Asian Carp Regional Coordinating Committee

Monitoring and Rapid Response Workgroup

Monitoring and Rapid Response Plan for Asian Carp in the Upper Illinois River and Chicago Area Waterway System

May 2012

ILLINOIS DEPARTMENT OF NATURAL RESOURCES

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The Asian Carp Monitoring and Rapid Response Plan was created by a team of biologists, scientists, managers, and administrators from state and federal agencies and includes technical input from government, university, and the private sector specialists. The original plan released in May 2010 was developed by S. Finney, R. Simmonds, S. Pescitelli, S. Shults, J. Mick, G. Sass, and R. Maher. This and earlier versions of the plan have benefitted from reviews by participants of the Monitoring and Rapid Response Work Group, Great Lakes state‟s natural resource agencies, non-governmental organizations, and staff from the Illinois Department of Natural Resources Division of Fisheries, U.S. Army Corps of Engineers and U.S. Fish and Wildlife Service. K. Baerwaldt, S. Herleth-King, M. Shanks, R. Simmonds, S. Finney, J. Stewart, P. Rogers, P. Thiel, N. Bloomfield, T. Hill, W. Doyle, S. Morrison, V. Santucci, K. Irons, S. Robillard, M. McClelland, D. Wyffels, T. Widloe, B. Caputo, S. Butler, D. Glover, J. Gross, and C. Jerde contributed project write-ups for the plan. K. Baerwaldt, W. Doyle, K. Irons, and F. Jakubicek provided pictures for the cover. B. Caputo prepared fixed and random site maps. V. Santucci assembled this draft of the plan.

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EXECUTIVE SUMMARY

The 2012 Monitoring and Rapid Response Plan (MRRP) is an updated version of the plan developed by the Monitoring and Rapid Response Workgroup (MRRWG) and released by the Asian Carp Regional Coordinating Committee (ACRCC) in May 2011. The updated plan outlines 2012 actions for Asian carp monitoring and removal in the Chicago Area Waterway System (CAWS) and upper Illinois Waterway and on-going evaluations of the effectiveness of barriers and gears used in the effort to keep Asian carp from becoming established in the CAWS and Lake Michigan. This and earlier versions of this plan have benefitted from reviews by technical experts and numerous written comments provided by workgroup members, Great Lakes state‟s natural resource agencies, and non-governmental organizations. For the purpose of this plan, the term „Asian carp‟ refers to Bighead Carp (*Hypophthalmichthys nobilis*) and Silver Carp (*H. molitrix*), exclusive of other Asian carp species such as Grass Carp (*Ctenopharyngodon idella*) and Black Carp (*Mylopharyngodon piceus*).

The workgroup is following an adaptive approach to Asian carp management and has prepared an interim summary report document (MRRWG 2012) containing preliminary results and analysis of actions completed for each of the 18 projects described in the 2011 MRRP. The interim reports document is considered a companion document to this 2012 MRRP and includes recommendations for modifications and enhancements to project plans based on past results and experiences. Knowledge gaps also were identified and these informed recommendations for new project plans included in this update.

Highlights of major changes that can be found in the updated plan include:

- The addition of random electrofishing and netting sites outside the five fixed sites upstream of the Dispersal Barrier that will be sampled twice monthly along with the fixed sites. Random sampling sites provide for more rigorous monitoring with conventional gears in areas outside of the fixed sites after statistical analyses of 2010 data indicated that it was appropriate to eliminate seasonal monitoring of CAWS reaches by electrofishing and reduce the number of electrofishing transects at fixed sites.
- A modified strategy for eDNA monitoring that provides efficiencies while maintaining broad coverage of key locations in the CAWS, early Asian carp detection capabilities, and guidance for initiation of rapid response removal actions.
- The capability to conduct targeted response actions at selected locations in the CAWS outside the rapid response threshold framework when information gained from such actions may benefit monitoring protocols, research efforts, or Asian carp removal and control efforts. Final decisions regarding rapid response remain under action agency authority with endorsement from the MRRWG.
- Adding hoop nets and mini-fyke nets to on-going monitoring with electrofishing gear and trammel/gill nets at fixed sites downstream of the Dispersal Barrier to enhance detection capabilities for adult and juvenile Asian carp.
- A new project to determine the distribution and movement of juvenile Bighead and Silver Carp in the Illinois Waterway.

- Additional tagged fish for acoustic telemetry evaluations of electric barrier effectiveness and movements of Asian carp and surrogate fish species through locks and water control structures at dams. In addition, the acoustic telemetry network will be expanded to include 60 stationary receivers in the Illinois Waterway and CAWS through cooperative efforts between the US Army Corp of Engineers, US Fish and Wildlife Service, and Southern Illinois University Carbondale.
- An updated plan for clearing fish from the barrier area in support of barrier maintenance. The plan includes protocols for water guns and a small-scale rotenone (if needed) to clear fish and evaluation of clearing success with split-beam hydroacoustics, side-scan sonar, and DIDSON imaging technology.
- A new project to assess Asian carp population dynamics and abundance in response to contracted commercial fishing in the lower Des Plaines and upper Illinois rivers. Effectiveness of commercial fishing as a control method also will be evaluated.
- Utilization of underwater video, in addition to DIDSON imaging sonar for evaluating fish behavior at the Dispersal Barrier.
- Evaluations of newly developed gears designed to capture and remove Asian carp. New gears that will be evaluated include: modified paupier trawls; modified purse seines, 6-foot diameter hoop nets; 30-foot deep, tied-down experimental gill nets; and Lake Michigan style pound (trap) nets. In addition, Chicago area bow fishing clubs will be encouraged to establish a carp tournament in the Brandon Road Pool or selected areas of the CAWS upstream of the Dispersal Barrier. A tournament will enhance potential encounters with Asian carp, if any are present in areas of the waterway targeted by bow fishers.
- A new program to survey local urban fishing ponds with DC electrofishing gear, trammel/gill nets, and eDNA monitoring to detect and remove any Asian carp that may have been introduced to the ponds through contaminated shipments of stocked sport fish.
- Protocols to appropriately transport Grass Carp captured during CAWS monitoring to a university laboratory for ploidy analysis. This work is in support of a broader study evaluating ploidy of feral Grass Carp throughout the Great Lakes Basin.

More detailed analyses and justifications for changes to sampling protocols can be found in the companion interim report document (MRRWG 2012). As in the past, individual project plans detail tactics and protocols that will allow us to achieve the overall goal and accomplish strategic objectives developed by the workgroup.

The overarching goal and objectives for the plan remain the same as in 2011. The overall goal is to prevent Asian carp from establishing self-sustaining populations in the CAWS and Lake Michigan. The five strategic objectives to accomplish the overall goal are:

1) Determine the distribution and abundance of any Asian carp in the CAWS, and use this information to inform rapid response removal actions;
2) Remove any Asian carp in the CAWS to the maximum extent practicable;
3) Identify, assess, and react to any vulnerability in the current system of barriers to exclude Asian carp from moving into the CAWS;
4) Determine the leading edge of major Asian carp populations and reproductive success of those populations; and

5) Improve understanding of the likelihood that Asian carp could become established in the Great Lakes.

Eighteen project plans have been prepared to achieve the overarching goal and objectives of the MRRP. Project plans in various stages of development are included to showcase the full range of work that will be on-going or initiated during the coming year. Project plans can be categorized geographically as occurring either upstream or downstream of the Dispersal Barrier and grouped into five categories: Monitoring Projects, Removal Projects and Evaluations, Barrier Effectiveness Evaluations, Gear Effectiveness Evaluations and Development Projects, and Alternative Pathway Surveillance.

Individual plan details, including maps can be found within the 2012 MRRP and are marked by a page number in parentheses next to the plan name. A brief summary of individual project plans follows.

MONITORING PROJECTS

Fixed and Random Site Monitoring Upstream of the Dispersal Barrier (17) – This project includes twice monthly standardized monitoring with DC electrofishing gear and contracted commercial fishers at five fixed sites in the CAWS upstream of the Dispersal Barrier. Monitoring also will include an additional 18 electrofishing transects and 25 net sets per month at randomly selected locations outside of fixed sites to maintain aerial coverage of the waterway. This project provides information on relative abundance and to a lesser degree distribution of Asian carp, if captured or observed, and other fish species that can be compared among sites and across time. Acquired data will inform rapid response removal actions.

Strategy for eDNA Monitoring in the CAWS (23) – This project presents a strategy for twice monthly eDNA monitoring in the CAWS upstream and downstream of the Dispersal Barrier. Sampling is focused on areas nearest Lake Michigan (i.e., North Shore Channel, Chicago River and South Branch Chicago River to Bubbly Creek, Little Calumet River, and Lake Calumet), but the strategy allows flexibility for sampling at other strategic locations as needed. With a long term view of results (e.g., multiple positive hits on consecutive sample dates at the same location), we will use eDNA sampling to detect the presence of Asian carp DNA in the waterway, inform rapid response removal actions, and guide decisions regarding the success of removal efforts and when individual actions should be terminated.

Larval Fish and Productivity Monitoring (29) – Sampling for fish eggs, larvae, and waterway productivity will occur approximately every two weeks from April-October at 10 sites downstream of the Dispersal Barrier (LaGrange to Brandon Road pools) and 3-4 sites in the CAWS upstream of the barrier. Sampling may occur more frequently when Asian carp eggs or larvae are more likely to be present (e.g., during spring months, a period of rising water levels, and shortly after peak flows). Information may be used to assess timing and extent of Asian carp reproduction in the Illinois River, Des Plaines River, and CAWS, provide early detection in the CAWS, examine relations between Asian carp and productivity variables, and inform possible control strategies targeting Asian carp spawning and early life history.

Young-of-Year and Juvenile Asian Carp Monitoring (33) – Monitoring for the presence of young-of-year Asian carp in the Illinois River, Des Plaines River, and CAWS will take place through sampling planned by other projects in the MRRP (e.g., Larval Fish and Productivity Monitoring, Fixed and Random Site Monitoring Upstream of the Dispersal Barrier, Fixed Site Monitoring Downstream of the Dispersal Barrier, Gear Efficiency and Detection Probability Study, Des Plaines River and Overflow Monitoring Project). Sampling targets a segment of the Asian carp population typically missed with adult sampling gears and provides information to help determine where in the waterway Asian carp are successfully recruiting young.

Distribution and Movement of Juvenile Asian Carp in the Illinois Waterway (35) – This project specifically targets sampling of young Asian carp in areas not sampled by standard monitoring and gear evaluation projects in an effort to better understand distribution and habitat use by young Bighead and Silver Carp in the Illinois Waterway. Specific areas include tributaries and shallow backwater habitats known to function as nursery areas for young Asian carp. Movement patterns of young will be determined with acoustic telemetry. Results from this project will contribute to our understanding of young Asian carp movement and habitat use and help assess the risk of these life stages challenging the Dispersal Barrier and gaining access to the CAWS and Lake Michigan.

Fixed Site Monitoring Downstream of the Dispersal Barrier (42) – This project includes monthly standardized monitoring with DC electrofishing gear and contracted commercial fishers at four fixed sites downstream of the Dispersal Barrier (in Lockport Pool and downstream from the Lockport, Brandon Road, and Dresden Island locks and dams). In addition, we have added hoop nets and mini-fyke nets to sampling protocols to enhance monitoring for adult and juvenile Asian carp. Results will provide information on the location of detectable Asian carp populations in the waterway (relative abundance and distribution) and their progression upstream over time. Population data may be compared among sites and across time.

REMOVAL PROJECTS AND EVALUATIONS

Rapid Response Actions in the CAWS (47) – This project includes a threshold framework to support decisions for response actions to remove any Asian carp from the CAWS upstream of the Dispersal Barrier with conventional gear or rotenone. It also allows for targeted response actions at selected locations in the CAWS outside the threshold framework when information gained from such actions may benefit monitoring protocols and Asian carp removal efforts.

Barrier Maintenance Fish Suppression (50) – This project provides a fish suppression plan to support USACE maintenance operations at the Dispersal Barrier. The plan includes clearing fish from between barriers with water gun technology and evaluating clearing success with split-beam hydroacoustics, side scan sonar, and DIDSON imaging sonar. A small scale rotenone plan is included as a back-up measure should mechanical clearing fail.

Barrier Defense Asian Carp Removal Project (60) – This program was established to reduce the numbers of Asian carp downstream of the Dispersal Barrier through controlled commercial fishing. We anticipate that reducing Asian carp populations will lower propagule pressure and the chances of Asian carp gaining access to waters upstream of the Dispersal Barrier. Primary

areas that will be fished include Starved Rock, Marseilles, and Dresden Island pools, though additional effort could be expended in Brandon Road and Lockport pools, if needed.

Monitoring Asian Carp Population Metrics and Control Efforts (62) – This project includes measuring population demographics of Asian carp populations in the Illinois Waterway, including estimates of population abundance with split-beam hydroacoustics and mark-recapture techniques. Work will focus on assessing population response to Asian carp removal by commercial fishers in Starved Rock, Marseilles, and Brandon Road pools, although down river evaluations also will occur. Effects of emigration and immigration will be determined with acoustic telemetry.

BARRIER EFFECTIVENESS EVALUATIONS

Telemetry Monitoring Plan (68) – This project uses ultrasonically tagged Asian carp and surrogate species to assess if fish are able to challenge and/or penetrate the Dispersal Barrier and pass through navigation locks in the upper Illinois Waterway. An array of stationary acoustic receivers and mobile tracking will be used to collect information on Asian carp and surrogate species movements.

Fish Behavior at the Dispersal Barrier (76) – This project uses Dual-Frequency Identification Sonar (DIDSON) and caged fish experiments to assess fish behavior at the Dispersal Barrier designed to prevent fish passage between Mississippi River and Great Lakes basins. Caged fish experiments will describe behavior of various-sized fish (not Asian carp) subjected to the barrier‟s electric field and DIDSON surveys will determine relative abundance of fish upstream, in, near, and downstream of the Dispersal Barrier.

Des Plaines River and Overflow Monitoring (89) – This project provides a plan to monitor for Asian carp spawning activity, if any exists, in the upper Des Plaines River downstream of the Hofmann Dam. It also will assess efficacy of the Asian carp barrier fence constructed between the Des Plaines River and Chicago Sanitary and Ship Canal (CSSC) by monitoring for any Asian carp eggs, larvae, and juveniles that may be transported to the CSSC via laterally flowing Des Plaines River floodwaters passing through the barrier fence.

GEAR EFFECTIVENESS EVALUATIONS AND DEVELOPMENT PROJECTS

Asian Carp Gear Efficiency and Detection Probability Study (91) – This project will assess efficiency and detection probability of gears currently used for Asian carp monitoring (DC electrofishing, gill nets, and trammel nets) by sampling at 10 sites in the Illinois River, lower Des Plaines River, and CAWS that have varying carp population densities. In addition, a variety of alternative sampling gears (hydroacoustics, midwater trawls, purse seines, trap nets, mini-fyke nets, hoop nets, cast nets, and seines) and newly developed gears (6-foot diameter hoop nets, 30-foot deep experimental gill nets, and Lake Michigan style pound nets) will be evaluated to determine their ability to detect juvenile and adult Asian carp. Results will inform decisions on appropriate levels of sampling effort and monitoring regimes, and ultimately improve Asian carp monitoring and control efforts.

Exploratory Gear Development Project (94) – A professional net designer will be consulted to develop and build enhanced purse seines and trawls (e.g., modified paupier push trawl) for more effective harvest of Asian carp. Enhanced gears will be evaluated in areas known to have abundant Asian carp populations. If effective, they may be used in place of rotenone for removal actions in the CAWS and for commercial fishing in the lower Illinois River or other Asian carp infested waterways.

Unconventional Gear Development Project (96) – The goal of this project is to develop an effective trap or netting method capable of capturing low densities of Asian carp in the deep-draft canal and river habitats of the CAWS, lower Des Plaines River, upper Illinois River, and possible Great Lakes spawning rivers. Alternative trap and net designs developed during the past year will be evaluated as part of the gear efficiency project, as outlined above. This year Chicago area bow fishing clubs will be encouraged to establish a carp tournament in the Brandon Road Pool or selected areas of the CAWS upstream of the Dispersal Barrier. A tournament will enhance potential encounters with Asian carp, if any are present in areas of the waterway targeted by bow fishers. In addition, a pilot study will evaluate the potential for natural agricultural material (e.g., corn or soybean meal/chaff) to act as an attractant for Asian carp possibly leading to more effective detection and capture in areas where carp abundance is low.

Water Gun Development and Testing (98) – Pneumatic water guns that emit high pressure underwater sound waves have potential to deter fishes or kill them if they are in close enough proximity to the wave source. This technology is being evaluated to determine its effects on lock structures in the CAWS (e.g., lock walls and in-water equipment) and as an alternative tool to rotenone for fish suppression in support of Dispersal Barrier maintenance. If proven successful, water guns may be further evaluated for potential use as a permanent tool to defend navigation locks in the CAWS or elsewhere to keep Asian carp from moving into the Great Lakes.

ALTERNATIVE PATHWAY SURVEILLANCE

Alternative Pathway Surveillance in Illinois (100) – This project will create a more robust and effective enforcement component of IDNR"s invasive species program by increasing education and enforcement activities at bait shops, bait and sport fish production/distribution facilities, fish processors, and fish markets/food establishments known to have a preference for live fish for release or food preparation. Monitoring with eDNA technology and conventional gears (electrofishing and netting) will take place in local fishing ponds to detect and remove any Asian carp introduced as contaminants in shipments of stocked sport fish. Monitoring and surveillance efforts will take place in the Chicago Metropolitan Area including Cook and Collar counties.

A broad range of sampling and removal tools are available to the MRRWG action agencies to accomplish the plan objectives outlined above. They include traditional sampling gears (e.g., electrofishing, trammel nets, experimental gill nets, mini fyke or trap nets, larval push nets, trawls, and seines), chemical piscicide (e.g., rotenone), high-tech sonic detection and imaging devices (e.g., ultrasonic telemetry and hydroacoustics, DIDSON, and side-scan sonar), and newly developed or developing techniques (e.g., eDNA, pneumatic water guns, and attraction pheromones). Whereas many of these gears and techniques are part of on-going monitoring and removal efforts, new tools are continually being added to the MRRP as it is periodically revised

and new techniques are developed. In many cases, multiple tools are being used to accomplish individual objectives and provide sufficient intelligence to allow for sound management decisions. This strategy of addressing questions from multiple fronts with a combination of gears and techniques has helped to increase the level of confidence in results provided by monitoring and removal projects to date. In addition, gear evaluations have been on-going (see gear development and evaluation projects below) and have been expanded in this revised MRRP (e.g., see Monitoring Asian Carp Population Metrics and Control Efforts and Water Gun Development and Testing Project). Research on calibration and further refinement of eDNA monitoring is also being pursued outside of this plan. Upon completion, these assessments should lead to improved Asian carp monitoring and removal outcomes, better understanding of the effectiveness of in-place barriers built to prevent Asian carp from gaining access to the CAWS and Lake Michigan, and improved interpretation of sampling results.

2011 ACCOMPLISHMENTS

- Total area sampled:
    - 200 miles of waterway from Starved Rock Lock and Dam to Lake Michigan
        - Including 76 miles of CAWS
- Estimated total effort, capture, and removal upstream of Dispersal Barrier:
    - 5,136 person-hours; 68,582 fish collected, 63 species
    - 321 hours of electrofishing
    - 79 miles of trammel/gill nets fished
    - No Bighead or Silver Carp captured or observed upstream of Dispersal Barrier
- Estimated total effort, capture, and removal downstream of Dispersal Barrier:
    - 7,675 person-hours; 68,308 fish collected, 68 species
    - 36 hours of electrofishing
    - 286 miles of trammel/gill nets fished
    - No Bighead or Silver Carp captured or observed in Lockport Pool; neither species captured, but one Bighead Carp observed in the Brandon Road Pool
    - 74 Bighead Carp and 13 Silver Carp captured and removed from Dresden Island Pool 15-24 miles downstream of the Dispersal Barrier
    - 23,451 Bighead Carp and 17,966 Silver Carp (>350 tons) removed from Marseilles and Starved Rock pools 24-65 miles downstream of the Barrier
- eDNA samples processed upstream of Dispersal Barrier in 2011
    - 881 estimated person-hours were spent collecting and filtering 2,378 water samples
    - 0 positives for Bighead Carp DNA upstream of the Dispersal Barrier*
    - 34 positives for Silver Carp DNA upstream of the Dispersal Barrier*

* Results of eDNA sampling must be interpreted with care because a relation between the number of positive detections and fish population abundance has not been established to date, or that eDNA indicates the presence of a live fish. See Strategy for eDNA Monitoring in the CAWS (page 23 of 2012 MRRP) for more details.

Further details on work conducted and results of the 2011 MRRP are available in the 2011 MRRP Interim Summary Report document available at www.asiancarp.us.

Monitoring and Rapid Response Plan for Asian Carp in the Upper Illinois River and Chicago Area Waterway System

May 2012

INTRODUCTION AND BACKGROUND

Asian carp were first sampled from the Illinois River during the 1990s and populations have since progressed upstream (Conover et al. 2007; Irons et al. 2009). For the purpose of this plan, the term „Asian carp" refers to Bighead Carp (*Hypophthalmichthys nobilis*) and Silver Carp (*H. molitrix*), exclusive of other Asian carp species such as Grass Carp (*Ctenopharyngodon idella*) and Black Carp (*Mylopharyngodon piceus*). Monitoring for Bighead and Silver Carp was originally incidental to standard routine sampling by the Illinois Department of Natural Resources (IDNR) and the Illinois Natural History Survey (INHS). Sampling directed toward Asian carp in the upper Illinois Waterway began with the US Fish and Wildlife Service's (USFWS) annual Carp Corral & Goby Roundup. Subsequently, the US Army Corps of Engineers (USACE) adopted a plan specifically to monitor Asian carp downstream of the Aquatic Nuisance Species Dispersal Barrier (Dispersal Barrier) located near Romeoville, Illinois. This barrier is designed to repel fish using an electric field to prevent fish movement between the Great Lakes and Mississippi River basins. Monitoring efforts and the need to perform maintenance work on the barrier precipitated a rotenone action in Lockport Pool during December 2009. This action resulted in the collection of a Bighead Carp in Lockport Pool downstream of the Dispersal Barrier. Monitoring also resulted in the sighting of a single Silver Carp in Brandon Road Pool and the capture of numerous Bighead Carp in Dresden Island Pool.

