Barrier Removal Project.

Family	Common Name	Occurrence and Relative Abundance of Fish Species **Downstream** of the Fish Passage Barrier [1]	Occurrence and Relative Abundance of Fish Species **Upstream** of the Fish Passage Barrier.[1]	Average time for spawning migration / return [2]	Comments
Bullhead/Catfishes	Black Bullhead	Common	Common	April / June	
Bullhead/Catfishes	Channel Catfish	Rare		May / July	
Bullhead/Catfishes	Yellow Bullhead	Present		May	
Herring	Gizzard Shad	Abundant		late-April / early-May	Dominant in Milwaukee Estuary
Minnows	Western Blacknose Dace	Abundant	Abundant	May / June	Dominant along with White Sucker and Creek Chub
Minnows	Bluntnose Minnow	Present	Abundant	late May / June	
Minnows	Common Shiner	Present	Abundant	late May / late July	
Minnows	Creek Chub	Abundant	Abundant	May / July (June peak)	Dominant along with White Sucker and Blacknose Dace
Minnows	Fathead Minnow	Common	Common	late May / early June	
Minnows	Golden Shiner	Common	Present	June / August	
Minnows	Common Carp	Common	Present	June	Exotic
Minnows	Emerald Shiner	Present		late May / early August	
Minnows	Goldfish	Common	Common	June	Exotic
Minnows	Spotfin Shiner	Present		Late-May / September (late June / late July Lake Michigan waters)	
Minnows	Central Stoneroller	Common	Abundant	late May / June	
Minnows	Hornyhead Chub	Present	Common	May / July	
Minnows	Pearl Dace		Rare	late March / April	Restricted to a tributary in upper Menomonee R Watershed upstream of Lepper Dam at Menomonee Fall (River Mile 21.8).
Mudminnows	Central Mudminnow	Common	Common	April	Migrations March-April
Perches	Johnny Darter	Common	Abundant	April / June	
Perches	Fantail Darter		Rare	April / June	
Perches	Walleye	Common		April / mid-May	
Family	Common Name	Occurrence and	Occurrence and	Average time for	Comments

		Relative Abundance of Fish Species **Downstream** of the Fish Passage Barrier [1]	Relative Abundance of Fish Species Up**stream** of the Fish Passage Barrier.[1]	spawning migration / return [2]	
Perches	Yellow Perch	Present	Present	April / early May	
Pikes	Northern Pike	Present	Present	mid-March / April	
Sticklebacks	Brook Stickleback		Common	early April / May	
Sturgeon	Lake Sturgeon	Rare		mid-March / April	Federal Listed Species. State Special Concern. On-going restoration effort underway for the Milwaukee R. Basin (inc. Menomonee R. Watershed) and Lake Michigan. No spawning migrations expected for near-term 15-years to 20-years until male and female mature, respectively.
Suckers	White Sucker	Abundant	Abundant	mid-March / April	Dominant along with Blacknose Dace and Creek Chub
Suckers	Golden Redhorse	Common		mid-April / May	
Suckers	Greater Redhorse	Present		mid-April / May	State Threatened
Suckers	Shorthead Redhorse	Common		mid-April / May	
Suckers	Silver Redhorse	Present		mid-April / May	
Sunfishes	Black Crappie	Present	Rare	May / June	
Sunfishes	Bluegill	Abundant	Common	late May / July	
Sunfishes	Green Sunfish	Common	Abundant	late May / Early June	
Sunfishes	Largemouth Bass	Common	Common	late April / early July	
Sunfishes	Pumpkinseed	Common	Common	early May / July	
Sunfishes	Smallmouth Bass	Common		April / mid-May	Emigration from spawning and summer habitat to deeper water habitat mid-September through mid-October
Trouts	Brook Trout	Rare		November / mid-December	Rare following cessation of Lake Michigan stocking. Habitat lacking for natural reproduction.
Trouts	Brown Trout	Present		October / mid-November	Non-native but actively managed as a game fish in Lake Michigan and tributary streams. Habitat lacking for natural reproduction.
Family	Common Name	Occurrence and Relative Abundance	Occurrence and Relative Abundance	Average time for spawning migration /	Comments

		of Fish Species **Downstream** of the Fish Passage Barrier [1]	of Fish Species Up**stream** of the Fish Passage Barrier.[1]	return [2]	
Trouts	Chinook Salmon	Common		September / October	Non-native but actively managed as a game fish in Lake Michigan and tributary streams. Habitat lacking for natural reproduction.
Trouts	Coho Salmon	Present		October	Non-native but actively managed as a game fish in Lake Michigan and tributary streams. Habitat lacking for natural reproduction.
Trouts	Rainbow Trout	Common		Strains: Skamania September / March; Ganaraska March-April / May; Chambers November-December / April	Relative abundance based on creel results. Non-native but actively managed as a game fish in Lake Michigan and tributary streams. Habitat lacking for natural reproduction.