Environmental DNA (eDNA) is a new surveillance method for use in aquatic environments that tests for the genetic presence of Bighead and Silver Carp (Jerde et al. 2011). The use of eDNA as an invasive species management tool is currently being refined through ongoing research. Specifically, USACE is leading an interagency eDNA Calibration Study (ECALS) with USGS and USFWS to reduce the uncertainty surrounding eDNA results (ACRCC 2012). The USACE began using eDNA in cooperation with the UND in August 2009 to monitor for Asian carp DNA in the Chicago Area Waterway System (CAWS). Early eDNA monitoring resulted in the discovery of Asian carp DNA in areas upstream of the Dispersal Barrier and prompted additional monitoring and rapid response actions. The additional monitoring resulted in the discovery of Asian carp DNA at several other locations in the CAWS. Intensive targeted use of conventional capture gear resulted in the capture, through commercial netting, of a live Bighead Carp in Lake Calumet upstream of the Dispersal Barrier.

An Asian Carp Regional Coordinating Committee (ACRCC) was established to provide coordinated communication and response to accomplish the goal of preventing Asian carp from becoming established in the Great Lakes. To facilitate the accomplishment of the goal, the ACRCC formed multiple workgroups, including the Monitoring and Rapid Response Workgroup (MRRWG). The MRRWG is co-led by the IDNR and the Great Lakes Fishery Commission (GLFC) and is comprised of liaisons from key state and federal agencies as well as independent technical specialists (see Appendix A for membership). The MRRWG was assigned the task of developing and implementing a Monitoring and Rapid Response Plan (MRRP) for Asian carp that were present or could gain access to the CAWS. Specifically, the group was asked to determine how best to identify the location and abundance of Asian carp in the CAWS, lower Des Plaines River, and upper Illinois River, and to identify appropriate response actions to address such findings. Many of the actions included in this plan were informed by recommendations presented in the National Asian Carp Control Plan (Conover et al. 2007).

The MRRP has gone through several versions and periodically will be revisited and modified as more information becomes available on Asian carp distribution and abundance and as rapid response needs change. Herein, we review plan development to date, present overarching strategic objectives, identify tools available to complete necessary work, and present 18 specific project plans detailing tactics and protocols that will allow us to accomplish strategic objectives and achieve the overall goal of preventing Asian carp from establishing populations in the CAWS and Lake Michigan.

PLAN DEVELOPMENT PROCESS

The purpose of the MRRP is to identify the best strategy for conducting monitoring and rapid response actions that will accomplish the goal of preventing Asian carp from establishing self-sustaining populations in the CAWS and Lake Michigan. The MRRWG initially (2009-2010) considered a multitude of actions and then more fully developed a dual approach that was considered to be the most promising to determine distribution and abundance of Asian carp. The initial approach was: 1) use eDNA testing of waterway samples to identify areas containing Asian carp DNA, and then use conventional sampling gears or rotenone to intensively sample those areas; and 2) use conventional netting and electrofishing gear to intensively sample fixed locations where Asian carp are most expected to be present if any existed, and to less intensively sample wider waterway reaches throughout the CAWS. Taking a conservative approach, the MRRWG considered positive eDNA detections as an indicator of the presence of Asian carp in the waterway for purposes of management and response strategies.

Initial sampling with conventional gear was completed in the CAWS upstream of the Dispersal Barrier during February and March 2010. Sampling targeted warm water discharges and backwater habitats where Asian carp were expected to congregate if present, and included reach-wide electrofishing runs along the entire waterway upstream of the barrier. No Asian carp were collected or observed during initial sampling efforts. As a follow-up to the initial sampling, the MRRWG was expanded to include the independent technical specialists listed in Appendix A.

The expanded workgroup met in April 2010 to discuss the results of initial monitoring, and the outcome of the meeting was a decision to: 1) proceed initially with eDNA sampling and rotenone

treatments at locations where sufficient evidence of the possible presence of Asian carp existed; and 2) reconsider netting, electrofishing, and other potential monitoring techniques, once information on Asian carp abundance was gathered from rotenone treatments. A consensus on general triggers to initiate rapid response actions was not reached by the workgroup, but specific triggers were developed for the Little Calumet River downstream from O'Brien Lock and Dam and the North Shore Channel downstream from Wilmette Pumping Station. Both sample reaches had multiple positive eDNA detections for Asian carp on one or more sample dates during 2009 and displayed physical characteristics conducive to response actions. The MRRWG determined that another positive detection at either location would trigger a conventional gear or rotenone sampling response to determine Asian carp presence and abundance.

Initial eDNA monitoring in 2010 took place from March through May and targeted areas of the CAWS upstream of the Dispersal Barrier that either had positive detections for Asian carp DNA during 2009 or lacked surveillance altogether. Of the 543 water samples analyzed for Bighead and Silver Carp, none contained Bighead Carp DNA and eight contained Silver Carp DNA; one each in the Calumet/Little Calumet River, North Shore Channel, and Chicago River and five in the Chicago Sanitary and Ship Canal (CSSC)/South Branch Chicago River (SBCR) near Bubbly Creek. These results elicited conventional gear rapid response actions at North Shore Channel (May) and CSSC/SBCR (June), and a combined rotenone and conventional gear response at Calumet/Little Calumet River downstream of O'Brien Lock and Dam (May). No Bighead or Silver Carp were captured or observed during any of these rapid response actions.

The MRRWG met after the spring 2010 rapid response actions and concluded that whereas eDNA detections suggested Asian carp may be present in the CAWS upstream from the Dispersal Barrier, results of intensive sampling with conventional gear and rotenone indicated that if any Asian carp were present in the waterway, they were present in low numbers. It also was noted that eDNA samples taken within block netted areas of the North Shore Channel and Calumet/Little Calumet River prior to rapid response actions were negative for Bighead and Silver Carp DNA, which was in agreement with conventional gear and rotenone sampling results for these actions. The work group recommended continued monitoring with eDNA and conventional gears and implementation of additional rapid response actions as needed to bolster abundance estimates and remove Asian carp from the system.

One additional rapid response action was initiated after an adult Bighead Carp (mature male 34.6 inches long and 19.6 pounds) was captured by contracted commercial netters in Lake Calumet on 22 June, 2010, which was the first day of sampling at designated fixed sites upstream of the Dispersal Barrier. This capture confirmed the presence of live Asian carp in the CAWS above the barrier and resulted in 11 days of sampling in Lake Calumet, the Calumet River, and Calumet Harbor from 23 June – 9 July. No Asian carp were captured or observed during the response. Additional water samples from Lake Calumet ($N = 114$), Calumet River and Harbor ($N = 95$), and Indiana ports and harbors ($N = 125$) were collected during July and August and analyzed for Asian carp DNA. None of the DNA testing indicated the presence of Bighead or Silver Carp DNA in any of the regions surveyed. Fixed site sampling continued on a twice monthly schedule throughout summer and fall 2010. Sampling resulted in the catch of >40,000 fish and no additional Bighead or Silver Carp.

In addition to sampling in the upper waterway, monitoring and removal of Asian carp took place downstream of the Dispersal Barrier in order to track the upstream progression of the detectable population front and reduce its abundance. The detectable population front is defined as the farthest upstream location where multiple Bighead or Silver Carp have been captured in conventional sampling gears during a single trip or where individuals of either species have been caught in repeated sampling trips to a specific site. Downstream monitoring and removal efforts suggested the location of the detectable population front was in the lower Dresden Island Pool about 55 miles from Lake Michigan. Monitoring also provided preliminary evidence that commercial netting may be useful for reducing Asian carp abundance within localized areas.

The MRRWG met again in September 2010 to discuss the results of all monitoring to that point and to modify the plan accordingly. A new plan was developed and reviewed over winter. It incorporated preliminary results of 2010 monitoring and removal efforts, discussions among action agency staff and technical experts at the September meeting, and numerous written comments provided by workgroup members, Great Lakes state‟s natural resource agencies, and non-governmental organizations. The plan included 18 project plans categorized geographically as occurring either upstream or downstream of the Dispersal Barrier and grouped into five categories: Monitoring Projects, Removal Projects, Barrier Effectiveness Evaluations, Gear Effectiveness Evaluations and Development Projects, and Alternative Pathway Surveillance. The 2011 MRRP was officially released and posted on the Asiancarp.org website in May 2011.

Implementation of the 2011 MRRP resulted in extensive sampling of 200 miles of waterway from Starved Rock Lock and Dam to Lake Michigan, including 76 miles of the CAWS. A total of 2,378 eDNA samples were collected upstream of the Dispersal Barrier resulting in 0 positives for Bighead Carp DNA and 34 positives for Silver Carp DNA. Three consecutive positives for Silver Carp DNA in Lake Calumet triggered the only rapid response action undertaken in 2011. No Bighead or Silver Carp were captured or observed during the response, nor was Bighead or Silver Carp DNA detected in eDNA samples taken immediately prior to initiation of sampling with conventional gears. In total, crews spent an estimated 5,136 person-hours to complete 321 hours of electrofishing and deploy 79 miles of net during all 2011 monitoring upstream of the Dispersal Barrier. The combined catch during these efforts was 68,582 fish representing 63 species; none of which were Bighead or Silver Carp.

Monitoring and removal downstream of the barrier during 2011 included 7,675 estimated person-hours, 36 hours of electrofishing, and 286 miles of trammel/gill nets fished. The catch included 68,308 fish representing 68 species. No Bighead or Silver Carp were captured or observed in Lockport Pool. Neither species was captured, but one Bighead Carp was observed in the Brandon Road Pool during an October netting effort. Sampling captured and removed 74 Bighead Carp and 13 Silver Carp from Dresden Island Pool 15-24 miles downstream of the Dispersal Barrier and 23,451 Bighead Carp and 17,966 Silver Carp (>350 tons) from Marseilles and Starved Rock pools 24-65 miles downstream of Dispersal Barrier. Extensive monitoring downstream of the barrier confirmed that the detectable population front was indeed located in the lower Dresden Island Pool about 47 miles from Lake Michigan and that its location had not changed compared to the previous year‟s sampling results.

Other highlights from 2011 MRRP projects included: the absence of Asian carp eggs, larvae, young-of-year and juveniles <12 inches long from all samples collected upstream of Henry, Illinois (over 100 miles from the Dispersal Barrier); higher productivity and zooplankton abundance in Lake Calumet and the Little Calumet River compared to other areas of the CAWS and Illinois Waterway; successful clearing of fish <12 inches long from the area between Barrier 2A and 2B with pneumatic water guns and assessment of clearing success with remote sensing gears (split-beam hydroacoustics, DIDSON, and side scan sonar), which allowed barrier maintenance to occur without a breach in barrier effectiveness or a costly rotenone application; assessments with telemetry, DIDSON, and other techniques confirming effectiveness of barriers designed to keep Asian carp from gaining access to Lake Michigan; evaluation of the effectiveness of established gears used to sample Asian carp and development of new or modified gears (e.g., 6-foot diameter hoop nets, surface-to-bottom experimental gill nets, modified purse seine, customized Lake Michigan style pound (trap) nets, and a modified push trawl called a paupier net); and the detection of large adult Bighead Carp in urban fishing ponds located in the Chicago area and other parts of Illinois thought to be the result of contaminated shipments of Channel Catfish from the late 1990s and early 2000s.

Further details of 2011 project results highlighted above can be found in the 2011 MRRP Interim Summary Reports document (MRRWG 2012) prepared by the workgroup and posted on Asiancarp.us. This compilation of summary reports was intended to foster an adaptive management approach to Asian carp monitoring and removal. It contains preliminary results and analysis of actions completed during 2011 (and in some cases 2010) for each of the 18 projects described in the 2011 MRRP. The interim reports document is considered a companion document to this updated 2012 MRRP and includes recommendations for modifications and enhancements to project plans based on past results and experiences. Knowledge gaps also were identified and these informed recommendations for new project plans included in the updated MRRP.

The workgroup met in January 2012 to review summary information from the past year‟s monitoring and removal efforts and consider recommendations for projects in the updated plan. Although individual project plans have been designed as standalone plans, they all support one or more of the overarching strategic objectives of the MRRP. Because multiple plans have been developed for some objectives, care has been taken to ensure that related plans provide complimentary rather than duplicative information. In many cases, field sampling can be coordinated or data shared to optimize personnel effort and reduce overall project costs.

If and as necessary, near shore areas of Lake Michigan will be addressed in a future version of the plan. However, it should be noted that INHS and IDNR Lake Michigan programs currently have ongoing near shore monitoring projects that could detect any Asian carp that might gain access to the Lake. The INHS samples three Lake Michigan sites with plankton nets and small-mesh gill nets, both of which may provide early detection of Asian carp larvae or juveniles. Sampling sites are located north of Waukegan, north of downtown Chicago, and near Jackson Harbor on the City‟s south side. These sites are located in the general vicinity of CAWS connections with Lake Michigan (i.e., Wilmette Pumping Station, Chicago Lock, and Calumet Harbor). The IDNR Lake Michigan program samples with gill nets (1- to 6-inch mesh) off of Chicago and Waukegan during spring, and again off Waukegan during fall. Electrofishing

samples are made at three harbors, including Calumet Harbor, during summer and fall; the furthest southern harbor sampled in fall is Jackson Harbor. Beach seining for juvenile fish occurs at five sites along the Illinois shoreline from the Wisconsin state line south to Jackson Harbor during summer.

Additional monitoring in Lake Michigan is currently being developed and coordinated by USFWS through a separate project funded, in part, by the Great Lakes Restoration Initiative (GLRI) and outlined in the 2012 Asian Carp Framework (ACRCC 2012).

LOCATION OF PRIMARY TARGET AREAS COVERED BY THE MRRP

The area covered by this plan (Figure 1) encompasses over 200 miles of waterways stretching from Starved Rock Lock and Dam to Lake Michigan and includes two target areas: 1) all waterways upstream of the Dispersal Barrier; and 2) waterways downstream of the Dispersal Barrier to Starved Rock Lock and Dam. The area upstream of the barrier includes approximately 76 miles of the Chicago Area Waterway System (CAWS). The downstream limit of the CAWS is the confluence of the Chicago Sanitary and Ship Canal (CSSC) and the Des Plaines River within the Brandon Road Pool (Figure 1). Waterways included in the area upstream of the Dispersal Barrier are: CSSC (18.3 miles); South Branch Chicago River (3.9 miles); Chicago River (1.6 miles); North Branch Chicago River (7.7 miles); North Shore Channel (7.6 miles); Calumet-Sag Channel (16.0 miles); Little Calumet River, including the South Leg (40 miles); Grand Calumet River to sheet pile obstruction (3 miles); Calumet River (7.5 miles); and Lake Calumet. Waterways downstream of the Dispersal Barrier include: CSSC, including the reach of CSSC downstream of Lockport Lock (6.0 miles); lower Des Plaines River (42 miles); and Illinois River (43 miles). Areas upstream of the Dispersal Barrier are a higher priority for monitoring and rapid response actions than areas downstream due to their closer proximity to Lake Michigan.

OVERALL GOAL AND OBJECTIVES OF PLAN

Overall Goal: *Prevent Asian carp from establishing self-sustaining populations in the CAWS and Lake Michigan.*

Five objectives have been identified to accomplish the overall goal. These objectives are:

1) Determine the distribution and abundance of any Asian carp in the CAWS, and use this information to inform rapid response removal actions;
2) Remove any Asian carp in the CAWS to the maximum extent practicable;
3) Identify, assess, and react to any vulnerability in the current system of barriers to exclude Asian carp from moving into the CAWS;
4) Determine the leading edge of major Asian carp populations and reproductive success of those populations; and
5) Improve understanding of the likelihood that Asian carp could become established in the Great Lakes.

Objective 1: Determine the distribution and abundance of any Asian carp in the CAWS, and use this information to inform rapid response removal actions. Knowledge of the distribution of Asian carp in the CAWS will inform decision makers on where and what actions

are most needed and appropriate to keep Asian carp from moving into Lake Michigan. Patterns may be identified that would facilitate removal actions (e.g., commercial netters or rotenone), placement of additional barriers (e.g., water gun barrier, chemical barriers, or oxygen depletion zones), and/or other appropriate actions. Projects developed to meet this objective include eDNA, fixed and random site monitoring upstream of the Dispersal Barrier and rapid response actions in the CAWS.

Knowledge of the abundance of Asian carp in the CAWS also will guide removal action and barrier placement decisions. In addition, it is a key piece of information required to determine the risk of Asian carp populations becoming established in the CAWS or Lake Michigan. Fixed site monitoring and rapid response actions have provided general information on Asian carp abundance in the CAWS and these standardized sampling efforts will provide for comparisons of relative abundance over time. Owing to the current presumed low numbers and difficulty of catching Asian carp, actual abundance will be quite challenging to determine. On-going gear evaluation projects may provide for enhanced abundance estimates by determining efficiencies of gears used to sample Asian carp and identifying new gears or techniques to enhance capture rates. In addition, several projects have been developed to assist with determination of Asian carp abundance in the CAWS (see larval fish and juvenile Asian carp monitoring projects, and Gear Efficiency and Detection Probability Study).

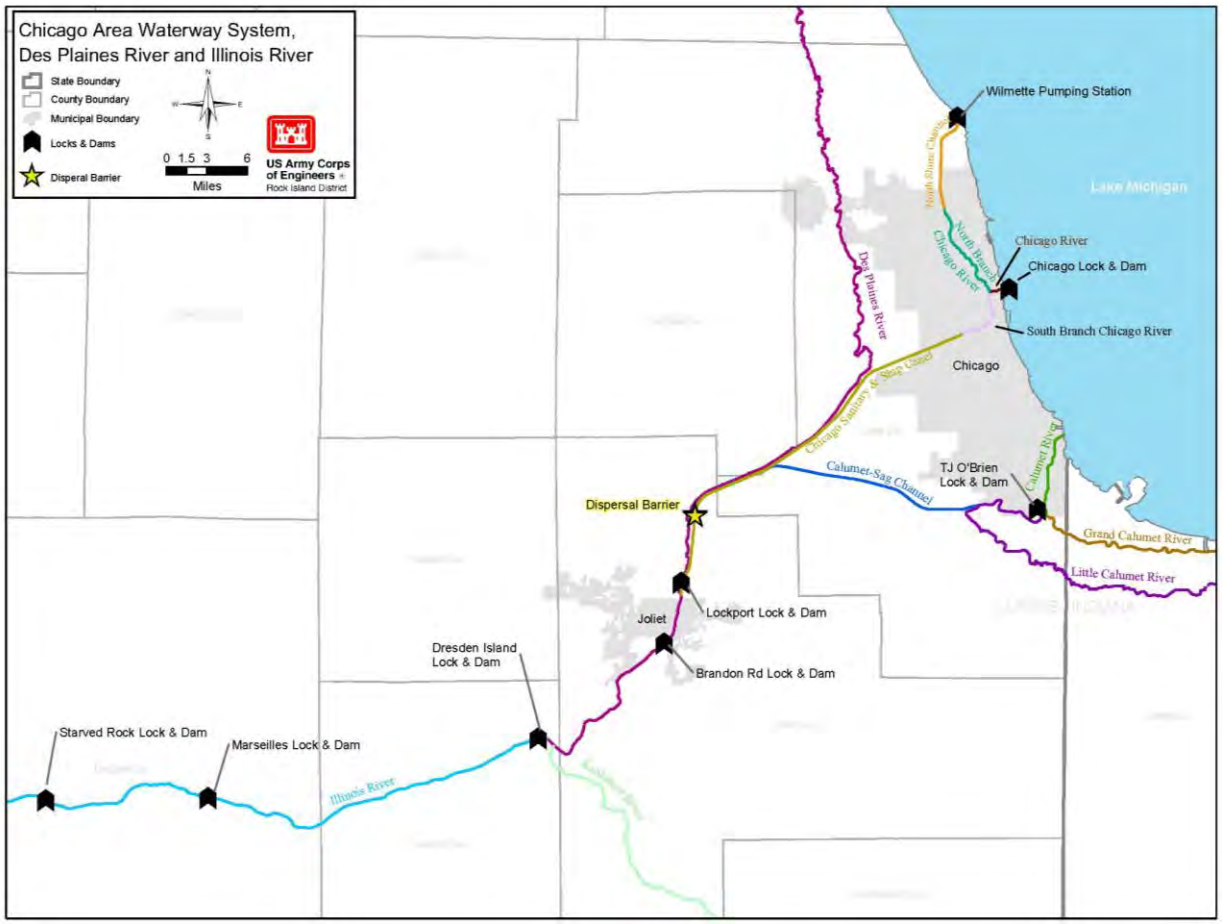

Figure 1. Map of the Chicago Area Waterways System (CAWS), Des Plaines River, and upper Illinois River.

Objective 2: Remove any Asian carp in the CAWS to the maximum extent practicable. The MRRWG is taking a cautious approach by attempting to remove all known Asian carp upstream of the Dispersal Barrier, including those that may be trapped between Barrier 2A and Barrier 2B before completion of barrier maintenance operations (see Barrier Maintenance Fish Suppression). Removal may occur incidentally when Asian carp are captured during routine monitoring or during rapid response actions targeting specific areas of the CAWS. Rapid-response teams will be mobilized when Asian carp have been captured or observed or when repeated patterns of eDNA detections suggest possible recurring presence of Asian carp (see Rapid Response Project plan below for more detailed discussion of response triggers).

Objective 3: Identify, assess, and react to any vulnerability in the current system of barriers to exclude Asian carp from moving into the CAWS. Many measures have been undertaken or are being considered to prevent Asian carp from entering the CAWS and ultimately Lake Michigan. Some of these measures include: improving the Dispersal Barrier in the CSSC by constructing new barriers 2A (operational in 2009) and 2B (operational in early 2011) and operating barriers at appropriate operating parameters (see Holliman 2011) to better repel small and large fish; constructing a rip-rap barrier to isolate the Illinois and Michigan Canal from the CSSC (completed in September 2010); constructing a 13-mile long concrete barrier/small-mesh fence to prevent the movement of Asian carp from the Des Plaines River to the CSSC upstream of the Dispersal Barrier during extreme flooding events (completed in September 2010). The USACE has been and continues to be the lead agency for most completed and proposed actions. The MRRWG will provide necessary monitoring data and coordinate with partners to assist control efforts relative to the Dispersal Barrier and other Asian carp exclusion measures. The following projects have been developed to enhance assessment and reaction to any barrier vulnerabilities: Telemetry Monitoring Plan, Fish Behavior at the Dispersal Barrier, Des Plaines River Monitoring, Barrier Maintenance Fish Suppression, and Water Gun Development and Testing.

Objective 4: Determine the leading edge of major Asian carp populations and reproductive success of those populations. It is critical to gather information on carp densities in the area downstream of the barrier in order to effectively assess the risks of Asian carp passing the Dispersal Barrier, to formulate rapid response actions to reduce fish passage risks, and to implement downstream population control measures. For example, the presence of Asian carp between the barrier and the Lockport Lock may necessitate the use of rotenone to remove fish when barriers are shut down for maintenance or if they experience emergency failures. In addition, harvesting Asian carp downstream of Lockport Lock with contracted commercial fishers should reduce the number of fish attempting to challenge or bypass the barriers. It is also important to know where reproduction is occurring because the greatest overall reduction in numbers of Asian carp can most effectively be accomplished by removing individuals that are members of the breeding population. Projects developed to address this objective include: Fixed Site Monitoring Downstream of the Dispersal Barrier, Barrier Defense Asian Carp Removal Project, Larval Fish and Productivity Monitoring, Young-of-Year and Juvenile Asian Carp Monitoring, Telemetry Monitoring Plan, Gear Efficiency and Detection Probability, Barrier Maintenance Fish Suppression, and new projects Distribution and Movement of Small Asian Carp and Monitoring Asian Carp Population Metrics and Control Efforts.

Objective 5: Improve understanding of the likelihood that Asian carp could become established in the Great Lakes. Understanding the combination of environmental and biological variables that could lead to the introduction of Asian carp populations in the Great Lakes is important to the overall project goal and may inform decisions regarding appropriate responses to Asian carp detected or captured in the CAWS. Central to this objective are two questions, both challenging to address: 1) how many Asian carp would it likely take to establish a reproducing population in Lake Michigan; and 2) how many fish are currently in the CAWS and Lake Michigan?

Answers to question 1 above are beyond the scope of this plan, but may be forthcoming upon completion of a bi-national risk assessment convened by the Great Lakes Fishery Commission and designed to assess the risk of establishment and potential effects of Asian carp in the Great Lakes.

Sampling during 2010 and 2011 has helped to provide an answer to the second question posed above. The capture of only one Bighead Carp in thousands of person-days of sampling effort throughout the CAWS upstream of the Dispersal Barrier (452 hours of electrofishing, 123 miles of trammel/gill net, 173 acres treated with rotenone, and other gears) suggests Asian carp abundance in the waterway currently is low (see MRRWG 2012 for more detailed data summaries). Additional sampling in the lower Des Plaines River and upper Illinois River has placed the detectable Asian carp population front at more than 45 miles and successfully reproducing populations at more than 135 miles from Lake Michigan. Combined, these results suggest the current level of risk of establishment is lower than expected prior to the initiation of sampling in February 2010. However, upstream movements may occur at some point in time so timely and consistent monitoring combined with rapidly deployed removal actions are needed should the level of risk increase.

TOOLS AVAILABLE TO ACCOMPLISH OBJECTIVES

A broad range of sampling and removal tools are available to MRRWG action agencies to accomplish the plan objectives outlined above. They include traditional sampling gears (e.g., electrofishing, trammel nets, experimental gill nets, fyke or trap nets, tow nets, and seines), chemical piscicide (e.g., rotenone), high-tech sonic detection and imaging devices (e.g., sonic telemetry and hydroacoustics, DIDSON, and side-scan sonar), and newly developed or developing techniques (e.g., eDNA, water guns, and attraction pheromones). Whereas many of these gears and techniques are part of on-going monitoring and removal efforts, new tools are continually being added to the MRRP as it is periodically revised and new techniques are developed. In many cases, multiple tools are being used to accomplish individual objectives and provide sufficient intelligence to allow for sound management decisions. This strategy of addressing questions from multiple fronts with a combination of gears and techniques has helped to increase the level of confidence in results provided by monitoring and removal projects to date. In addition, gear evaluations have been on-going (see gear development and evaluation projects below) and have been expanded in this revised MRRP (e.g., see Monitoring Asian Carp Population Metrics and Control Efforts and Water Gun Development and Testing Project). Research on calibration and further refinement of eDNA monitoring is also being pursued outside of this plan. Upon completion, these assessments should lead to improved Asian carp

monitoring and removal outcomes, better understanding of the effectiveness of in-place barriers built to prevent Asian carp from gaining access to the CAWS and Lake Michigan, and improved interpretation of sampling results.

Following are general discussions of the gears and techniques included in this plan and current status of existing or developing techniques. Detailed protocols on the use of each gear are included in the Project Plans section below.

eDNA - For the past three years, eDNA has been used to monitor for the possible presence of Asian carp DNA throughout the CAWS, Des Plaines River, and near shore waters of Lake Michigan. This technique is potentially useful for early Asian carp DNA detection and to identify distribution patterns of DNA in the waterway because it can presumably detect the presence of DNA in water when fish populations are at very low levels of abundance (Jerde et al. 2011). A positive eDNA sample indicates the presence of Asian carp DNA and the possible presence of live fish. At present, eDNA evidence cannot verify whether live Asian carp are present, whether the DNA may have come from a dead fish, the number of Asian carp in an area, or whether water containing Asian carp DNA may have been transported from other sources (e.g., translocation by vessel, birds, or through subterranean cracks and fissures). Furthermore, eDNA cannot provide precise, real-time information on where Asian carp might be due to the requisite two-week sample processing time. These and other unknowns about eDNA are being evaluated.

This plan calls for the use of eDNA, in combination with other techniques, during regular monitoring, barrier maintenance fish suppression, and rapid response removal actions. At this point in time and taking a conservative approach, we consider positive detections as an indicator of the presence of Asian carp in the waterway for purposes of management and response strategies. However, based on sampling experiences in 2010, eDNA cannot reliably serve as a sole "trigger" of rapid response actions nor does it appear justifiable to deploy rapid response teams for each reported positive eDNA result. When viewed over the long term (e.g. multiple positive hits on consecutive sample dates at the same location), these data will be used to guide decisions on the location and timing of targeted rapid response removal actions.

Additional research (e.g., the USACE ECALS study; ACRCC 2012) to refine and modify eDNA sampling procedures is presently under way to assess the potential of false positive and false negative results, which must be minimized when the purpose of sampling is to make comparisons over time and between different sites. Calibration studies also are currently under way to assess whether this technique has potential to provide estimates of population abundance. How eDNA is used to determine presence and abundance of Asian carp and how it informs response actions will continue to be evaluated as we gain more experience through research.

DC Electrofishing - Electrofishing is an important fish sampling tool incorporated in nearly every sampling action outlined in this plan. We will continue to use electrofishing to monitor for adult, juvenile and young-of-year Asian carp at fixed and random sites throughout the waterway and during rapid response and barrier maintenance actions. In addition, electrofishing will be used to salvage sport fish and obtain sentinel fish during rotenone events, and to collect fish for implantation of sonic transmitters, as part of the on-going Telemetry Monitoring Plan,

Monitoring Asian Carp Population Metrics and Control Efforts, and Distribution and Movement of Small Asian Carp projects. As an active sampling technique, electrofishing provides for coverage of large areas of the waterway with moderate effort. Thus, it can provide information on fish distribution in the waterway, as well as relative estimates of abundance when standardized samples are compared spatially or temporally.

Electrofishing efficiency for capturing Asian carp has come into question, especially in the CAWS where these fish may be present in low numbers and waters are often deeper than 9 feet. However, recent electrofishing in the upper Illinois Waterway (upper Dresden Island and Brandon Road pools) has resulted in the visual observation of a single Silver Carp (2009) and the capture of a Bighead Carp (2010), both in areas where Asian carp populations are thought to be low. Furthermore, gear evaluation study results have shown electrofishing to be one of the most productive gears for sampling Silver Carp (MRRWG 2012). We incorporate two approaches to maximize the potential usefulness of electrofishing as a sampling tool during standard monitoring and rapid response events. First, we utilize high frequency and duration sampling effort to increase the likelihood of encountering a rare fish; and second, we concentrate effort in areas where the likelihood of capture is greatest (i.e., where multiple eDNA detections occur, below migration barriers, or in areas with shallow water habitats, such as main channel borders, barge slips, or non-navigable portions of the waterway).

This plan includes on-going and proposed studies to enhance our understanding of electrofishing efficacy and the relation between electrofishing catch rates and estimates of Asian carp population size (see Asian Carp Gear Efficiency and Detection Probability Study). Changes to monitoring and rapid response protocols were made in this plan as results from research efforts have become available.

Trammel/Gill Nets - Large-mesh trammel or gill nets (bar mesh = 2.0-5.0 inches) are frequently used in combination with electrofishing during fixed site monitoring and removal actions in the CAWS, lower Des Plaines River, and upper Illinois Waterway. These nets target large juveniles and adult Asian carp and are typically fished in deeper, side channel or offshore habitats not effectively sampled with electrofishing gear. Net dimensions vary depending on need from 6-15 feet high and 100-600 yards long, but are standardized for monitoring at 8-10 feet high, 200 yards long, and mesh sizes of 3.0 – 4.5 inches. Sets may be of short or long duration. Short duration sets are typically 15-20 minutes long and include driving fish into the nets with electrofishing gear or noise (e.g., plungers on the water surface, pounding on boat hulls, or racing tipped up motors). Short duration sets can take place in main channel habitats during active navigation because nets are not left unattended. Long duration sets range from 3-24 hours and must take place out of the navigation channel or during planned navigation closures because the gear is left unattended. Both methods have been shown to be effective at capturing Asian carp, but overnight sets are preferred during rapid response actions in the CAWS to maximize chances of capturing an Asian carp when population abundance is low.

New net designs will be incorporated into sampling programs as they become available. Last year, tied-down gill nets made of high strength material (e.g., braided nylon, multi-strand manofilament and Dyneema) were included in sampling and removal efforts to improve capture rates for large adults that tend to break through standard monofilament mesh nets, particularly

during warm summer months. This year, newly developed surface-to bottom experimental gill nets will be field tested as part of the gear evaluation study.

Contract Commercial Fishers - The IDNR has contracted with commercial fishers to assist with monitoring and removal actions throughout the waterway upstream and downstream of the Dispersal Barrier. Commercial fishers benefit the program by providing extensive knowledge of Asian carp habits in large Illinois rivers, hands-on experience at capturing Asian carp for commercial harvest, and appropriate-sized boats and specialized equipment to conduct effective netting operations (e.g., large-mesh trammel nets in lengths ≥300 feet, tied-down gill nets of similar lengths, ½ mile long commercial seines, and large diameter hoop nets). Commercial fishers collected the first Asian carp in Illinois waters from the Illinois and Ohio rivers. In addition, commercial fishing is recognized as one of the most effective tools to reduce Asian carp numbers in higher carp density areas in a cost effective manner (Conover et al. 2007), and it produced the only known capture of a live Asian carp upstream of the Dispersal Barrier. Commercial fishers have and will continue to be hired to conduct trammel/gill net sampling during fixed and random site monitoring in the CAWS, fixed site monitoring downstream of the Dispersal Barrier, rapid response removal events in the CAWS, and harvest efforts to reduce population size in the upper Illinois River as part of the Barrier Defense Asian Carp Removal Project. In each instance, IDNR biologists or technicians will be assigned to commercial net boats to monitor netting operations and record data.

Rotenone - Rotenone is a valuable Asian carp eradication tool and it may be the best available sampling technique for determining fish population abundance, especially in the deep waters that comprise much of the CAWS. When applied in confined areas with appropriate water temperatures, most treated fish float to the water surface within 3-4 days where they can be gathered, identified, and enumerated. Unpublished data from the USGS suggests that Asian carp will sink initially after exposure to rotenone, but will float sooner than some other species. Efficacy of individual rotenone actions may be evaluated by employing caged sentinel fish to assess treatment effects and diver transects or lift-nets to estimate recovery rates. Rotenone actions also provide opportunities to assess effectiveness of conventional gears and eDNA when sample data collected from within a treatment zone is compared to rotenone results.

While valuable, recent experience with two rotenone events that sampled 2.6 and 6.7 miles of the CAWS has shown that rotenone actions require extensive planning (1-2 months), labor (>250 workers), and financial expenditures (>$1.5 million). Several factors contributed to the enormity of these rotenone actions, including: logistics in a large urban center; state and federal regulatory requirements (e.g., NEPA, FIFRA, NPDES, and CERP; notice for waterway closures); need to stand up an Incident Command Structure (ICS); State procurement requirements and high costs of chemicals, specialized equipment, and contractual services; and fertile waters with abundant non-target fish populations. Pre-event planning and logistical requirements alone make rotenone ineffective as a rapid response tool. However, the MRRWG supports rotenone use for emergency eradication of Asian carp populations in the CAWS and for fish suppression during barrier maintenance operations after other removal options (e.g., electrofishing, commercial netting, and newly developed pneumatic water gun technology) have been implemented and shown to be unsuccessful.

Rotenone applications will be limited to targeted treatment areas within the CAWS. Treating the entire waterway is considered impractical due to costs, logistics, and availability of chemical. The technique also is considered overly aggressive for use in the lower Des Plaines and upper Illinois rivers downstream of the CAWS due to the lower threat of establishment in Lake Michigan, high labor and financial costs, and negative impact on non-target fish communities. A multitude of factors may influence decisions of when and where rotenone actions should occur, including:

a) Nature of available evidence for the presence of Asian carp (e.g., re-occurring eDNA detections, fish in hand, visual observation);
b) Number of lines of evidence identifying Asian carp presence and timeframe that evidence was gathered;
c) Precise location(s) where evidence was collected (e.g., main channel vs. below structural barrier vs. off-channel or backwater);
d) Results of previous rotenone and other sampling methods at a particular location;
e) Water temperature, chemistry, and flow characteristics;
f) Size of necessary treatment area;
g) Disturbance to public stakeholders;
h) Presence of one or more Asian carp species;
i) Season and anticipated weather conditions;
j) Existence of an emergency and the urgency surrounding such an emergency (e.g., loss of power at the electrical barriers); and
k) Need for closure of commercial and/or recreational navigation.

Whereas decisions on use will be based on multiple lines of evidence and best professional judgment of biologists, scientists, and managers from participating action agencies, the ultimate decision to use rotenone will be made by managers within agencies who have jurisdiction over rotenone application (i.e., IDNR for Illinois waters and Indiana DNR for Indiana waters).

Experimental Gill Nets - Experimental gill nets are one of the gears being evaluated by INHS for use in monitoring Asian carp populations. Experimental nets with mesh sizes >2.0 inches have produced limited catches to date. However, nets with panels having mesh sizes from 0.75 to 2.0 inches have shown promise as a monitoring tool for young-of-year and early juvenile fishes. Poor recruitment years for Asian carp in the Illinois Waterway the past two years has prevented rigorous evaluations of gears targeting young-of-year and juvenile fish. We will continue to assess small mesh experimental nets in Asian carp young-of-year and juvenile monitoring efforts at stations throughout the Illinois Waterway and CAWS. If proven effective, we will use experimental nets to supplement targeted monitoring for young Asian carp by electrofishing that began during summer/fall 2010.

Mini-Fyke Nets - Small frame fyke nets have been used successfully by USFWS and INHS to sample for young-of-year Asian carp in the lower Illinois River and should prove useful in the upper waterway in areas where shallow, near shore habitat can be found. Enhanced monitoring to detect successful Asian carp reproduction or movements of young-of year from the lower river to the CAWS is important because risk of barrier passage and population establishment in Lake Michigan increase if either occurs. Mini-fyke nets were included in gear evaluations at stations

in the CAWS and Illinois Waterway during 2011 and will be added to monitoring efforts for young Asian carp at downstream fixed sites in 2012.

Larval Push Nets - From June through October 2010 and April – October 2011, INHS used boat-mounted, 0.5-meter diameter larval push nets to sample for Asian carp eggs and larvae at stations located throughout the Illinois Waterway from the LaGrange Pool upstream through the CAWS (including the confluence of the Des Plaines River and CSSC). Asian carp eggs and larvae were sampled only from the lower Illinois River downstream from the Peoria Lock and Dam in both years. Monitoring for fish eggs and larvae will continue at stations throughout the waterway during 2012 and will begin in April when water temperatures and flow conditions are first suitable for Asian carp spawning. In addition to routine monitoring, additional samples will be taken in the CAWS and Des Plaines River confluence with the CSSC within a week after spring or summer flooding events to monitor Asian carp spawning that may be triggered by high flow conditions.

Trawls and Purse Seines - The INHS and USFWS-Columbia Fish and Wildlife Conservation Office have been evaluating trawls and purse seines as methods to sample and remove Asian carp juveniles and adults from the waterway. Results to date have been largely discouraging, but modifications to gears are being made and evaluations will continue this coming year. We will include these gears in future monitoring and removal plans if and when they are shown to be effective. A modified shrimper‟s push trawl called a paupier trawl has been developed and tested by USFWS. The trawl shows promise for sampling juvenile Asian carp from shallow water habitats pending some modifications to design. The Service is planning to make necessary adjustments and conduct additional field trials in 2012.

Ultrasonic Telemetry - The USACE began a telemetry monitoring project during 2010 to determine: 1) if fish are able to challenge and/or penetrate the Dispersal Barrier; 2) if Asian carp are able to navigate through lock structures in the upper Illinois River, lower Des Plaines River, and CAWS; and 3) upstream movement of the leading Asian carp population front. The project includes surgically implanting individually coded ultrasonic transmitters (approximate battery life = 2.5 years) in ~200 fish (Bighead Carp, Silver Carp and surrogate species) and monitoring tagged fish movements with a series of stationary and mobile hydrophones. A total of 182 tags were implanted during 2010 and 2011. To date, 3.7 million detections have been recorded with a 75% detection rate. Preliminary conclusions from small fish and adult fish telemetry studies are that the barriers are effectively preventing all upstream passage of tagged fish and Common Carp can navigate through the locks on the upper Illinois Waterway, but the same behavior has not been observed for Asian carp.

Acoustic telemetry work will be expanded in 2012 through cooperative effort between USACE, USFWS, and SIUC. Work that will investigate both juvenile and adult life stages of Asian carp populations is planned for the middle and lower Illinois Waterway to determine habitat use, movement rates, and to monitor the leading edge of the population front. Data from these three studies will be shared to provide a comprehensive view of Asian carp movement in the system, and will involve the deployment of 60 stationary receivers in the same acoustic network (Figure 2).

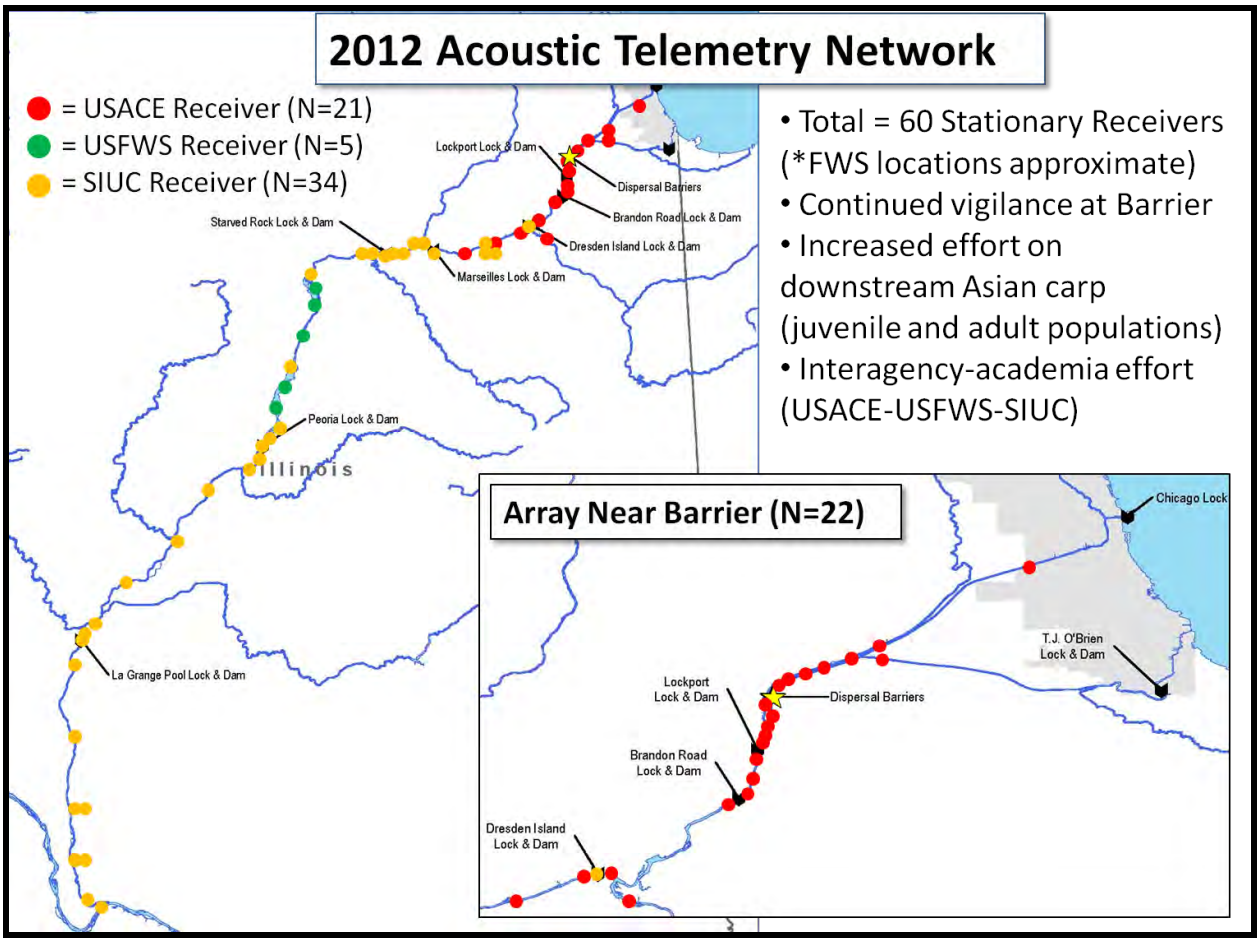

Figure 2. Map of the 2012 acoustic telemetry stationary receiver network in the Illinois Waterway and CAWS.