Legend:
Relative Abundance
Rare = Species account between 1975 and 1987 but no accounts since 1987
Present = 1-10 specimens since 1987
Common = >10 <100 specimens since 1987
Abundant = >100 specimens since 1987

This page deliberately left blank.

Downstream of barrier (16 sample events at 4 sample reaches since1987)

species	count	Relative Abundance
COHO SALMON	1	Present
FRESHWATER DRUM	1	Present
GREATER REDHORSE	1	Present
NORTHERN PIKE	1	Present
SILVER REDHORSE	1	Present
YELLOW BULLHEAD	1	Present
BROWN TROUT	1	Present
HORNYHEAD CHUB	1	Present
SPOTFIN SHINER	1	Present
EMERALD SHINER	2	Present
BLUNTNOSE MINNOW	2	Present
ROUND GOBY	2	Present
COMMON SHINER	5	Present
BLACK CRAPPIE	5	Present
RAINBOW TROUT	6	Present
SMALLMOUTH BASS	12	Common
GOLDEN SHINER	18	Common
SHORTHEAD REDHORSE	18	Common
GOLDEN REDHORSE	20	Common
JOHNNY DARTER	24	Common
PUMPKINSEED	26	Common
CHINOOK SALMON	30	Common
FATHEAD MINNOW	34	Common
WALLEYE	39	Common
CENTRAL STONEROLLER	70	Common
LARGEMOUTH BASS	75	Common
BLACK BULLHEAD	87	Common
COMMON CARP	88	Common
GREEN SUNFISH	96	Common
BLUEGILL	222	Abundant
WHITE SUCKER	238	Abundant
CREEK CHUB	274	Abundant
WESTERN BLACKNOSE DACE	613	Abundant
GIZZARD SHAD	3240	Abundant

Present 1-10 specimens since 1987
Common >10 <100 specimens since 1987
Abundant >100 specimens since 1987

Upstream of barrier (9 sample events at 7 sample reaches since 1987)

species	count	Relative Abundance
GOLDEN SHINER	1	Present
YELLOW PERCH	1	Present
NORTHERN PIKE	7	Present
BROOK STICKLEBACK	12	Common
PUMPKINSEED	13	Common
COMMON CARP	16	Common
CENTRAL MUDMINNOW	17	Common
GOLDFISH	19	Common
FATHEAD MINNOW	30	Common
BLACK BULLHEAD	33	Common
LARGEMOUTH BASS	41	Common
BLUEGILL	68	Common
HORNYHEAD CHUB	83	Common
BLUNTNOSE MINNOW	211	Abundant
JOHNNY DARTER	248	Abundant
GREEN SUNFISH	281	Abundant
COMMON SHINER	314	Abundant
CENTRAL STONEROLLER	884	Abundant
WHITE SUCKER	1295	Abundant
CREEK CHUB	1664	Abundant
WESTERN BLACKNOSE DACE	2737	Abundant

Appendix 2 Fish Collection Voucher Label

Fish Collection Voucher Label Rev: 08/30/2010

Basin (Code): Milwaukee (050) Watershed (Code): Menomonee (MI03) County (Code): Milwaukee (41)

Waterbody: Menomonee River WIBC: 16000 Project: Menomonee River Fish Passage Project

Collector(s): _____

Sample Date: _____/_____/_____

Sample Location: _____

Number of Specimens Preserved: _____

Comments: _____

_____

_____

_____

Taxonomist Name (Last, First): _____

Date: _____/_____/_____

Taxonomic Key: _____

_____

Common Name	Number	Specimen Retained or Disposed

Appendix 3 **Thermistor and Field Thermometer Accuracy Check**

Thermistor and Field Thermometer Accuracy Check

Name (Last, First): _____

Thermistor Manufacturer/Model: _____

Thermistor Serial Number: _____

Date/Time	Certified Thermometer Temp. (nearest 0.5 C)	Thermistor Temp. (nearest 0.5 C)	Field Thermometer Temp. (nearest 0.5 C)
_____	_____.__	_____.__	_____.__
_____	_____.__	_____.__	_____.__
_____	_____.__	_____.__	_____.__
_____	_____.__	_____.__	_____.__
_____	_____.__	_____.__	_____.__
_____	_____.__	_____.__	_____.__
_____	_____.__	_____.__	_____.__
_____	_____.__	_____.__	_____.__
_____	_____.__	_____.__	_____.__
_____	_____.__	_____.__	_____.__