Dual-Frequency Identification Sonar (DIDSON), Split-Beam Hydroacoustics, and Side-scan Sonar - Several types of sonar devices are available for locating individuals or groups of fish, monitoring localized fish movements and behavior, and mapping underwater structures and habitat. Each type of sonar has inherent benefits, but an important limitation of all sonar devices is the inability to identify marked fishes to species, genus, or even family. None the less, the species of fish being observed with these tools may not be of great consequence; if a fish of a certain size and similar form is penetrating the barrier, it is assumed that an Asian carp could too. Even with the species-specific limitation, sonar devices have proved useful for locating and enumerating fish near the Dispersal Barrier, estimating fish population abundance, and verifying success of fish clearing activities in support of barrier maintenance. We continue to evaluate these remote sensing gears as potential monitoring tools or aids to improve effectiveness of other sampling gears.

Imaging sonar, such as DIDSON, can provide detailed video images of fishes and underwater objects. However, these devices lack vertical resolution because they track in two dimensions and may be range limited under certain conditions. The USACE conducted a survey of the electric barriers in the CSSC with DIDSON during 2010 and preliminary results showed schools of smaller fish above and below Barrier I and above and below Barrier 2A. Several larger fish

also were observed below Barrier 2A. The DIDSON camera was used in 2011 to conduct wild fish evaluations at, in, and around the barriers and to view behavior of fishes in cages dragged through the barriers. We will continue to use DIDSON for additional fish counts at the barrier and to evaluate presence of fish between barriers after barrier maintenance fish clearing operations (see Fish Behavior at the Dispersal Barrier and Barrier Maintenance Fish Suppression).

Split-beam hydroacoustics has been used to locate fish and collect data on fish abundance, size distribution, and behavior at ranges in excess of 100 meters. Higher-end hydroacoustic devices track in three dimensions, so they have the ability to provide distance, bearing, and vertical locations of objects or fish in the water column within the area surveyed by the transducer beam. This can be particularly useful when a fixed-position monitoring system is used to monitor fish locations and behavior near anthropomorphic structures, such as dams, fishways, navigation locks, or potentially the Dispersal Barrier. The INHS has been evaluating split-beam hydroacoustics as a potential Asian carp monitoring tool over the past two years and this research will continue in the coming field season. The USGS will use a fixed-site hydroacoustics unit to monitor fish movement and response to water gun operations during a field experiment in the Illinois River near Morris, Illinois. Hydroacoustics data in combination with conventional data for species verification has been used to estimate Asian carp abundance in the Illinois River (Garvey et al. 2012). This work will continue in the upper Illinois Waterway during the coming year. In addition, success of fish clearing operations in support of barrier maintenance have and will continue to be evaluated with split beam hydroacoustics, as well as DIDSON and side scan sonar.

Multi-beam side scan sonar offers wide angle coverage of a water body, but lacks fine scale resolution. These systems are typically used for mapping bottom morphology and detecting underwater objects and bathymetric features. Side scan sonar was used to determine water depths and survey for bottom obstructions prior to commercial seining in the rapid response action at Lake Calumet in 2010 and likely will be used to obtain similar information in the future. At present, there are no plans to use side scan sonar for fish monitoring or to examine fish behavior at the Dispersal Barrier, but it has proved useful in evaluating success of fish clearing operations at the barrier.

PROJECT PLANS

Eighteen project plans have been prepared to achieve the overarching goal and objectives of the MRRP. These plans are in various stages of development due to the continuing expansion of efforts to control Asian carp. Several plans were prepared and implemented during 2010, others were newly developed in 2011, and still others are newly proposed and only recently scoped out. We included in this MRRP project plans from various stages of development to showcase the full range of work that will be on-going or initiated during the coming year. Consequently, the type and amount of information included in the project plans below will vary with the level of plan development to date. Work to improve existing plans and create new projects will be on-going throughout the year. Projects and schedules are included as a guideline for implementation; however actual plans may vary depending upon logistics and funding.

Fixed and Random Site Monitoring Upstream of the Dispersal Barrier

Participating Agencies: IDNR (lead); USFWS – Columbia, Carterville, and La Crosse Fish and Wildlife Conservation Offices (field support)

Location: Monitoring will take place in the CAWS at the CSSC, Chicago River, South Branch Chicago River, North Branch Chicago River, North Shore Channel, Calumet River, Little Calumet River, Calumet-Sag Channel, Lake Calumet Connecting Channel, and Lake Calumet.

Introduction and Need: Frequent and standardized sampling can provide useful information to managers tracking population growth and range expansion of aquatic invasive species. Information gained from regular monitoring (e.g., presence, distribution, and population abundance of target species) is essential to understanding the threat of invasion and informs management decisions and actions to reduce the risk of population establishment. Detections of Asian carp DNA upstream of the Dispersal Barrier during 2009 initiated the development of a monitoring plan that will use electrofishing and contracted commercial fishers to sample for Asian carp at five fixed sites upstream of the Dispersal Barrier. Fish community analysis comparing 2010 data from fixed and reach electrofishing samples indicated that the chosen fixed site locations supported fish communities with more fish, higher species richness, and higher diversity (MRRWG 2012). Monitoring results will continue to contribute to our understanding of Asian carp population abundance in the CAWS and guide conventional gear or rotenone rapid response actions designed to remove fish from areas where they have been captured or observed.

Extending sampling beyond designated fixed sites can increase the chance of encountering Asian carp in the CAWS and provide useful information on distribution patterns of target and non-target fish species. Fish distribution data can, in turn, inform site selection for removal actions or other monitoring and control measures. In addition, these data may contribute to the evaluation and possible future adjustment of fixed site sampling locations. We will sample 26 randomly selected electrofishing sites and 26 randomly selected trammel/gill net sites per month in addition to fixed site sampling. Random sites will be located in portions of the waterway outside of the designated fixed sites and will extend sampling effort to include nearly all of the 76 miles of waterway that makes up the CAWS.

Objectives: We will use standardized DC electrofishing and contracted commercial netters to:

1) Monitor for the presence of Asian carp in the CAWS upstream of the Dispersal Barrier;
2) Determine relative abundance of Asian carp in locations and habitats where they are likely to congregate;
3) Determine Asian carp distribution in the CAWS; and
4) Obtain information on the non-target fish community to help verify sampling success, guide modifications to sample locations, and assist with detection probability modeling and gear evaluation studies.

Status: This project began in 2010 and is on-going. Electrofishing (DC) and trammel/gill net samples were taken at the five fixed sites twice monthly from June through November 2010 (June through September for 2010 netting). In 2011, fixed sites were sampled twice monthly from April through November and once each month during March and December. Over 6,000

estimated person-hours were spent sampling at fixed sites and additional netting locations upstream of the Barrier in 2010 and 2011. Effort was equal to 341 hours of electrofishing and 91 miles of trammel/gill net deployed. The catch was 93,659 fish representing 64 species and two hybrid groups. No Bighead or Silver Carp were captured or observed during electrofishing in either year. Likewise, no Silver Carp were captured or seen during contracted commercial netting in either year, nor were any Bighead Carp caught in 2011. One adult Bighead Carp (mature male 34.6 inches in length and 19.6 pounds) was captured by netters in Lake Calumet on 22 June 2010. This fish is the only verified live Bighead or Silver Carp known from the CAWS upstream of the Dispersal Barrier to date. For more detailed results see the 2011 interim summary report document (MRRWG 2012).

Methods: The sample design includes intensive electrofishing and netting at five fixed sites where we anticipate catching Asian carp, if they are present in the waterway, and at four random site sampling areas (Figure 3). Sampling will take place monthly during March and December (weather permitting) and twice monthly from April through November. No sampling at fixed sites is planned for January and February because several of the sites are typically ice covered during these months. To maximize the potential usefulness of netting and electrofishing, particularly given the apparent low densities of Asian carp in the generally deep-water habitat of the CAWS, stations were located in areas where the likelihood of capture is greatest (i.e., where eDNA has been detected, below migration barriers, or both). The five fixed sites are mostly located at the upstream-most areas of the CAWS near Lake Michigan. These areas were identified for intensive sampling under the assumption that Asian carp upstream of the Dispersal Barrier would swim upstream and congregate below the next existing barriers, namely the T.J. O‟Brien and Chicago Locks and the Wilmette Pumping Station. Habitat and collection conditions were taken into consideration in the selection of the locations and boundaries of the fixed sites. For example, Lake Calumet (Site 1) was included because it possesses backwater-like conditions favored by Asian carp and is known to contain bigmouth buffalo, a species thought to favor habitat similar to Asian carp. The Little Calumet River (Site 2) was extended downstream to include favorable habitat near the Acme Bend. Finally, Site 3 was shifted downstream of the Chicago Lock in order to include more favorable habitat and collection conditions (e.g., less boat traffic and resulting wave action).

The entire CAWS upstream of the Dispersal Barrier has been divided into four random site sampling areas that will be sampled three times per month with DC electrofishing gear and commercial trammel/gill nets (Figure 3). Random site sampling will exclude areas of the waterway designated as fixed sites, because these areas are sampled by electrofishing and netting twice each month as part of fixed site monitoring. Random sites will be generated with GIS software from shape files of designated random site areas and will be labeled with Lat-Lon coordinates in decimal degrees. A list of random sites will be generated for the entire year for each random site sampling area and assigned for each sample day, after which sampled sites will be eliminated from the list to prevent duplicate sampling. Fixed and random site sampling will provide intense sampling in areas thought to be the most likely places to catch Asian carp, if they are in the waterway, and somewhat less intense broad coverage of the entire CAWS.

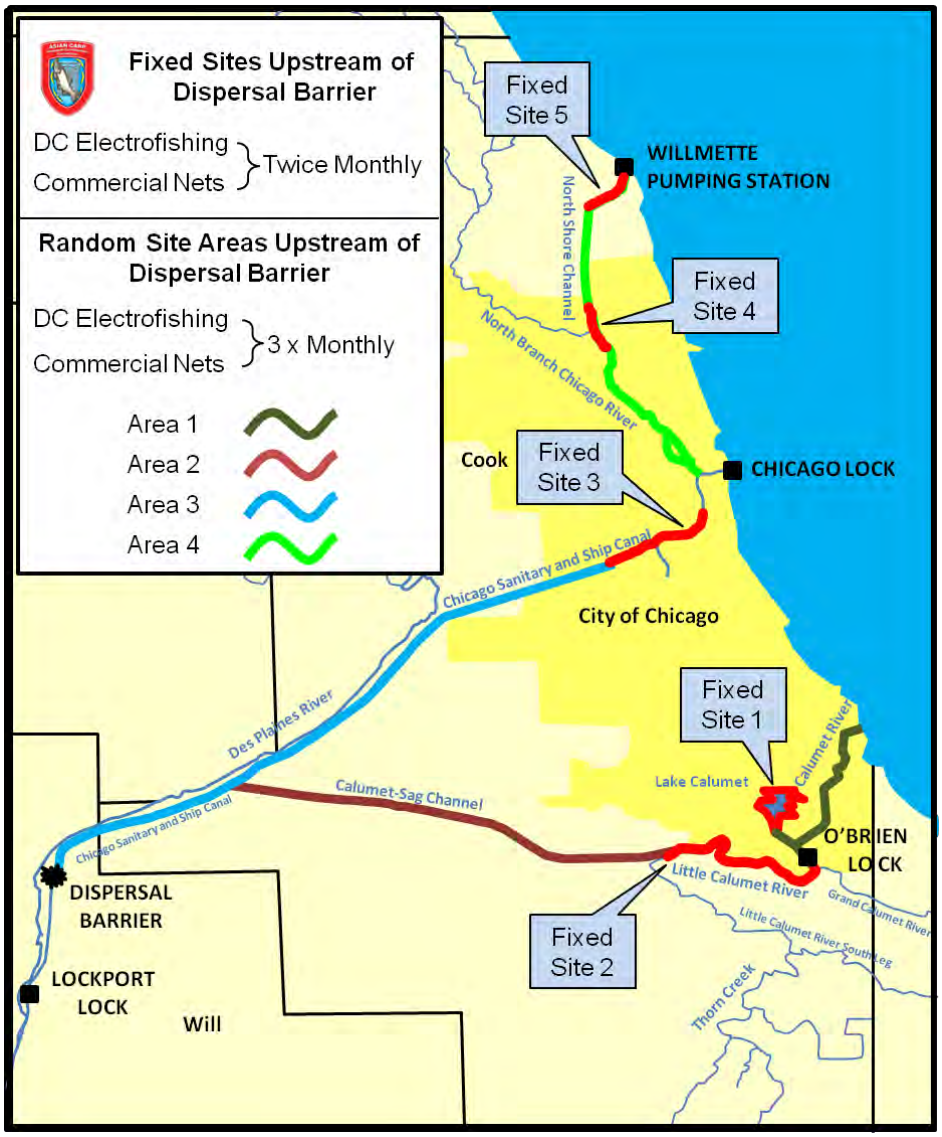

Figure 3. Fixed sites and random site sampling areas for electrofishing and commercial netting upstream of the Dispersal Barrier.

Upstream Fixed Site Descriptions and Effort - A description of fixed site locations and sampling effort targets is summarized below. The duration of each electrofishing run will be 15 minutes and lengths of each net set will be 200 yards. See Appendix B for detailed maps of each site.

Site 1 – Lake Calumet. Sampling will be limited to shallower areas north of the Connecting Channel (this avoids deep draft areas with steep walls but includes channel drop off areas that exist north of the Connecting Channel).

- six (6) electrofishing runs
- 2,000 yards of trammel or gill net

Site 2 – Calumet/Little Calumet River O'Brien Lock to its confluence with the Little Calumet River South Leg (~7 miles)

- eight (8) electrofishing runs
- 1,600 yards of trammel or gill net

Site 3 – CSSC and South Branch Chicago River from Western Avenue upstream to Harrison Street (~4 miles).

- eight (8) electrofishing runs
- 1,000 yards of trammel or gill net

Site 4 – North Branch Chicago River and North Shore Channel from Montrose Avenue north to Peterson Avenue (~2 miles).

- four (4) electrofishing runs
- 400 yards of trammel or gill net

Site 5 – North Shore Channel from Golf Road north to Wilmette Pumping Station (~2 miles).

- Four (4) electrofishing runs
- 400 yards of trammel or gill net

Upstream Random Site Sampling Area Descriptions and Effort - A description of random site sampling areas and sampling effort targets is summarized below. As with fixed sites, the duration of each electrofishing run will be 15 minutes and lengths of each net set will be 200 yards. Four random site areas have been identified to facilitate coordination with fixed site sampling.

Area 1 – Lake Calumet Connecting Channel and Calumet River from O'Brien Lock and Dam to Calumet Harbor.
Area 2 – Calumet-Sag Channel from its confluence with the CSSC to Little Calumet River.
Area 3 – CSSC from Western Avenue downstream to the Dispersal Barrier.
Area 4 – North Shore Channel (between Fixed Site 4 and 5), North Branch Chicago River, and Chicago River.

Sampling at random site areas will take place three times per month, twice during fixed site sampling and one additional day each month.

	Number of 15-min. electrofishing transects per trip		Number of 200-yard trammel/gill net sets per trip	
Random site areas	Fixed site days (twice monthly)	Additional days (1 day/month)	Fixed site days (twice monthly)	Additional days (1 day/month)
Area 1	4	0	0	3
Area 2	2	2	2	3
Area 3	2	2	3	3
Area 4	2	2	2	3
Total	10	6	7	12

Electrofishing Protocol - All electrofishing will use DC current and include 1-2 netters (two netters preferred). Locations for each electrofishing transect for both fixed sites and random sites will be identified with GPS coordinates. For fixed sites, transects were selected from 2010 and 2011 data and represent transects with the highest mean catch-per-unit-effort and species richness. Random site coordinates will be randomly generated, as described above. Electrofishing transects should begin at each coordinate and continue for 15 minutes in a downstream direction in waterway channels (including following shoreline into off channel areas) or in a counter-clockwise direction in Lake Calumet. Fixed site sampling locations will remain the same throughout the year and should be sampled repeatedly with each site visit. This represents a change from past years when exact sampling areas within the sites were left to the discretion of field crews and should lead to more consistent monitoring results.

While electrofishing, operators may switch the safety pedal on and off at times to prevent pushing fish in front of the boat and increasing the chances of catching an Asian carp. Common Carp will be counted without capture and all other fish will be netted and placed in a tank where they will be identified and counted, after which they will be returned live to the water. Periodically, a subsample of 10 fish of each species per site will be measured in total length and weighed to provide length-frequency data for gear evaluations. Schools of young-of-year gizzard shad <6 inches long will be subsampled by netting a portion of each school encountered and placing them in a holding tank along with other captured fish. Young-of-year shad will be examined closely for the presence of Asian carp and counted to provide an assessment of young Asian carp in the waterway. We will count all captured Asian carp, as well as those observed but not netted. We may observe more Asian carp than we net because of the difficulty in capturing these fish with electrofishing gear. Refer to Appendix C for detailed protocols on reporting, handling, and chain-of-custody for captured Asian carp. Fish species codes can be found in Appendix E and sample data sheets are included in Appendix F. Crew leaders should fill in as much information on the data sheets as possible for each station/transect and record the location for the start of each run either with GPS coordinates (decimal degrees preferred) or by marking on attached maps.

Netting Protocol – Contracted commercial fishers will be used for net sampling at fixed and random sites and nets used will be large mesh (3.0-4.0 inches) trammel or gill nets 8-10 feet high and in lengths of 200 yards. Locations for each net set for both fixed sites and random sites will be identified with GPS coordinates. For fixed sites, locations were selected from 2010 and 2011 data and represent net sets with the highest mean catch-per-unit-effort and species richness. Random site coordinates will be randomly generated, as described above. Net sets will take place within 500 yards of a designated coordinate at a specific location agreed upon by the commercial fisher and attending IDNR biologist. Sets will be of short duration and include driving fish into the nets with noise (e.g., plungers on the water surface, pounding on boat hulls, or racing tipped up motors). In an effort to standardize netting effort, sets will be 15-20 minutes long and "pounding" will extend no further than 150 yards from the net. Nets will be attended at all times. Captured fish will be identified to species and tallied on standard data sheets. Periodically, a subsample of 10 fish of each species per site will be measured in total length and weighed. Locations of net sets should be recorded with GPS coordinates (decimal degrees preferred) or by marking on attached maps. An IDNR biologist or technician will be assigned to each commercial net boat to monitor operations and record data. All Grass Carp sampled will be

stored on ice and the heads will be removed and shipped to SIUC for ploidy analysis (see protocols in Appendix D).

Suggested boat launches for fixed and random site sampling.

Fixed Site 1 and Random Site Area 1 – O'Brien Lock Launch – Contact the Lockmaster for permission.

Fixed Site 2 – Launch at O'Brien Lock and lock through to sample below or pay at marina on east side of river downstream of the dam.

Fixed Site 3, 4, and 5 and Random Area 4 – Western Avenue Launch – No contact necessary. Limited number of parking passes available (State and Federal trucks exempt).

Random Site Area 2 - Launch at O'Brien Lock and lock through to sample below or pay at marina on east side of river downstream of the dam; Worth Launch (RM 311) – No contact necessary during summer.

Random Site Area 3 – Western Avenue Launch; Summit Launch (RM 313) – No contact necessary during summer; Cargill Launch – Inform Martin Castro at MWRD, will need to pass through barrier zone to access sampling area.

Sampling Schedule: A tentative sampling schedule for 2012 and the agency responsible for electrofishing is shown in the table below.

Week of	Agency	Week of	Agency
Mar 26	IDNR	Aug 6	USFWS
Apr 16	USFWS	Aug 20	IDNR
Apr 30	IDNR	Sep 10	USFWS
May 7	USFWS	Sep 17	IDNR
May 21	IDNR	Oct 1	USFWS
Jun 11	USFWS	Oct 22	IDNR
Jun 25	IDNR	Nov 5	USFWS
Jul 9	USFWS	Nov 19	IDNR
Jul 23	IDNR	Dec 3	USFWS

Deliverables: Results of each sampling event will be reported for weekly sampling summaries. Data will be summarized for an annual interim report and project plans updated for annual revisions of the MRRP.

Strategy for eDNA Monitoring in the CAWS

Participating Agencies: USACE (lead), USFWS and IDNR (field support), USEPA (field and lab support)

Location: Monitoring will take place in the CAWS upstream of Lockport Lock and Power Station

Introduction and Need: Monitoring is essential to determine the effectiveness of efforts to prevent self-sustaining populations of Asian carp from establishing in the Great Lakes. In the past, traditional fishery techniques have been used to detect the presence of Asian carp in the Upper Illinois Waterway; however, these methods have been somewhat ineffective at targeting these species at low densities. With funding from USACE, the University of Notre Dame applied a method to detect environmental DNA (eDNA) left behind in the aquatic system by the targeted species (Jerde et al., 2011). Use of this method has been to provide detection of Asian Carp DNA where fish, if they exist at all, exist at very low densities (e.g., CAWS). The results of eDNA sampling in conjunction with traditional fishery techniques will guide rapid response actions designed to remove Asian carp from the waterway. Results of eDNA sampling will also be used to inform decisions regarding the success of removal efforts and when individual actions should be terminated.

At present, the capacity to process eDNA is 120 samples per week. The sampling strategy for the 2012 field season takes into account the current level of sample processing, but the number of samples required was determined based on sampling regime and results from prior years (i.e., 2009-2011), individual site characteristics, and the need to gather information from several strategically important reaches of the waterway.

Objectives: eDNA sampling will be used to:

1) Determine whether Asian carp DNA is present in strategic locations in the CAWS to help guide rapid response actions; and
2) Detect Asian carp DNA in areas targeted for rapid response actions, as a measure of the effectiveness of conventional gear or rotenone removal efforts

Status: Sampling for Asian carp DNA began during June 2009 in the upper Illinois River and continued through August 2010 at other locations, including the Des Plaines River, CAWS, and near shore areas of Lake Michigan. In the summer of 2010, Federal agencies assumed the lead for eDNA monitoring. The USACE became responsible for coordinating sampling, processing samples, and posting results; while the U.S. Fish and Wildlife Service and Illinois Department of Natural Resources became responsible for sample collection. During the 2011 field season, a total of 1693 water samples were collected from the CAWS upstream of the Dispersal Barrier, 57 from below the Dispersal Barrier, and 114 from the upper Des Plaines River (i.e., between Hofmann Dam and the Lemont Road Bridge). In addition, 684 samples were collected over the course of three days in October from the CAWS as part of the eDNA snapshot sampling event. Detailed results from the 2011 field season are available in the 2011 interim summary report document (MRRWG 2012).

To date, no relationship between the number of positive detections and Asian carp population abundance has been established, therefore eDNA results should be interpreted with caution. Additional research on the calibration of the eDNA method has been occurring since 2010; however, the full results of this multi-agency study will not be known until 2013. Until completion of this additional research to calibrate eDNA results and assess potential alternative sources of DNA in the waterway, the MRRWG views positive eDNA results as an indicator of the possible presence of live Asian carp. When viewed over the long term (e.g., multiple positive hits on consecutive sample dates at the same location), these data will be used to guide decisions on the location and timing of targeted rapid response removal actions.

Methods: Standard operating procedures have been outlined in the eDNA Quality Assurance Project Plan (USACE 2011) and were reviewed and agreed upon by all partnering agencies (e.g. USACE, USFWS, and IDNR). In general, IDNR and USFWS will collect 60 water samples on a bi-monthly basis from a specified reach on Monday or Tuesday. Samples will be transferred to USACE biologists at the USEPA laboratory in Chicago where they will be filtered and preserved in a -20ºC freezer. Preserved samples will be shipped overnight to the ERDC laboratory for analysis. Results will be posted on a USACE web site after analysis of each sampling event is complete (approximately 14 days). A general description of the eDNA sample collection method is given below. Detailed field, laboratory, and reporting protocols are available in the eDNA Quality Assurance Project Plan (USACE 2011).

Locations-Samples will be collected every two weeks from late May through October (weather permitting) such that Lake Calumet and each partial barrier to Lake Michigan are sampled once every 30 days (N= 114 samples and 6 cooler blanks bi-monthly; Figure 4). Sample locations were selected based on habitat thought to be preferred by Asian carp (Lake Calumet) and entry points to Lake Michigan (North Shore Channel downstream from Wilmette Pumping Station, Chicago River downstream from Chicago Lock, and Little Calumet River downstream from T. J. O'Brien Lock and Dam. Sampling is complementary to fixed site sampling conducted with conventional gears in the locations listed below.

- North Shore Channel (60 samples) and South Branch Chicago River to the Chicago Lock (60 samples)
- Little Calumet River downstream of O'Brien Lock (60 samples) and Lake Calumet (60 samples)

Paired sampling stations will be sampled in the same day once every other week so that all four stations will be sampled every 30 days. An additional 480 samples will be available for the 2012 field season. These samples will be used for sampling associated with rapid response actions or to monitor the Upper Des Plaines River, CSSC and Calumet-Sag Channel confluence, the CSSC upstream and downstream of the Dispersal Barrier, or other locations determined to be strategically important (e.g., re-sampling a site with previous positive detections for Asian carp DNA). The USACE will provide aerial site maps with specific sampling locations for each sample 1-2 weeks prior to each sampling event. In addition, sampling maps will be provided with the coolers upon pick-up from the USEPA laboratory, as well as a box of nitrile gloves, datasheets, COC form, handheld depth sonar, and sprayer with 10% bleach solution.

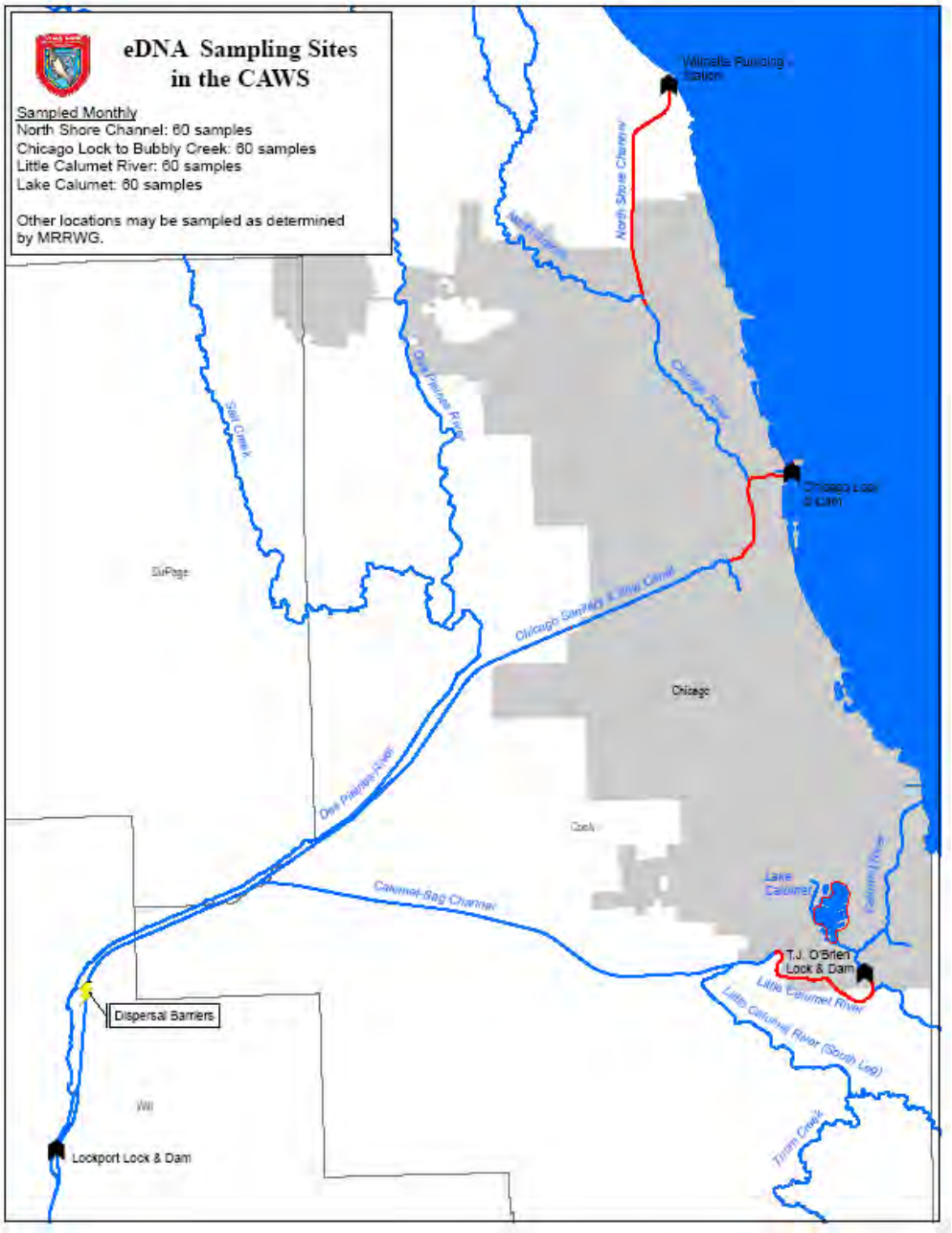

Figure 4. Locations for eDNA sampling in the CAWS.

The proposed strategy allows for eDNA sampling to take place in support of conventional gear or rotenone rapid response actions or other evaluations that might occur at locations other than those identified above. Highest sampling priority has been set for barriers to Lake Michigan (e.g. Wilmette Control Works, Chicago Lock and O'Brien Lock) and Lake Calumet. Sampling priority for the additional 480 samples that are not part of regular fixed site sampling will be directed by the MRRWG, and may include: 1) Rapid Response Action sites 2) CSSC upstream and downstream of the Dispersal Barrier; 3) CSSC and Calumet-Sag Channel confluence; and 4) upper Des Plaines River. A minimum of 60 samples is recommended for each eDNA sampling

event to reduce the probability of obtaining false negative results. Changes to the sampling frequency and/or procedures may be made by the MRRWG, as needed to minimize the risk of Asian carp entering the CAWS upstream of the barrier.

eDNA Sample Collection Protocol.

1) Sampling will be cancelled or postponed due to contamination concerns if a combined sewer overflow (CSO) occurs two days prior to sampling and/or if observed precipitation exceeds 1.5 inches in 24 hours five days prior to sampling. Sample crews will be notified as soon as possible of a cancellation.
2) The sampling boat and transport trailer must be disinfected prior to launching by spraying the outer surfaces (i.e. hull, motor, etc.) with a hand-held sprayer containing a prepared 10% bleach/water solution.
3) Prior to launch, crew members will be given their specific duties for the sampling trip. One crew member will be designated as the boat operator and will be in charge of driving the vessel to sample locations. A second crew member will be designated as the lead sampler and will be in charge of collecting all water samples and measuring water depth and temperature. A third crew member will record GPS location (decimal degrees) and habitat measurements for each water sample on a datasheet.
4) Sampling will begin at the first transect located at the DOWNSTREAM end of the reach to be sampled and will proceed in an UPSTREAM direction.
5) When arriving at a sample site, the lead sampler will put on sterile exam gloves (powderless latex or nitrile).
6) Going in consecutive order, the lead sampler will remove a labeled 2L sample bottle from the sample cooler.
7) Just prior to collecting the sample, the lead sampler will unscrew and remove the lid from the sample bottle.
8) The lead sampler will then reach over the upstream side or the bow of the boat with the 2L sample bottle and fill the bottle by skimming the water surface. The sample bottle should not be submerged or dipped beyond the upper 2 inches of the surface water for sample collection.
9) Once the sample bottle is completely filled (approximately 1 inch of space should be left within the sample bottle) the lead sampler will screw the lid back on to the bottle until it is tight. The closed bottle should then be returned to the sample cooler from which it was removed.
10) The lead sampler will take a surface water temperature and depth measurement at the sample site. The data recorder will record the bottle ID number, GPS location (decimal degrees), time of sample, water temperature, and water depth on the data sheet.
11) If the lead sampler pulls a transport blank (2L of DI water filled prior to trip) from the cooler, the sampler will unscrew and remove the lid to expose the bottles contents to the atmosphere for 5 seconds, reseal the bottle, fully submerge the bottle in the field water, and return the bottle to the cooler from which it was removed. The lead sampler should

relay to the data recorder that the sample was a blank, so that it can be recorded on the data sheet next to the appropriate ID number. BLANKS ARE TAKEN IN TANDEM WITH THE NEXT ACTUAL SAMPLE AND DO NOT REPLACE A SAMPLE IN THAT LOCATION. If a blank was collected, the boat will remain at the same location and an actual sample will be taken.

12) Duplicate samples are collected as part of quality control. Duplicate sample locations are designated as red stars on the aerial location map. Duplicate samples will be collected the same a regular sample; however, the lead sampler should relay to the data recorder that the sample is a duplicate, so that it can be recorded on the data sheet next to the appropriate sample ID. DUPLICATE SAMPLES ARE TO BE TAKEN IN TANDEM WITH THE NEXT REGULAR SAMPLE. If a duplicate sample is designated, this sample should be taken concurrently with the regular sample, side-by-side, to best replicate the regular sample collection. If a blank sample is pulled from the cooler at a designated duplicate location on the aerial map, take the duplicate sample at the NEXT DESIGNATED REGULAR SAMPLE LOCATION.
13) Steps 5 through 12 should be repeated until sampling has been completed for the targeted reach.
14) Once sampling is complete, ice will be added to the sample coolers as soon as possible. Enough ice should be added to each cooler to completely surround each sample bottle and maintain an inside temperature of 40ºF. If at any time during transport the inside temperature of the cooler(s) rises above 40ºF, additional ice should be added.
15) Chain-of-custody (COC) forms will be completed for every sample. All samples, including blanks, will be logged onto COC forms. The forms will be collected and signed whenever the coolers are transferred between parties.

Boat Launches for eDNA Sampling.
North Shore Channel – Western Avenue Launch – No contact needed.
Chicago Lock to Bubbly Creek – Western Avenue Launch – No contact needed.
Little Calumet River – O'Brien Lock Launch – Contact the O'Brien Lockmaster for permission. Will need to launch at O'Brien Lock and lock through to sample downstream of lock and dam.
Lake Calumet – O'Brien Lock Launch – Contact the O'Brien Lockmaster for permission.

Sampling Schedule: A tentative sampling schedule for 2012 is shown in the table below. Date and agency assignments will remain fixed, whereas the station sampling will be assigned for each week by USACE following monitoring plan protocols described above.

Week of	Agency	Week of	Agency
May 21	IDNR	Aug 20	IDNR
Jun 11	USFWS	Sep 10	USFWS
Jun 25	IDNR	Sep 17	IDNR
Jul 9	USFWS	Oct 1	USFWS
Jul 23	IDNR	Oct 22	IDNR
Aug 6	USFWS		

Deliverable: Results of each sampling event will be reported on the USACE website http://www.lrc.usace.army.mil/AsianCarp/eDNA.htm within 2 weeks of sample collection. Data will be summarized for an annual interim report and project plans updated for annual revisions of the MRRP.

Field Points of Contact

Name	Agency	Office #	Mobile #	Email
Mike McClelland	IDNR			Michael.McClelland@Illinois.gov
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Larval Fish and Productivity Monitoring in the Illinois Waterway

Participating Agencies: INHS (lead), Western Illinois University and Eastern Illinois University (field and lab support)

Location: Larval fish and productivity sampling will take place at ten sites in the Illinois and Des Plaines River downstream of the Dispersal Barrier (LaGrange, Peoria, Starved Rock, Marseilles, Dresden Island, and Brandon Road pools), and at four sites in the CAWS upstream of the Dispersal Barrier.

Introduction and Need: Factors affecting the early life stages of fish strongly affect recruitment to adult populations. The rapid establishment and continued spread of Bighead Carp and Silver Carp in the Illinois Waterway is in part due to their ability to reproduce and for their young to survive under the prevailing environmental conditions found in this system. Larval Asian carp have previously been collected in the Alton Pool of the Illinois River (DeGrandchamp et al. 2007), and juveniles have been captured in the LaGrange Pool (Irons et al. 2011) but the extent of Asian carp reproduction elsewhere in the Illinois Waterway is unknown. A more detailed evaluation of factors affecting reproduction and recruitment in different sections of the Illinois Waterway is needed to better understand Asian carp population dynamics in this system and potentially develop management strategies targeting early life stages. Information on the spatial and temporal distribution of Asian carp eggs and larvae will help to identify adult spawning areas, determine reproductive cues, and characterize relationships between environmental variables and survival of young Asian carp.

Asian carp are filter-feeding planktivores that have the ability to deplete plankton densities and alter zooplankton community composition. Because Asian carp require sufficient food resources to optimize feeding and sustain their growth, they are likely to associate with areas of higher productivity (Calkins et al. 2011). Phytoplankton and zooplankton densities are expected to vary considerably both across the longitudinal gradient of a large river and among habitats within river segments. Therefore, identifying patterns in nutrient concentrations, phytoplankton densities, and zooplankton abundance may indicate locations where Asian carp are most likely to be located. Examining relationships between the abundance of Asian carp, other planktivorous fishes, and productivity variables will provide information on Asian carp foraging ecology and will help focus sampling and removal efforts. This information will also be useful for examining relationships among nutrients, phytoplankton, and zooplankton abundance in a large river system.

Objectives: We are sampling fish eggs and larvae in the Illinois Waterway to:

1) Identify areas where Asian carp are reproducing;
2) Determine the timing of Asian carp spawning in this system;
3) Determine the detectability of larval fish in standard ichthyoplankton sampling gear; and
4) Examine relationships between environmental variables (e.g., temperature, discharge, habitat type) and abundance of Asian carp eggs and larvae.

Productivity variables are being measured to:

1) Identify high-productivity areas where Asian carp are likely to be located;
2) Determine relationships between productivity and the abundance of Asian carp and other planktivorous fishes; and
3) Examine relationships among nutrients, phytoplankton, and zooplankton density in the Illinois Waterway.

Status: Larval fish and productivity sampling was conducted during June 3 – October 2, 2010, and April 27 – October 3, 2011. Over 800 larval fish samples were collected during these efforts, resulting in the capture of 9,727 larval fish. Larval and early-juvenile Asian carp were only collected in June 2010 from the Illinois River at Havana (n = 78), and in June 2011 below Peoria Lock and Dam (n = 2). Other larval fish taxa were most abundant during June in the Illinois River, and during July in the CAWS. Clupeids, primarily Gizzard Shad, were the most abundant larval fish taxa captured. Cyprinid (excluding Asian carp) and centrarchid larvae were also abundant in the upper Illinois River.

Productivity sampling occurred concurrently with larval fish sampling in both 2010 and 2011. Phosphorus concentrations were found to be lowest at sites closest to Lake Michigan, increased to their highest levels within the CAWS, and gradually declined with increasing distance downstream on the Illinois River. Phosphorus and chlorophyll concentrations were found to be negatively correlated, with the highest chlorophyll levels observed in the lower Illinois River. Chlorophyll concentrations declined with increasing distance upriver, but were relatively variable within the CAWS. Crustacean zooplankton densities varied little among sites in the Illinois and Des Plaines Rivers, whereas dreissenid veliger densities were low in the Illinois River, but increased substantially in the Des Plaines River and the CAWS. Rotifer densities declined with increasing distance upriver, but increased again to their highest level in the CAWS. Densities of all zooplankton groups were highest in the Little Calumet River and in Lake Calumet. For more detailed results see 2011 interim summary report document (MRRWG 2012).

Methods: Four larval fish samples are being collected at each of the ten sites downstream of the electric barrier, and at three sites in the CAWS (Figure 5; Table 1). Samples are collected using a 0.5 m-diameter ichthyoplankton push net with 500um mesh. Sampling transects are located on either side of the river channel, parallel to the bank, at both upstream and downstream locations within each study site. To obtain each sample, the net is pushed upstream using an aluminum frame mounted to the front of the boat. Boat speed was adjusted to obtain 1.0 – 1.5 m/s water velocity through the net. Flow is measured using a flow meter mounted in the center of the net mouth and is used to calculate the volume of water sampled. Fish eggs and larvae are collected in a meshed tube at the tail end of the net, transferred to sample jars, and preserved in 90-percent ethanol. The presence of any fish eggs is being noted and all eggs are being retained for future analyses. Larval fish are being identified to the lowest possible taxonomic unit in the laboratory.

Productivity patterns are being evaluated by measuring total phosphorus and chlorophyll *a* concentrations, as well as zooplankton abundance. Water samples are collected at each site using an integrated tube sampler lowered to twice the Secchi depth. Chlorophyll *a* concentrations are estimated fluorometrically with an acetone extraction, and total phosphorus

Figure 5. Map of larval fish and productivity sampling sites in the Illinois Waterway.

Table 1. Larval fish and productivity monitoring sites in the CAWS and Illinois Waterway.

Pool	Water Body	Location	Larval Fish	Productivity
LaGrange	Illinois River	Lily Lake	X	X
LaGrange	Illinois River	Bath Chute	X	X
LaGrange	Illinois River	Matanzas Lake	X	X
LaGrange	Illinois River	Havana	X	X
LaGrange	Illinois River	Peoria Dam Tailwater	X	X
Peoria	Illinois River	Henry	X	X
Starved Rock	Illinois River	Ottawa	X	X
Marseilles	Illinois River	Morris	X	X
Dresden Island	Des Plaines River	Treats Island / I-55	X	X
Brandon Road	Des Plaines River	Des Plaines/CSSC confluence	X	X
Lockport	Calumet-Sag Channel	Worth Boat Ramp		X
Lockport	Little Calumet River	I-57 to Indiana Ave. (Fixed Site 2)	X	X
Lockport	CSSC	Kedzie Ave. to Damen Ave. (Fixed Site 3)	X	X
Not applicable	Lake Calumet	several sites w/in lake (Fixed Site 1)	X	X

concentrations are determined by measuring sample absorbance with a spectrophotometer after an acid molybdate extraction. Zooplankton are being collected by obtaining vertically-integrated water samples using a diaphragmatic pump. At each site, 90 L of water is filtered through a 63 μm mesh to obtain crustacean zooplankton, whereas 10 L of water is filtered through a 20 μm mesh to obtain rotifers. Organisms are transferred to sample jars and preserved in Lugols solution (4%). In the laboratory, individual organisms are being be separated into major

taxonomic groups, counted, and measured using a digitizing pad. Densities are being calculated as the number of individuals per liter of water sampled.

Sampling Schedule: In 2012, sampling will occur at approximately two week intervals at all sites from April to October. Sampling may occur more frequently during periods when Asian carp eggs and larvae are likely to be present (e.g., during spring months, during periods of rising water levels, or shortly after peak flows).

Deliverables: Results of each sampling event will be reported for weekly sampling summaries. Data will be summarized for an annual interim report and project plans updated for annual revisions of the MRRP.

Young-of-Year and Juvenile Asian Carp Monitoring

Participating Agencies: IDNR (lead); INHS, USFWS, and USACE (field support)

Location: Sampling will take place in the Illinois River, Des Plaines River, and CAWS.

Introduction and Need: Bighead and Silver Carp are known to spawn successfully in larger river systems where continuous flow and moderate current velocities transport their semi-buoyant eggs during early incubation and development. Spawning typically occurs at water temperatures between 18 and 30ºC during periods of rising water levels. Environmental conditions suitable for Asian carp spawning may be available in the CAWS and nearby Des Plaines River, particularly during increasingly frequent flooding events.