Comments:

Appendix 4 Thermistor Deployment and Retrieval Form

Thermistor Deployment and Retrieval Form

Name (Last, First): _____, _____

Project: _____

Thermistor Manufacturer/Model: _____

Thermistor Serial Number: _____

Deployment Location Description: _____

Deployment Geolocation (lat/lon) (DD.DDD): _____

Thermistor Accuracy Check Date: _____/_____/_____

Field Thermometer Accuracy Check Date: _____/_____/_____

Deployment Date: _____/_____/_____ Time: _____ Field Thermometer Temp.(nearest 0.5 C): _____.____

Retrieval Date: _____/_____/_____ Time: _____ Field Thermometer Temp.(nearest 0.5 C): _____.____

Thermistor Launch Date: _____/_____/_____ Time: _____

Thermistor Delay (circle one): _____ hours minutes seconds

Thermistor Sample Interval (circle one): _____ hours minutes seconds:

Comments:

Appendix 5 Fisheries Station Summary and Sample Collection Forms (not to actual scale)

Wisconsin Department of Natural Resources

Fisheries Sample Station Form

Station Summary

Stream Name _____ WIBC _____ Date: ____/____/____ Station Name: _____

Project Station ID _____ SWIMS Station ID _____ FH Database ID _____

Lat/Lon Method _____ County _____

Start Lat _____ Start Lon _____ End Lat _____ End Lon _____

Water Characteristics

Time (24-hr) _____ Air Temp (C) _____ Water Temp. (C) _____ Discharge (m^3/s) _____ USGS Station ID _____ Time (24-hr) _____

Relative Water Clarity: Clear_____ Turbid _____ Stained _____ Relative Water Level: Normal _____ Below _____ (m) Above _____(m)

Channel and Basin Characteristics

Channel Condition: Natural _____ >20-yr Post-channelization _____ 10-20-yr Post-channelization _____ <10-yr Post-channelization _____ Concrete _____

Percent Channelized _____ Other _____ Mean Stream Width _____ (m) Stream Order _____

Sample Description

Type: CPE _____ Depletion _____ Mark/Re-Capture _____ IBI _____ GET _____ Other (specify) _____ Station Length (m) _____

Time (24-hr): Start1_____ End1 _____ Start2 _____ End2_____ Start3 _____ End3_____

Type of Pass: Upstream Only _____ Downstream Only _____ Upstream and Downstream _____ Other (specify) _____

Gear Description (include number of units)

Backpack Shocker _____ Stream Shocker _____ Mini-Boom Shocker _____ Number of Anodes/Unit _____ _____ _____ Number of Droppers/Unit _____

Electrical Output Volts _____ Amps _____ Pulse Rate _____ Duty Cycle _____

Other _____

Comments:

Recorder/Observer: _____ Observer(s): _____

Data Entered and Proofed by: _____ Date: ____/____/____ Checked by: _____ Date: ____/____/____

Wisconsin Department of Natural Resources — **Fisheries Sample Collection Form**

Waterbody: _____ **WBIC** _____ **Date:** ____/____/____ **Station Name:** _____

Project Station ID **SWIMS Station ID** **FH Database ID** **Page** _____ **of** _____

SPECIES or COMMON NAME	TOTAL LENGTH (mm) (inches)	SEX Female Male Unk. (F,M,U)	SPAWN Green Ripe Spent (G,R,S)	DELT	MORT	CLIP GIVEN	(type) TAG NO. GIVEN	(type) TAG NO. GIVEN	CLIP OBS	(type) TAG NO. OBS.	(type) TAG NO. OBS.	VOUCHER #

Comments:

Recorder/Observer: _____ Observer(s): _____

Data Entered and Proofed by: _____ Date: ____/____/____ Checked by: _____ Date: ____/____/____

Appendix 6 Photograph Documentation Log

Camera Make _____ Camera Model _____

Project Station ID	Photo Date mo/day/yr	Photo Time	Photographer	Photo ID	Photograph Description (subject, direction, condition, other)