Successful reproduction is considered an important factor in the establishment and long term viability of Asian carp populations. The risk that Asian carp will establish viable populations in Lake Michigan increases if either species is able to successfully spawn in the CAWS. Successful spawning in the upper Des Plaines River also could pose a threat because larval fish may be washed into the CSSC upstream of the dispersal barrier during extreme flooding. The transport of larvae to the CSSC can occur despite the installation of concrete barrier and fencing between the waterways because larval fish are small enough to pass through the ¼-inch mesh fencing used for the separation project. Whereas larvae washed into the CSSC likely would be transported downstream past the Dispersal Barrier during flooding, these fish might become established in the lower Lockport Pool and recruit to the juvenile life stage. This poses a threat because small fish <3.0 inches long might be capable of swimming upstream past the Dispersal Barrier at the current settings (Holliman 2011). An additional threat may occur if juvenile Asian carp from spawning events in downstream pools migrate to the Lockport Pool via navigation locks. Even though there has been no evidence of successful Asian carp reproduction in the CAWS, Des Plaines River, or upper Illinois River, targeting young-of-year and juvenile Asian carp in monitoring efforts is needed because these life stages may not be detected in conventional sampling geared toward adults.

Objectives: We will use multiple gears suitable for sampling small fish to:

1) Determine whether Asian carp young are present in the CAWS, lower Des Plaines River, and Illinois River; and
2) Determine the uppermost waterway reaches where young Asian carp are successfully recruiting.

Status: Sampling for young Asian carp as part of standard monitoring began in late summer 2010 and continued through 2011. Electrofishing protocols for fixed site monitoring upstream and downstream of the Dispersal Barrier were modified to include small fish sampling. Small mesh experimental gill nets (mesh sizes = 0.75-2.0 inches) and mini-fyke nets were added to the gear evaluation study and fished at several stations in the Illinois River, Des Plaines River, and CAWS. In addition, we used mini-fyke nets in combination with electrofishing and experimental gill nets during two fall sampling events in the Lockport Pool downstream of the Barrier. No young Asian carp were captured with any sampling gears upstream of Starved Rock

Lock and Dam. For more detailed results see 2011 interim summary report document (MRRWG 2012).

Methods: As in the past, 2012 sampling for young-of-year and juvenile Asian carp will take place through other projects of the MRRP. Projects included are Larval Fish and Productivity Monitoring, Fixed and Random Site Monitoring Upstream of the Dispersal Barrier, Fixed Site Monitoring Downstream of the Dispersal Barrier, Gear Efficiency and Detection Probability Study, and the Des Plaines River and Overflow Monitoring Project. Electrofishing protocols will include subsampling schools of small fish <6 inches long (typically gizzard shad) by netting a portion of each school encountered during each electrofishing transect. Netted small fish will be held in a holding tank and examined individually for the presence of Asian carp before being returned to the waterway. Keeping small fish tallies separate from larger fish will provide an estimate of the relative abundance of young Asian carp in each sample of small fish.

In addition to electrofishing, mini-fyke nets and small mesh experimental gill nets will be fished at several stations in the Illinois Waterway and CAWS (see Gear Efficiency Study) and mini-fyke nets will be fished at fixed sites downstream of the Dispersal Barrier (see Fixed Site Sampling Downstream of the Dispersal Barrier below). These gears will be set in shallower habitats off of the main navigation channel and fished for 1-2 net-nights. Mini-fyke nets will be incorporated into fixed site monitoring plans upstream of the barrier if successful spawning and recruitment of young Asian carp progresses up the waterway closer to Lake Michigan.

Additional sampling gears that target small fish, such as midwater trawls, purse seines, and cast nets are currently being evaluated. We will add new gears to our arsenal of sampling tools pending results and recommendations of current researchers. Some of these gears (push trawl and beach seine) will be used in targeted monitoring of Asian carp in tributaries and backwater habitats of the Illinois Waterway downstream of the Brandon Road Lock and Dam as part of a new study evaluating distribution and movement of small Asian carp (see Distribution and Movement of Small Asian Carp in the Illinois Waterway plan below).

Sampling Schedule: Small fish sampling will take place from March through November 2012, as part of other monitoring projects in the MRRP.

Deliverables: Results of each sampling event will be reported for weekly sampling summaries. Data will be summarized for an annual interim report and project plans updated for annual revisions of the MRRP.

Distribution and Movements of Small Asian Carp in the Illinois Waterway

Participating Agencies: USFWS - Carterville Fish and Wildlife Conservation Office (lead)

Location: Areas sampled will be within the Peoria, Starved Rock, Marseilles, and Dresden Island pools. Known populations of adult Asian carp exist in all pools of the Illinois Waterway (IWW) from Dresden Island downstream. Recent sampling has shown the farthest upstream extent of records of small Asian carp (≤ 300mm TL) in the Illinois River has been near the town of Henry, Illinois (Peoria County) at river mile 190 where young-of-year have been collected (LTRMP Data; MRRWG 2012). In the event that small Asian carp are found upstream of Dresden Island Pool, sampling will be extended upstream. Likewise, if small fish are not captured in Peoria Pool or above, sampling will be extended downstream into the LaGrange Pool in order to ensure that we meet the study objectives.

Introduction and Need: Asian carp populations, including the nonnative Silver Carp and Bighead Carp, are spreading throughout the Mississippi River Basin (Conover et al. 2007; Chapman and Hoff 2011; O"Connell et al. 2011). Kolar et al. (2007) rated the probability of Silver and Bighead Carp spreading to previously uncolonized areas as "high" and assigned this rating a "very certain" degree of certainty. Silver and Bighead Carp are invasive species that have been expanding their range in the U.S. since the early 1980"s when they first began to appear in public waters (Freeze and Henderson 1982; Burr et al 1996). Populations of Asian carp have grown exponentially because of their rapid growth rates, short generation times, and dispersal capabilities (DeGrandchamp 2003; Peters et al. 2006; DeGrandchamp et al. 2008). Asian carp have been shown to exhibit very high reproductive potential with high fecundity and the potential for a protracted spawning period (Garvey et al. 2006). Garvey et al. (2006) stated that high reproductive capacity of both species, in particular Silver Carp ensure that attempts to exclude or remove individuals will require a massive undertaking that targets young, small-bodied fish as well as adults.

Populations of Asian carp have become well established in the lower and middle reaches of the Illinois River. Because of the connection of the upper Illinois River waterway to Lake Michigan, natural resource managers are concerned about the potential invasion of Asian carp into the Great Lakes (Conover et al. 2007). If Bighead or Silver Carp gain entry into Lake Michigan they could pose a significant threat to fisheries by competing with established, economically and recreationally important species for limited plankton resources (Sparks et al. 2011). Kolar et al. (2007) noted that the most probable pathway for gaining access to the Great Lakes is through the CSSC. Therefore, the CSSC is also the key to stopping large numbers of carp from expanding their range into Lake Michigan and the Great Lakes (Conover et al. 2007).

At present a system of electric fish barriers operated by the USACE is intended to block the upstream passage of Asian carp through the CSSC. Laboratory testing has shown that the operational parameters currently in use at the barrier are sufficient to stop large bodied fish from passing through. However, the most recent testing of operational parameters using small Bighead Carp (51 to 76 mm total length) revealed that operational parameters may be inadequate for blocking small fish passage (Holliman 2011). For this reason there exists some concern that

small-sized Asian carp, if present, might represent a threat to breach the electric barrier. This highlights the need to better define the distribution and demographic characteristics of small Asian carp in the middle and upper IWW allowing us to fully characterize and assess the risk they may pose to the barriers. Additionally, there is an ongoing need to understand the reproduction of these species in the IWW so that managers might better target small sized fish for eradication or other management actions in the future.

The purpose of this study is to establish where young (young-of–year to age-2) Bighead and Silver Carp occur in the IWW through intensive, directed fish sampling which targets these life stages. For the purposes of this study, fish specimens less than 300mm total length will be considered "small fish" based on previously published estimates of age-1 and age-2 Bighead Carp (Shrank and Guy 2005). Sampling will employ the best known methods for detection and collection of Asian carp (Irons et al. 2011). Gears used will include small-mesh fyke nets, DC electrofishing, experimental gill nets, seines, and an experimental boat mounted push-trawl. The use of small-mesh fyke nets and boat electrofishing has been shown to provide complimentary information when employed in shallow water areas (Ruetz et al. 2007). In addition to traditional collection methods, we will implant small Bighead and Silver Carp with ultrasonic transmitters to allow monitoring of small to large-scale fish movements and gross habitat use.

Status: This is a new project for 2012.

Objectives:

1) Determine the relative distribution, abundance, and age structure of small Asian carp in the middle and upper Illinois Waterway;
2) Determine movement patterns of small Asian carp in the middle and upper Illinois Waterway; and
3) Combine distribution, abundance, and movement data to characterize the risk that small Asian carp pose to the Great Lakes via the Chicago Area Waterway System.

Methods:

Fish Capture

Site/Habitat Selection - Sites within each pool will be selected to maximize the likelihood of capturing small Bighead and Silver Carp. Sites selected will be in areas off of the navigation channel. These areas include backwaters, side channels, side channel borders, tributary mouths, and tributaries at points of fish passage barriers. Efforts will be made to sample all habitats available to small Asian carp, including areas inaccessible to traditional fisheries boats. Shallow backwaters and pools which are disconnected from the main channel except during flooding events are areas that Asian carp likely occupy but are rarely sampled effectively if at all. We are currently in the process of developing methods to use LTRMP Aquatic Area GIS layer data to calculate available area of habitat in each of the four pools and determine the amount of off channel habitat available for sampling.

Small Asian carp are known to ascend tributaries and aggregate below barriers to upstream passage (J. Stewart, USFWS, personal observation; R. Sauer, IDNR, personal communication). Asian carp are also known to aggregate near the mouths of tributary streams during high water

events (Tracy Hill, USFWS, personal communication). Tributary mouths and the lower reaches of tributaries will also be sampled. Within tributaries, we will attempt to identify barriers to Asian carp upstream movement (i.e., barrier presence), and sample the available habitat in the immediate area downstream of the barrier with appropriate gears for the habitat present. Tributaries of the IWW have a variety of physical characteristics which range from deeply incised mud banks and soft bottom substrates, to shallow, rock-bottom streams. Dams or other fish barriers can limit the upstream movement of fishes on numerous tributaries within the proposed study area of the IWW. These structures represent areas of potential Asian carp aggregations.

Sample site allocation will be determined randomly within appropriate habitat blocks and constitute an equal percentage of the available habitat in each pool as determined from analysis of remote sensing information. Final in-field site selection will be based on predetermined randomly selected locations but will be left ultimately to the discretion of the biologist in the field subject to the realities in the field (e.g. a randomly chosen site may be high and dry so an alternative nearby site would be chosen instead). The order in which each pool is sampled within and between sampling cycles will be randomized. We are in the process of determining the size (area of water covered) and number of sampling sites per pool.

Net Sampling - Standardized nets used at randomly selected locations will consist of ten to 20 mini-fyke nets (20-40 net nights) and 4 large frame fyke nets (8 net nights). Fyke nets will be set the morning of the first and second day of sampling and fished overnight for two nights. In addition to mini- and large-frame fyke nets, up to four small mesh experimental gill nets (1.3, 1.9, 2.5, 3.2, and 3.8 cm square mesh) will be deployed opportunistically in appropriate deeper water habitats (i.e. tributary mouths, deeper runs of tributaries, and deeper areas of backwaters). Use of gill nets at sites during this study will be optional and employed when the habitat(s) present warrants their use. In areas of appropriate habitats (wade-able depths with sufficiently firm substrate for seining), small meshed seines may be used to sample. Examples of habitats to be sampled by seining include shallow areas at barriers to upstream fish passage, disconnected wetland areas, or other areas inaccessible to boats. Seines will include 4.6 m x 1.8 m, 4.8 mm mesh straight seine, and a 9.1 m x 1.8 m, 4.8-mm mesh bag seine. Additional mini-fyke nets may also be fished opportunistically in areas adjacent to fish barriers or in isolated pools inaccessible to boats.

Electrofishing - Daytime DC boat electrofishing runs will be made (15 minute runs). All fish will be collected and at the end of each 15 minute run fish will be processed. We are in the process of determining the number of electrofishing runs to be done per sampling location.

Push-Trawl Sampling - In appropriate habitats, a boat mounted push-trawl will be used to sample shallow waters. Sampling effort will be quantified by length of trawl haul and number of hauls. Quantification of catch-per-unit-effort (CPUE) will be the number of individuals per species per square meter trawled. Target lengths of trawl hauls will be between 25 and 100 meters but will vary with the amount of fishable habitat present at a given location. The push-trawl employed has a skate balloon trawl net of 4 mm mesh, 1.8 m body length, 0.76 x 0.38 m otter boards, 2.4 m foot rope, and an effective net fishing width 1.8 m across. We are in the process of determining the number of push-trawl runs to be done per sampling location.

Fish Identification and Archiving - All sampled fish other than Bighead and Silver Carps will be identified to species, enumerated and all live native fish will be released. Large collections of small-bodied fishes will be preserved and returned to the laboratory for identification and enumeration. All Asian carp captured and not implanted with transmitters will be identified, measured for total length (mm), weighed to the nearest gram, and destroyed or given to researchers for aging, or other life history data collection. A subsample of small Asian carp specimens will be preserved as vouchers and retained to provide a permanent physical, geographic, and temporal record. Vouchers of any additional exotic species collected will be preserved for archiving. Exotic fish species not preserved for voucher specimens will be destroyed. Voucher specimens of all exotic species will be deposited into one or more fish collections (SIUC, INHS, and FMNH).

Asian Carp Aging and Natal Water Determination - Postcleithrum bones and lapilli otoliths will be removed from a subsample of Asian carp collected from each site. Postcleithral bones and otoliths from up to 30 fish will be removed, placed in individually marked envelopes and returned to the lab for ageing. Postcliethral bones will be sectioned with a Buhler isomet low speed saw and aged under a dissecting microscope. Lapilli will be embedded in thermoplastic resin, lightly sanded with 1000 grit sandpaper and read using a compound microscope. Two independent readers will make ring counts and a third reader will resolve disagreements between readers. In addition to ageing, a subset of otoliths will be provided with all collection data to Dr. Gregory Whitledge at Southern Illinois University at Carbondale for stable isotope analysis of fish natal origin.

Habitat Measurements – Macro habitat information will be recorded for each sampling location (e.g. backwater, side channel border, tributary mouth). Physical and chemical habitat measurements will be made at each collection site. Habitat measurements will be recorded at the time of each net retrieval, electrofishing run, push trawl run, or seine haul. Global Positioning System (GPS) coordinates will be recorded for all net sets, beginning and end of electrofishing runs, beginning and end of push trawl runs, and locations of seine hauls. Physical measurements will include: depth, Secchi depth, and substrate composition (i.e. mud, sand, silt, vegetation, gravel, etc.). Water quality measurements will include: temperature, salinity, specific conductance, dissolved oxygen, and pH. Water quality measurements will be taken with a Hydrolab Quanta analytical instrument. Water movement will be measured at each location using a Marsh-McBirney model 2000 Flo-Mate portable flowmeter. Thickness of the organic sediment layer will be measured by pushing a meter stick into the sediment to the bottom of the soft organic layer and recording this depth (Nelson et al. 2009)

Fish Sampling Frequency and Effort – Sampling will be conducted on an eight-week cycle. Each pool will be sampled with mini-fyke and large frame fyke nets and electrofishing for four days per eight-week cycle from June to November for a total of three sampling periods per pool or 12 total sampling efforts. The Peoria and Starved Rock pools will receive a full four days of sampling per cycle and the Marseilles and Dresden Island pools will be sampled during the same week in each sampling cycle (1/2 the sampling sites in the upstream pools as the two downstream ones). Sampling may extend into December if conditions and catch characteristics require. Push trawl sampling will be done during one week per sampling cycle and will consist

of one day of push trawling per pool. One week per sampling cycle will be devoted to sampling below fish barrier sites in tributary streams. Mobile telemetry tracking will be done one to two times (one to two weeks) per sampling cycle as time and availability of tagged fish permits.

Fish collection sampling effort per pool by gear type at each site is broken down as follows:

Gear Type	Location	Sampling frequency	Sampling Duration
Mini-fyke net	All	Every 8 weeks	2 nights
Large- fyke net	All	Every 8 weeks	2 nights
DC electrofishing	All	Every 8 weeks	2 days
Exp. push-trawl	All	Every 8 weeks	1 days
Exp. gill nets	Deep water areas	As needed	Variable as needed
Seines	Fish barriers/ isolated pools	As needed	Variable as needed

Telemetry

Ultrasonic Transmitter Tagging - During the course of fish sampling, all equipment necessary to implant fish with ultrasonic transmitters will be maintained in a ready state with the field crew. When small Asian carp of sufficient health and weight are encountered they will be surgically implanted with ultrasonic transmitters (Vemco, Model V7-4L; 69 kHz, 7 mm diameter, 22.5mm long) for remote individual identification. V7-4L transmitters have a 138 day battery life. Each transmitter will be tested for recognition prior to its use with a portable hydrophone and receiver (Vemco Model VH110-10M and Vemco Model VR100, respectively). Fish to be tagged will be held in a holding tank with fresh oxygenated water. They will be anesthetized using a solution of clove oil (approximately 40ml/l of holding water) and will be implanted with transmitters according to surgical procedures described by Summerfelt and Smith (1990). During surgery, fish gills will be constantly irrigated with oxygenated water containing the anesthetizing solution. Following surgery, fish will be measured for total length (mm) and weight (g), placed in a container of fresh, oxygenated water and allowed to revive before release at or near the site of capture.

Stationary Telemetry Receivers - The remote ultrasonic receivers placed in the Illinois River will be a component of the larger telemetry array that is currently being expanded to span the length of the main stem Illinois River system. Fishery researchers with Southern Illinois University Carbondale and the US Army Corp of Engineers are currently using VEMCO transmitters and receivers throughout the Illinois River (Wes Bouska, SIUC, personal communication). Additional VR2 stationary receivers will be deployed strategically along the middle and upper IWW as Asian carp specimens are implanted and released back into the wild (e.g. additional VR2 receivers can be deployed between existing SIUC or USACE receivers to increase coverage density). Data gleaned from stationary receivers will provide information on gross movements of tagged fish including detection of any movements through lock and dam facilities. Data will be downloaded every sampling cycle in conjunction with mobile telemetry sampling. Additional downloads may become available from other researchers doing adult Asian carp telemetry in the area.

Mobile Telemetry - Mobile telemetry will be performed in order to determine gross habitat usage by tagged fish. Mobile telemetry will occur one to two times per sampling cycle after implanted fish are released. One week of effort will be allotted for finding all fish with transmitters per sampling cycle (two weeks if time permits). Tagged fish will be located as closely as possible using mobile telemetry and GPS coordinates. Physicochemical habitat parameters will be measured as previously described at the sites tagged fish are located.

Data Analyses

Descriptive statistics such as presence/absence and mean counts from fish capture data will be presented. Graphs of raw numbers of Asian carp caught using the different gear types will be used to determine which method is most effective at capturing small fish. Chemical/physical variables will be summarized at each site using principal components analysis (PCA). The PC scores will be plotted on a PCA bi-plot and the scores labeled by pre-assigned categories related to Asian carp (zero carp, low carp, med carp, high carp). Fish capture data will be used to determine if certain environmental conditions are associated with their presence/absence or relative abundance. Fish age data will be presented graphically.

Non-metric multidimensional scaling (NMDS) will be used to examine variation in adult fish assemblage structure (i.e., species abundance) among sites with and without Asian carp using Primer-E LTD software (Clarke and Gorley 2001). NMDS is used to analyze assemblages by producing an ordination plot that shows the relative differences in assemblage structure between sample pairs, where pairs with a larger dissimilarity are further apart on the ordination diagram (Minchin 1987; Clarke 1993). Analysis of similarity (ANOSIM) will be used to test for significant differences in assemblage structure among sites with and without Asian Carp. Global R is the test statistic for ANOSIM, which ranges from 0 to 1. Values of zero indicate overlapping assemblages that do not differ, while values of 1 indicate differing structure and assemblages that can be distinguished from one another (Clarke and Gorley 2001).

A series of descriptive statistics of fish movement, including the distance travelled and the bearing between locations, will be calculated from telemetry data to determine basic movement patterns and assess habitat selection by Asian carp. A formal risk assessment of small fish crossing the electric barrier will be considered and may be performed based on the results of small Asian carp distribution and abundance data generated by this study.

Sampling Schedule:

March - May 2012
Gear acquisition, field logistics planning, field crew scheduling, preliminary field assessment of methods

June 2012
Initiation of field sampling

June - November 2012
Bimonthly field sampling, fish identification in lab, laboratory otolith and postcleithrum processing and aging, telemetry data analysis, data entry, fish data analysis

December 2012
Complete fish identification and aging of otolith and postcleithrum

January-March 2013
Final data analyses and draft annual report generation

Deliverables: Results of each sampling event will be reported for weekly sampling summaries. Data will be summarized for an annual interim report and project plans updated for annual revisions of the MRRP. Any findings of small carp in areas significantly upstream towards the barrier will be reported immediately to Todd Turner, USFWS Assistant Regional Director-Fisheries or Charlie Wooley, USFWS Deputy Regional Director - Region 3, and the MRRWG.

Fixed Site Monitoring Downstream of the Dispersal Barrier

Participating Agency: IDNR (lead); USACE (field support)

Location: Monitoring will take place in the CSSC, lower Des Plaines River and upper Illinois River. Specifically, we will sample the Lockport Pool downstream of the Dispersal Barrier, the Brandon Road Pool, the Dresden Island Pool from Brandon Road Lock and Dam downstream to 0.25 miles south of the I-55 Bridge, and Marseilles Pool from Dresden Island Lock and Dam downstream to Peacock Slough.

Introduction and Need: Standardized sampling can provide useful information to managers tracking population growth and range expansion of aquatic invasive species. Information gained from regular monitoring (e.g., presence, distribution, and population abundance of target species) is essential to understanding the threat of possible invasion upstream of the Dispersal Barrier. For this project, we use DC electrofishing and contracted commercial netters to sample for Asian carp in the four pools below the Dispersal Barrier. A goal of this monitoring effort is to identify the location of the detectable population front of advancing Asian carp in the Illinois Waterway and track changes in distribution and relative abundance of leading populations over time. The detectable population front is defined as the farthest upstream location where multiple Bighead or Silver Carp have been captured in conventional sampling gears during a single trip or where individuals of either species have been caught in repeated sampling trips to a specific site. Monitoring data from 2010 and 2011 have contributed to our understanding of Asian carp abundance and distribution downstream of the Dispersal Barrier and the potential threat of upstream movement toward the CAWS.

Objectives: Standardized sampling will consist of DC electrofishing, contracted commercial netting, hoop nets and mini-fyke nets to:

1) Monitor for the presence of Asian carp in the four pools below the Dispersal Barrier;
2) Determine relative abundance of Asian carp in locations and habitats where they are likely to congregate;
3) Supplement Asian carp distribution data obtained through other projects (e.g., Asian Carp Barrier Defense Project); and
4) Obtain information on the non-target fish community to help verify sampling success, guide modifications to sample locations, and assist with detection probability modeling and gear evaluation studies.

Status: This project began in 2010 and is on-going. Samples were taken at four fixed sites in each of the four pools once monthly from April through November 2010 and March through November 2011with DC electrofishing gear and July through September 2010 and April – November 2011 with trammel and gill nets. In total, 2,515 estimated person-hours of labor were expended to complete 58.5 hours of electrofishing and deploy 46.6 miles of trammel/gill net over the two years. No Bighead or Silver Carp were captured by electrofishing or netting in Lockport and Brandon Road pools, although one adult Bighead Carp was observed in Brandon Road Pool by a net crew in October 2011. Monitoring indicated higher abundance of Bighead and Silver Carp in Marseilles Pool than Dresden Island Pool. For more detailed results see 2011 interim summary report document (MRRWG 2012).

Methods: The sample design includes intensive electrofishing and netting at four fixed sites in each of the four pools below the Dispersal Barrier (Figure 6). Sampling will take place monthly from March through November. No sampling at fixed sites is planned for December, January, and February because several of the sites are typically ice covered during these months. The fixed sites in each of the four pools are located primarily in the upper ends below lock and dams structures, and in habitats where Asian carp are likely to be located (backwaters and side-channels).

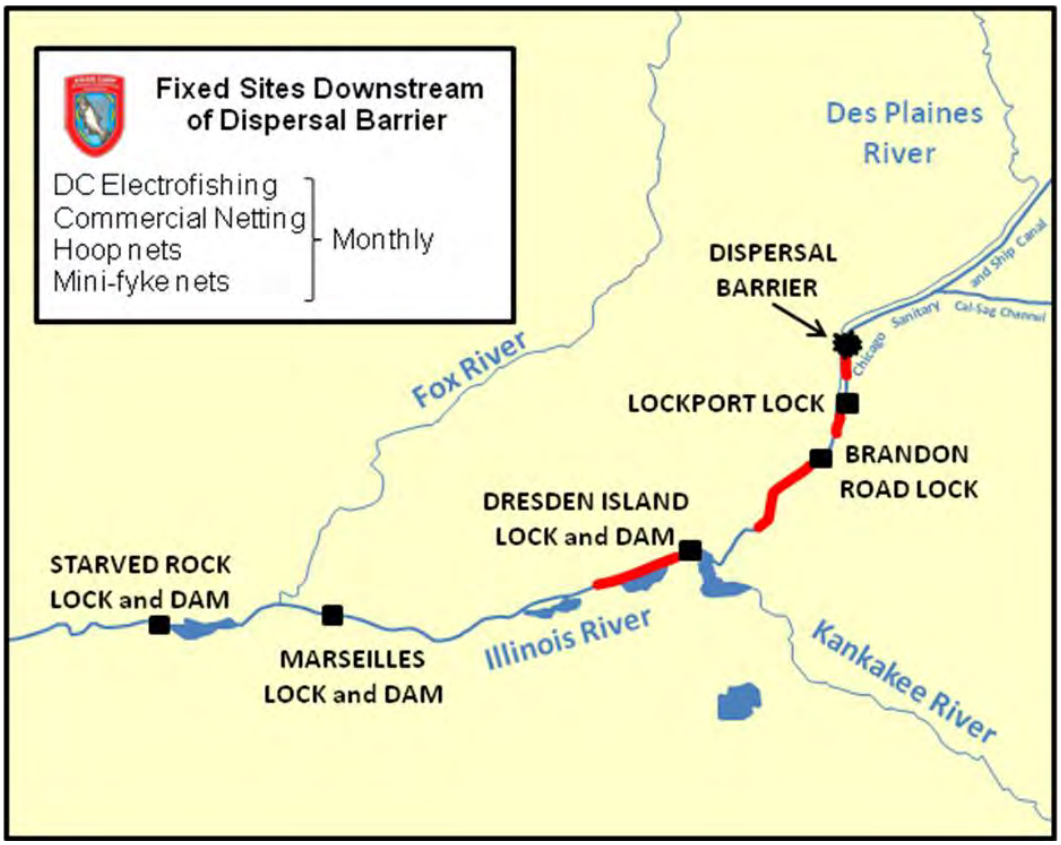

Figure 6. Map of fixed sites for electrofishing and commercial net sampling for Asian carp downstream of the Dispersal Barrier.

Fixed Sites Downstream of the Dispersal Barrier Description and Effort: A description of fixed site locations and sampling effort targets is summarized below. There are four (4) 15 minute electrofishing runs, four (4) 200-yard trammel/gill net sets, eight (8) hoop net nights with 6-foot diameter hoop nets, and four (4) mini-fyke net nights planned for each of the four pools. Hoop and mini-fyke nets will be deployed at or near trammel/gill net sites. See Appendix B for detailed maps of each site.

Lockport Pool

- 1E1 starts at the Romeo Road Bridge on the east side of the canal and goes downstream
- 1E2 starts at the north end of the large haul slip of Hanson Material Services on the west side of the canal and goes downstream

- 1E3 starts at the upstream end of the MWRD Controlling Works and goes downstream
- 1E4 starts at the Rt. 7 Bridge on the west shore and goes downstream

- 1G1 is in the big haul slip of Hanson Material Services.
- 1G2 is upstream of Rt. 7 Bridge on the west side of the canal
- 1G3 is just downstream of the Rt. 7 Bridge on the west side of the canal
- 1G4 is just downstream of Cargill Grain Elevator on the west side of the canal

Brandon Pool

- 2E1 is in the bay below the Lockport Hydropower Plant
- 2E2 starts just above the confluence of the CSSC and Des Plaines River and goes downstream
- 2E3 starts just above the confluence of the Des Plaines River and the Illinois Michigan Canal and goes up the canal
- 2E4 starts at the I-80 Bridge and goes downstream along the east shore

- 2G1 just downstream of the confluence of the Des Plaines River
- 2G2 at the confluence of the Illinois Michigan Canal
- 2G3 just downstream of I-80 on the east shoreline
- 2G4 between I-80 and the Brandon Road Lock & Dam

Dresden Island Pool

- 3E1 in the bay on east side of river below the Brandon Road Dam
- 3E2 starts at the lower end of Treats Island and goes up into the side channel
- 3E3 is in Mobil Oil Corporation Cove
- 3E4 starts at I-55 Bridge on southeast shoreline and goes downstream

- 3G1 is in the bay on east side of river below the Brandon Road Dam
- 3G2 downstream of the casino on the west side of the river
- 3G3 in the lower end of the Treats Island side channel
- 3G4 is in Mobil Oil Corporation Cove

Marseilles Pool

- 4E1 along the west side of Big Dresden Island
- 4E2 along the east shoreline across form Big Dresden Island
- 4E3 at the back end of the north portion of Peacock Slough
- 4E4 is the south portion of Peacock Slough

- 4G1 is just upstream of the mouth of Aux Sable Creek
- 4G2 is at the mouth of the Commonwealth Edison Co. Cove
- 4G3 is just inside the north portion of Peacock Slough
- 4G4 is in the back of the south portion of Peacock Slough

Electrofishing Protocol - All electrofishing will use DC current and include 1-2 netters (two netters preferred). Locations for each electrofishing transect will be identified with GPS

coordinates. Electrofishing transects should begin at each coordinate and continue for 15 minutes in a downstream direction in waterway channels (including following shoreline into off channel areas) or in a clockwise direction in backwater sloughs. Fixed site sampling locations will remain the same throughout the year and should be sampled repeatedly with each site visit. This represents a change from past years when exact sampling areas within the sites were left to the discretion of the field crews and should lead to more consistent monitoring results.

While electrofishing, operators may switch the safety pedal on and off at times to prevent pushing fish in front of the boat and increasing the chances of catching an Asian carp. Common Carp will be counted without capture and all other fish will be netted and placed in a tank where they will be identified and counted, after which they will be returned live to the water. Periodically, a subsample of 10 fish of each species per site will be measured in total length and weighed to provide length-frequency data for gear evaluations. Schools of young-of-year gizzard shad <6 inches long will be subsampled by netting a portion of each school encountered and placing them in a holding tank along with other captured fish. Young-of-year shad will be examined closely for the presence of Asian carp and counted to provide an assessment of young Asian carp in the waterway. We will count all captured Asian carp, as well as those observed but not netted. We may observe more Asian carp than we net because of the difficulty in capturing these fish with electrofishing gear. Sample data sheets are included in Appendix F. Crew leaders should fill in as much information on the data sheets as possible for each station/transect and record the location for the start of each run either with GPS coordinates (decimal degrees preferred) or by marking on attached maps.

Netting Protocol – Contracted commercial fishers will be used for net sampling at fixed sites and nets used will be large mesh (3.0-4.0 inches) trammel or gill nets 8-10 feet high and in lengths of 200 yards. Locations for each net set will be identified with GPS coordinates. Net sets will take place within 500 yards of a designated coordinate at a specific location agreed upon by the commercial fisher and attending IDNR biologist. Sets will be of short duration and include driving fish into the nets with noise (e.g., plungers on the water surface, pounding on boat hulls, or racing tipped up motors). In an effort to standardize netting effort, sets will be 15-20 minutes long and "pounding" will extend no further than 150 yards from the net. Nets will be attended at all times. Captured fish will be identified to species and tallied on standard data sheets. Periodically, a subsample of 10 fish of each species per site will be measured in total length and weighed. Locations of net sets should be recorded with GPS coordinates (decimal degrees preferred) or by marking on attached maps. An IDNR biologist or technician will be assigned to each commercial net boat to monitor operations and record data.

Single hoop nets will be deployed by IDNR biologists at four locations in each pool, where they will be fished for two days each month. Specific set locations will vary, but nets typically will be set offshore, in current, and parallel to the navigation channel. The INHS has reported success catching Asian carp with hoop nets set just outside the navigation channel at the top of channel drop-offs during the gear evaluation study, so these areas will be targeted during fixed site hoop netting. Four mini-fyke nets will be set at four locations in each pool and fished for one net-night per month. Mini-fyke nets will be set in shallow off-channel areas with leads affixed to the shoreline and running perpendicular to shore. Though hoop and mini-fyke nets

will be left unattended, care will be taken to set them in locations that will not interfere with commercial navigation or recreational boat traffic.

Suggested boat launches for fixed site sampling.
Lockport Pool – Cargill Launch – Inform Martin Castro of MWRD.

Brandon Road Pool –Ruby Street Launch in Joliet on the west side of the river.

Dresden Island Pool – Big Basin Marina under the I-55 Bridge on north side of the river. Contact Russ to get let in without paying. If you have to pay you can take the receipt to Office to get reimbursed.

Marseilles Pool – Stratton State Park Launch in Morris on the north side of the river.

Sampling Schedule: A tentative sampling schedule for electrofishing and netting for 2012 is shown in the table below. Hoop and mini-fyke netting will occur monthly either the week before or after the week of scheduled electrofishing and netting.

Week of	Electrofishing	Week of	Netting
Mar 19	IDNR/USACE	Mar 26	IDNR
Apr 23	IDNR/USACE	Apr 30	IDNR
May 14	IDNR/USACE	May 21	IDNR
Jun 18	IDNR/USACE	Jun 25	IDNR
Jul 16	IDNR/USACE	July 23	IDNR
Aug 13	IDNR/USACE	Aug 20	IDNR
Sep 10	IDNR/USACE	Sep 17	IDNR
Oct 15	IDNR/USACE	Oct 22	IDNR
Nov 12	IDNR/USACE	Nov 19	IDNR

Deliverables: Results of each sampling event will be reported for weekly sampling summaries. Data will be summarized for an annual interim report and project plans updated for annual revisions of the MRRP.

Rapid Response Actions in the CAWS

Participating Agencies: IDNR (lead); INHS, USFWS, and USACE (field support), USCG (waterway closures when needed), USGS (flow monitoring and dye tracking when needed), MWRD (waterway flow management and access), USEPA and GLFC (project support)

Location: Rapid response removal actions will take place in the CAWS upstream of Lockport Lock and Power Station.

Introduction and Need: Preventing Asian carp from gaining access to Lake Michigan via the CAWS requires monitoring to detect and locate potential invaders and removal efforts to reduce population abundance and the immediate risk of invasion. Removal actions that capture or kill Asian carp once their location is known may include the use of conventional gears (e.g., electrofishing, nets, and commercial fishers), chemical piscicides (e.g., rotenone), or both strategies. Decisions to commence removal actions, particularly rotenone actions, often are difficult due to high labor, equipment, and supply costs. Furthermore, a one-size-fits-all formula for rapid response actions is not possible in the CAWS because characteristics of the waterway (e.g., depth, temperature, water quality, morphology, and habitat) are highly variable. In this plan, we present a threshold framework for response actions with conventional gear or rotenone. The proposed thresholds are meant to invoke consideration of removal actions by the MRRWG, and are not intended to be rigid triggers requiring immediate action. The final decision to initiate a rapid response action and the type and extent of the action ultimately will be based on the best professional judgment of representatives from involved action agencies.

Objectives: The plan objectives are:

1) Remove Asian carp from the CAWS upstream of Lockport Lock and Power Station when warranted; and
3) Determine Asian carp population abundance through intense targeted sampling efforts at locations deemed likely to hold fish.

Status: Actions to capture and remove Asian carp from the CAWS began in February 2010 and will continue as needed. This past year, we completed one removal actions with conventional gears in Lake Calumet after three consecutive eDNA sampling events yielded positive detections for Silver Carp DNA. Sampling effort combined across all actions during 2010 and 2011 included 9757 estimated person-hours to complete 183 hours of electrofishing, 31.8 miles of trammel or gill net four 800-foot commercial seine hauls, and treatment of 173 acres (2.6 miles) of river with rotenone. For more detailed results see 2011 interim summary report document (MRRWG 2012).

Methods: We will use conventional gears and/or rotenone to capture and remove Asian carp from the CAWS upstream of Lockport Lock and Power Station, and eDNA testing to inform decisions regarding the success of removal efforts and when individual actions should be terminated. Each response action will be unique to location, perceived severity of the threat, and likelihood of successfully capturing an Asian carp. For example, consecutive positive DNA detections at the shallow North Shore Channel might elicit a 2- to 3-day conventional gear response with two electrofishing and netting crews. Capture of a live Asian carp at the same

location might initiate a 2-week response with 5-10 sampling crews and additional types of gear. Furthermore, capture or credible observations of multiple Bighead or Silver Carp in a deep-draft channel, such as the Little Calumet River below O"Brien Lock, might call for an emergency rotenone action to eradicate the local population. In general, small-scale removal actions will require fewer sampling crews and gear types than larger events, although all events will include multiple gears for more than one day of sampling and participation by commercial fishers, if available.

New methods to drive, capture, and kill Asian carp are constantly being developed and evaluated as part of the ACRCC Framework (see water gun, gear evaluation, and alternative gear projects in this plan and pheromone research outlined in the 2012 Framework). Such techniques may allow biologists to drive or attract Asian carp to barge slips or other backwater areas where they can be captured more easily or killed. We will incorporate new technologies in rapid response actions when they have been sufficiently vetted and shown to be of practical use.

Threshold Framework-The proposed thresholds for response actions with conventional gears and rotenone apply to monitoring efforts in the CAWS upstream of Lockport Lock and Power Station. Again, this threshold framework is meant to inform decisions to initiate response actions and guide the level of sampling effort put forth during such actions. Actual decisions to respond and the type, duration, and extent of response actions will be made by agency representatives with input from the MRRWG. Action agencies also may conduct targeted response actions at selected locations in the CAWS outside the rapid response threshold framework when information gained from such actions may benefit monitoring protocols, research efforts, or Asian carp removal and control efforts..

The framework includes three levels of response triggers and a feedback loop that advises for continued sampling or an end to the action (Figure 7). The first threshold level (Level 1) includes either three consecutive eDNA sampling events with positive detections for Bighead Carp, Silver Carp, or both species, or the observation of live Asian carp by a credible source (i.e., fisheries biologist or field technician). A suggested response for Level 1 might include 2-4 electrofishing boats and crews and 1-2 commercial fishing boats and crews sampling for 2-3 days. A Level 2 threshold would include the capture of a single live Bighead or Silver Carp. A Level 2 response might employ 4-6 electrofishing boats and crews, 3-5 commercial fishing boats and crews, and additional gears (e.g., hydroacoustics, commercial seines, and trap or fyke nets). Level 2 events might last up to 10 days. The capture of two or more Asian carp from a single sampling event-location or the credible observation of two or more Asian carp at one location would signify a Level 3 threshold. Crossing the Level 3 threshold would trigger an immediate Level 2 conventional gear response action and consideration of a rotenone response. Where feasible (e.g., non-navigation reaches, barge slips, backwater areas), block nets will be used in an attempt to keep Asian carp in the area being sampled. Collecting water samples for eDNA analysis at the completion of each response action will determine whether Asian carp eDNA is still present in the targeted sampling area and inform decisions to continue sampling or terminate the response. The final decision to terminate a response will rely on best professional judgment of participating biologists, managers, and agency administrators.

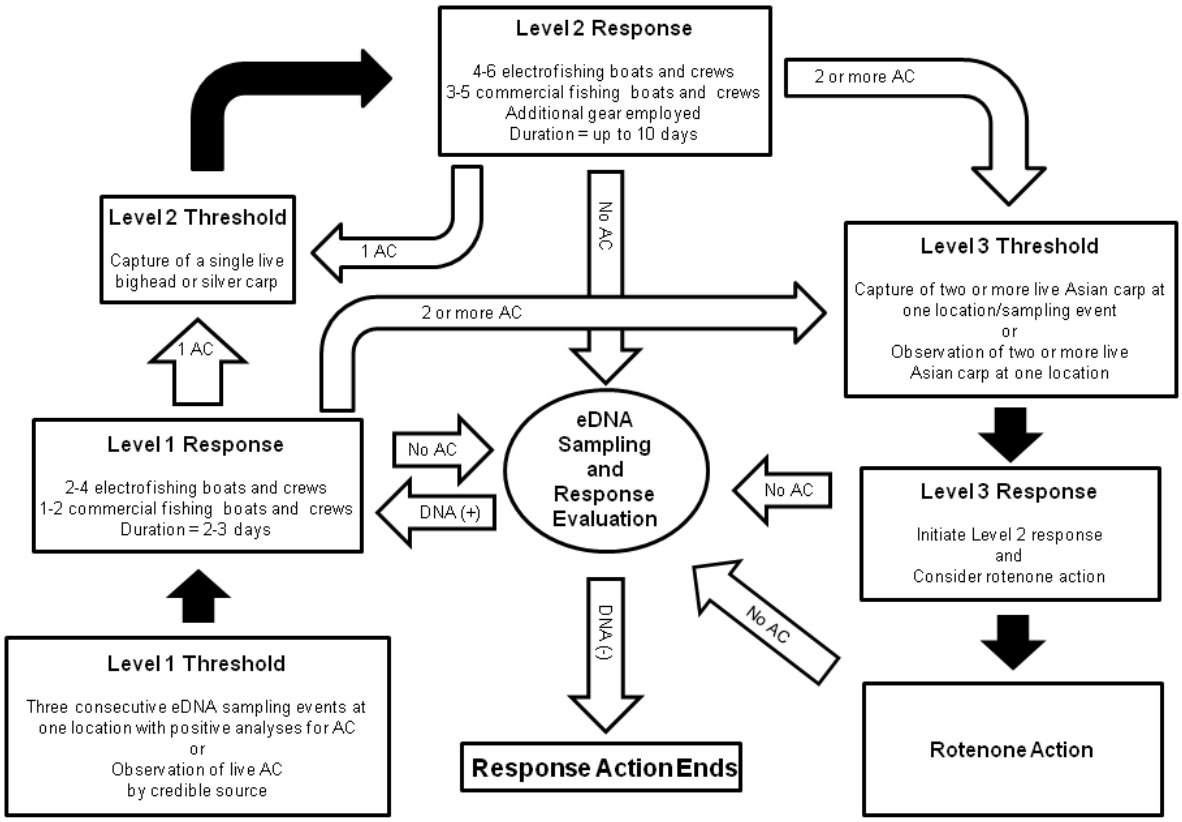

Figure 7. Thresholds for Asian carp (AC) response actions with conventional gears and rotenone.

Sampling Schedule: It is not possible to provide a detailed sampling schedule for this project because removal actions are dependent upon results of conventional gear and eDNA monitoring and recommendations of the MRRWG.

Deliverables: Results for each removal action will be reported daily during events and compiled for weekly sampling summaries. Data will be summarized for an annual interim report and project plans updated for annual revisions of the MRRP.

Barrier Maintenance Fish Suppression

Participating Agencies: IDNR (lead); SIUC, WIU, INHS, USFWS, USACE and USGS (field support); USCG, USEPA and MWRD (project support)

Location: Sampling to assess abundance of Asian carp may take place in the Lockport Pool of the CSSC between Lockport Lock and Power Station and the Dispersal Barrier (RM 291.0-296.1). Fish clearing with water guns and surveillance with split-beam hydroacoustics, side scan sonar, and DIDSON will occur between the Romeo Road Bridge and the arched overhead pipe at the upstream boundary of the barrier zone. The work area will be extended about 0.25 miles in both upstream and downstream directions if a backup rotenone action is necessary to allow for chemical application and detoxification stations.

Introduction and Need: The USACE operates three electric aquatic invasive species barriers (Barrier 1, 2A and 2B) in the CSSC at approximate river mile 296.1 near Romeoville, Illinois. Barrier 1 (formerly the Demonstration Barrier) is located farthest upstream (about 800 feet above Barrier 2B) and is operated at a setting that has been shown to repel adult fish. Barrier 2A is located 220 feet downstream of Barrier 2B and both of these barriers now operate at parameters that have been shown to repel fish as small as 3.0 inches long in the laboratory (Holliman 2011). Barrier 2A and 2B must be shut down for maintenance approximately every 6 months and the IDNR has agreed to support maintenance operations by providing fish suppression at the barrier site. Fish suppression can vary widely in scope and may include application of piscicide (rotenone) to keep fish from moving upstream past the barriers when they are down. This was the scenario for a December 2009 rotenone operation completed in support of Barrier 2A maintenance and before Barrier 2B was constructed. With Barrier 2A and 2B now operational, fish suppression actions will be smaller in scope because one barrier can remain on while the other is taken down for maintenance.

Barrier 2B has been designated the primary barrier in the electrical barrier system and it is operational most of the time. In contrast, Barrier 2A is typically held in warm standby mode until it is needed. With this barrier operation protocol, IDNR will lead fish surveillance and suppression at the barrier whenever Barrier 2B is scheduled for maintenance or if Barrier 2B shuts down unexpectedly due to mechanical or electrical problems. Fish suppression is necessary because, based on 2 years of conventional fish sampling and eDNA monitoring in the CAWS upstream and downstream of the Dispersal Barrier, there is a strong possibility that Asian carp could be present in this reach of the waterway, potentially even immediately below Barrier 2B. If this is the case, when Barrier 2B is powered down for maintenance or loses power, any Asian carp immediately below Barrier 2B could move upstream with only the original demonstration barrier between the fish and Lake Michigan. This creates an unacceptable level of risk that Asian carp could gain access to the upper CAWS and Lake Michigan, and reduces the redundancy that is considered an essential feature of the entire barrier system. The intent is to drive fish below Barrier 2A, which would then be brought online and would serve as the primary barrier until Barrier 2B maintenance activities are completed and it resumes normal operations.

Following is a generalized plan to provide fish suppression at the barriers in support of Barrier 2B maintenance. Operations to clear fish may take from 1-5 days and will include physical fish driving techniques and, if necessary, a small-scale rotenone action. We also include a plan for intensive fish sampling to detect presence and assess abundance of any Asian carp juveniles and adults that may be in the canal immediately downstream of the barrier.

Objectives: The IDNR will work with federal and local partners to:

1. Assess the need for fish suppression actions at the barriers through surveillance with split-beam hydroacoustics, side scan sonar, and DIDSON imaging sonar;
2. Eliminate fish from between barriers prior to maintenance operations or after an unintentional shutdown of Barrier 2B by driving fish from the area with water guns, increased flows induced by a canal drawdown, or if needed, a small-scale rotenone action; and
3. Conduct intensive sampling to assess abundance of Asian carp juveniles and adults in the CSSC between the electric barriers and Lockport Lock and Power Station, when standard monitoring detects their presence in the Lockport Pool downstream of the barriers.

Status: Fish suppression in support of barrier maintenance began in 2009 and is on-going. A multi-agency fish clearing action occurred during October 2011. Water guns were used to successfully clear fish from the between-barrier area allowing barrier 2A to be energized and Barrier 2B to be taken down for maintenance. During fall 2010 and before fish clearing operations, we completed two intensive 3-day sampling events in the Lockport Pool downstream of the Dispersal Barrier. Sampling gears included DC electrofishing, trammel nets, experimental gill nets, mini-fyke nets, mid-water trawl, purse seine, tandem trap nets and hydroacoustics imaging. No adult or juvenile Bighead or Silver Carp were captured or observed during either event. For more detailed results of fish clearing and sampling relative to barrier maintenance see the 2011 interim summary report document (MRRWG 2012) and the Monitoring Asian Carp Population Metrics and Control Efforts plan below.

Methods:

Project Overview – Our current approach to fish suppression at the barrier is to first survey the area with remote sensing gears to assess the need for fish clearing operations either to support barrier maintenance or after an unplanned power loss at Barrier 2B. If fish of a certain size are present (currently >12 inches long although this could change with perceived risk of juvenile presence), then we will use pneumatic water guns to drive fish from the area and, if needed, a canal drawdown to increase current velocity over the barriers and enhance chances of clearing fish. If mechanical clearing fails, we will invoke a small-scale rotenone to clear fish from the area. Finally, we include a plan for intensive sampling in the Lockport Pool downstream of the barrier as a measure of the risk that Asian carp might pass the barrier during maintenance and a gauge of the level of fish suppression activities needed to eliminate the possibility of upstream fish passage.

Remote Sensing and Mechanical Clearing Operations- Surveys will be conducted with split beam hydroacoustics, side scan sonar, and DIDSON to determine if fish are present in the target area and to evaluate the success of physical fish clearing actions. Clearing will be considered successful when no fish larger than 300 mm (12 inches) are observed between the barriers, after

which Barrier 2B can be taken down for maintenance. By selecting a cut-off of 300 mm, we will be targeting sub adult and adult Asian carp, and excluding young-of-year fish. Excluding young-of-year Asian carp from the assessment is appropriate because there is no indication of their presence in the Lockport Pool based on 2+ years of sampling and the known location of spawning adults (i.e., downstream of Starved Rock Lock and Dam; see 2011 interim report document for more detailed information). Additionally, eggs, larvae, or young-of-year have not been observed upstream of Starved Rock Lock and Dam in the past decade. Our approach may be considered conservative because sub adult and younger Asian carp have never been captured upstream of the Marseilles Pool.

Multiple surveys are necessary to enhance confidence in results that fish are either present or absent from the area between the barriers. The principal remote sensing tools are split-beam hydroacoustics and side scan sonar. These gears are operated simultaneously and provide about 98% coverage of the waterway with just three passes of the barrier area (10- to 15-minute survey duration; see 2011 Barrier Maintenance Fish Suppression final report in MRRWG 2012). Portions of the water column not viewed with these gears (e.g., immediately below water surface and against canal walls and areas where the canal wall is broken and eroded away) will be surveyed with DIDSON imaging sonar. The DIDSON also will be used to verify that images identified on other sonar are actually fish and not stationary objects or interference. Total time required to complete a single set of surveys and process the data is about 60-75 minutes.

During a typical maintenance shutdown, we will first ask USACE to power up Barrier 2A so that both barriers are operating simultaneously and then conduct the first surveys with all three remote sensing gears. The detection of fish >12 inches long in the target area will initiate mechanical suppression actions. Mechanical suppression will include driving fish downstream out of the between-barrier area with pneumatic water guns. Testing of the effects of water guns on canal walls and equipment was completed during 2011 (for more details see Water Gun Development and Testing report in MRRWG 2012). Figure 8 provides a map and description of a mechanical fish clearing operation at the Dispersal Barrier.

A second set of surveys will occur after mechanical removal operations have taken place with both barriers operational to assess the effectiveness of mechanical removal efforts. It is beneficial to have low flow conditions during remote sensing surveys to reduce interference to hydroacoustics scans caused by air bubbles entrained in the water column. Operators at MWRD have been helpful in modifying flows to assist with fish clearing operations. A third set of surveys will take place before recommendations are given to shut down Barrier 2B. The presence of any large juveniles or adult fish (>12 inches long) between the barriers signifies that a rotenone action likely will be necessary to eliminate fish from the area. In contrast, a pre-planned rotenone action may be cancelled if mechanical suppression is shown to be successful.

Canal closures may not be necessary for remote sensing surveys when one barrier is operating (2A or 2B); however, they will be needed for mechanical fish suppression activities or whenever both barriers are operating simultaneously. Typically, IDNR will make a request to USCG for safety zone closures to navigation in the vicinity of the barriers for 5 hours each morning (7:00 a.m. to 12:00 p.m.) on 4-5 days during the week of barrier maintenance fish clearing. A

contingency week should also be planned in case equipment failure or inclement weather precludes operations. All closure requests will be made 45 days prior to a planned event.

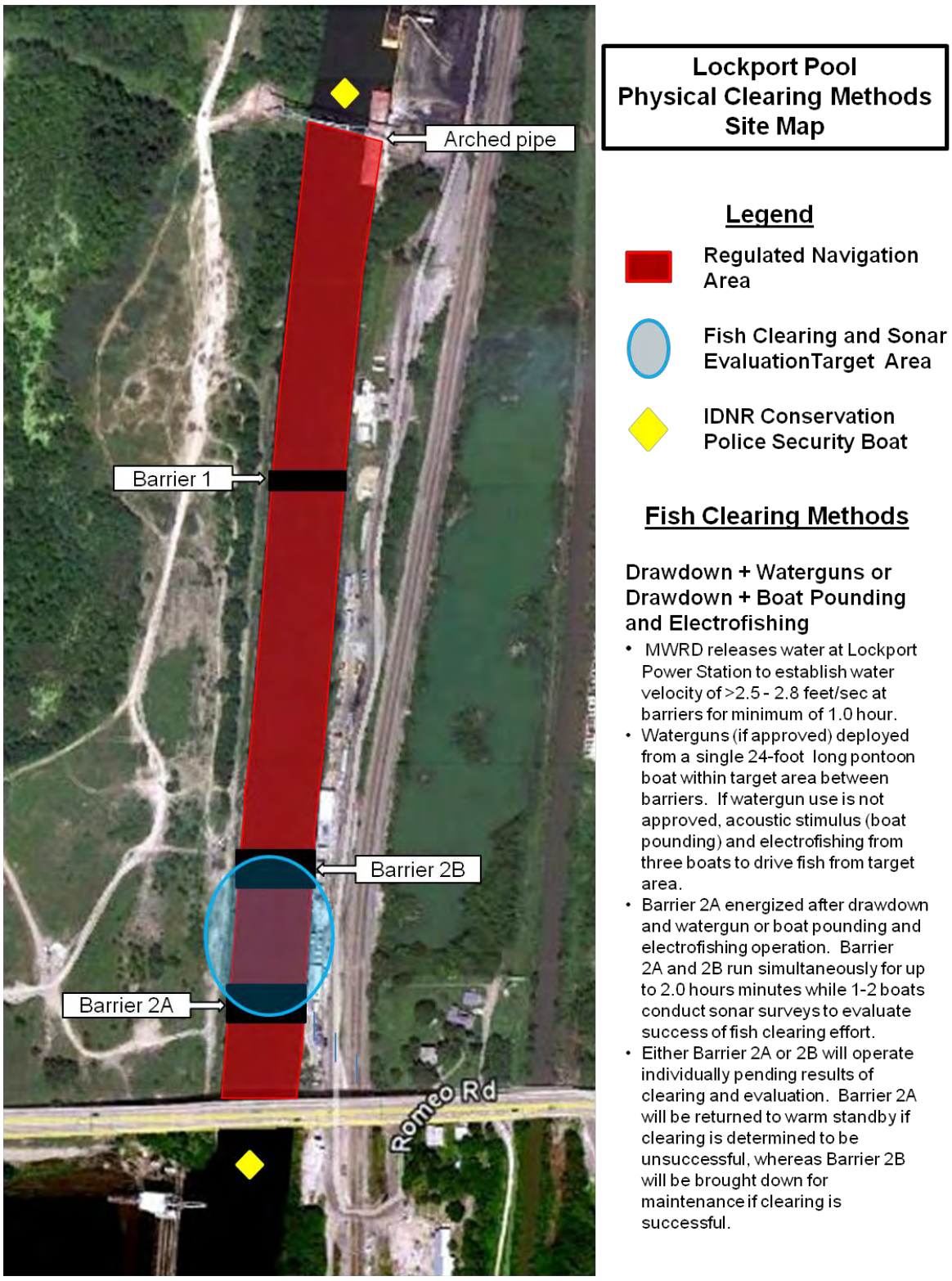

Figure 8. Map and descriptions of a fish clearing operation at the Dispersal Barrier.

Water level drawdown to increase current velocity appears to be a good technique to assist mechanical clearing operations with ancillary observations of Common Carp challenging the barrier at low flows. Dr. Jan Hoover (USACE) has been working with swimming ability of sub-adult Bighead and Silver Carp. Dr. Hoover does admit this is a tough question to answer in regards to an open system but suggests that a proposed drawdown would work best with these things in mind: 1) low initial flow in the canal; 2) a rapid rate of increased flow; 3) a prolonged duration of elevated flow; 4) a reach with relatively smooth sides and bottom; 5) cool water temperatures.

We believe that combining a drawdown with physical fish driving techniques would maximize the movement of fish from this area to a more desired location downstream. The increased flows provided by a drawdown are intended to provide > 2.0-2.5 feet/second velocities. The flows can be coordinated so that we can bring up Barrier 2A during highest flows, and within 30 minutes have reduced flows for remote sensing with split-beam hydroacoustics, side scan sonar, and DIDSON imaging techniques. The flows provided by MWRD operations at Lockport Lock and Powerhouse will warrant a Broadcast to Mariners, but will not require a discharge variance and will be within MWRD operating parameters. Increased flows have been found to produce bubbles in the water column that interfere with hydroacoustics results by creating false detection of fish and screening portion of the water column from view. For these reasons canal drawdown will only be used in situations when fish are not easily cleared from the area with water guns.

Small Scale Rotenone Action - Rotenone is considered the fallback method for fish suppression should other clearing efforts prove to be unsuccessful. If necessary, rotenone will be applied from boats at a location just upstream of the arched overhead pipe that designates the upstream boundary of the barrier Regulated Navigation Area (RNA) Safety Zone enforced by the USCG (Figure 9). This will create a rotenone slug that will travel downstream and mix throughout the water column driving fish from the target area between barriers or killing them. The rotenone slug will be detoxified with liquid sodium permanganate pumped from boats at a location south of the Romeo Road Bridge. Unlike fish clearing methods discussed above, the effect of rotenone on fish is well known and has been documented often, precluding the need for on-site evaluation. Barrier 2B will be turned down for maintenance once stable operation of Barrier 2A has been confirmed.

Although rotenone is an effective technique for controlling fish populations, there are several reasons for attempting physical removal of fish prior to rotenone application. Even the proposed small-scale rotenone action will be costly (estimated 150-250K), require extensive labor and permitting (minimum 40-50 persons; NEPA, NPDES, IDNR CERP, and Special Local Needs labeling), and require a longer duration canal closure than physical fish clearing (estimated 8-10 hours vs. 0-5 hours). In addition, barrier maintenance must occur regularly at approximately 6 month intervals. Developing methods that are less expensive and disruptive to canal users is beneficial to all involved stakeholders. In contrast to rotenone, physical clearing methods will not pollute waters or kill many fish. Fish killed with rotenone must be collected and disposed of in an EPA approved toxic waste landfill. Perceptions that rotenone actions "poison" the water have been expressed by potential purchasers of commercially harvested Asian carp from down river locations. These perceptions may adversely affect the success of Asian carp commercial market development projects. Furthermore, while rotenone is used and neutralized successfully

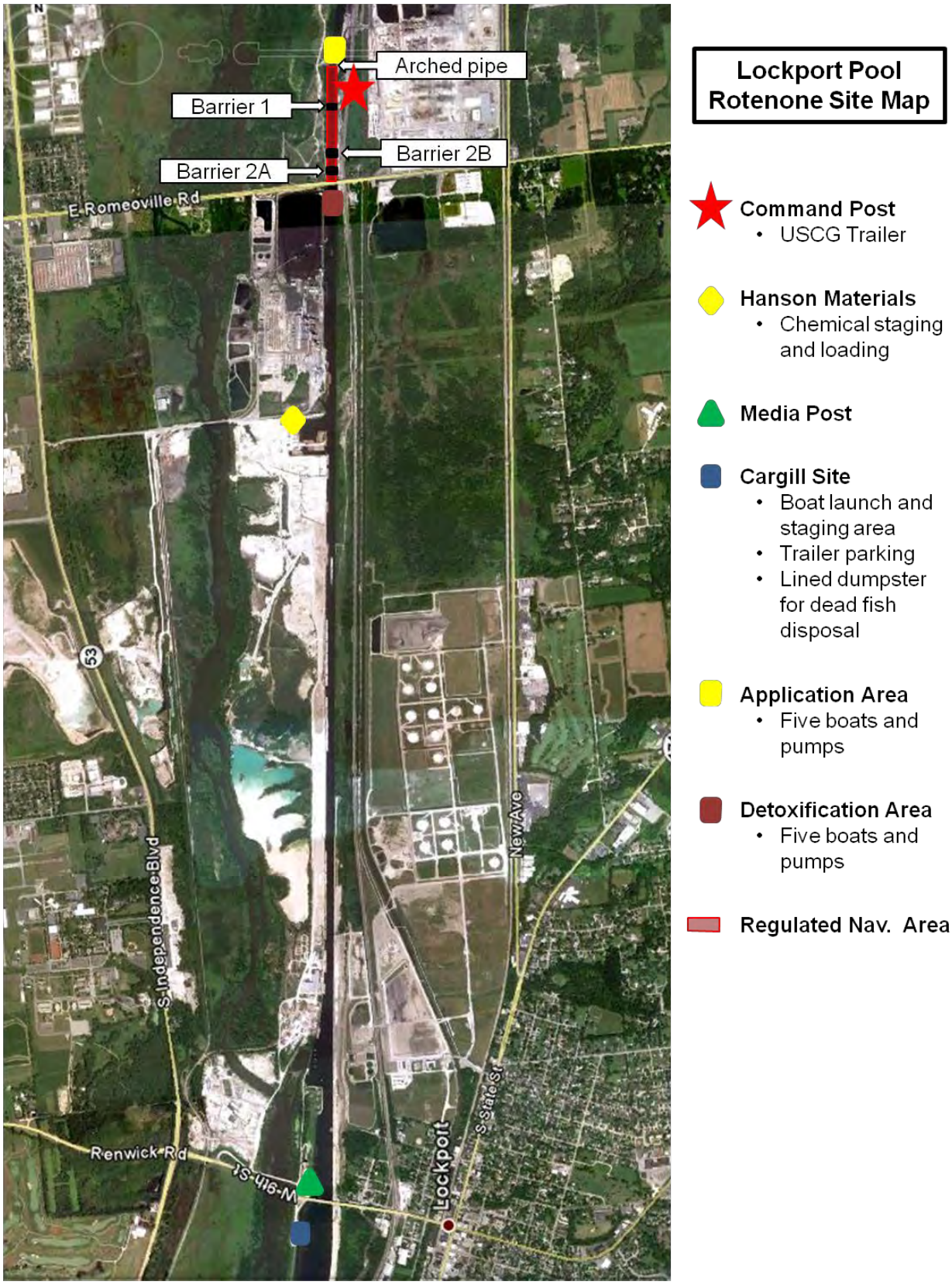

Figure 9. A map of a small-scale rotenone operation to clear from the Dispersal Barrier.

in most cases, there is the possibility that mechanical or environmental factors could allow rotenone to travel outside of the treatment area where additional aquatic resources could be unintentionally harmed. And finally, the USACE telemetry program to assess effectiveness of the barriers will be adversely impacted should tagged fish in the vicinity of the barriers be eradicated by rotenone.

A small-scale rotenone action will take place if remote sensing surveys indicate fish >12 inches long may be present between Barriers 2A and 2B and mechanical suppression measures fail to drive fish from the area. All operations will occur between Hanson Material Service"s large barge slip (~RM 295.2) and a point about 0.25 miles upstream of the arched pipeline (up to RM 297). No work is planned in the designated RNA, although it will be necessary for some boats to pass through the RNA to get to upstream chemical application stations (see Safety and Communication section below for RNA restrictions). IDNR will stand up an Incident Commend Structure (ICS) for a rotenone action and will work closely with USCG and USACE (possibly in Unified Command) during all phases of project planning and implementation to ensure a safe and successful event. Detailed plans for a rotenone action will be prepared by IC staff, but a general overview of possible operations is presented here. In all, we anticipate a 3-4 day operation with 12-15 boats, 45-50 field crew, and 15-20 IC staff and support crew. This estimate does not include security and safety zone enforcement boats and crews. Day 1 will include travel to the site, gear preparation, and the collection of sentinel fish for detoxification monitoring.

The bulk of the work will occur on the second day of operations and a 10-hour daytime canal closure will be necessary on this day. During Day 2, we will apply approximately 125 gallons of rotenone from boats ($N = 5$) located at a station upstream of the RNA. The chemical will be allowed to mix and flow downstream over the barriers killing fish or forcing them out of the area. Dye will be used to track the leading and trailing boundaries of the rotenone slug. Reactivation of Barrier 2A must be synchronized with the passing of the tail end of the rotenone slug through the barrier area to prevent movement of fish back into the treatment zone. Detoxification with approximately 750 gallons of sodium permanganate applied from boats (N = 3-4) will take place downstream of the barrier RNA. The exact location of the detoxification station will be based on consultations with personnel from the Midwest Generation power plant and their level of concern over permanganate entrainment through the plant cooling system. Cages with sentinel fish will be placed at several downstream locations in the Lockport Pool to ensure that detoxification was successful. Although a large kill is not anticipated, we will have 2-3 recovery boats and crews and one dumpster on hand for the collection and disposal of dead fish. Fish recovery will continue on the third and fourth day of the event, as needed.

Lockport Pool Sampling - Fish sampling may take place in the CSSC from Lockport Lock and Power Station to the downstream boundary of the barrier RNA (Figure 10) when deemed necessary by the MRRWG. Sampling has been shown to be effective without waterway closures, but closures can be requested if sampling is to take place in the main navigation channel for extended periods of time. An example of sampling gears and anticipated effort from a fall 2010 multi-gear operation is included in the following table and text. All captured fish will be identified to species, counted, and a subsample of 20 fish per species per gear will be measured (mm total length). Except for Asian carp, all captured fish will be returned live to the

Methods	Boat/crew	Number of sets, runs, or samples	Duration
eDNA sampling	1 boat; 3 crew	120 samples total; 60 upstream and 60 downstream of barrier	5-6 hours collection time
DC electrofishing	2 boats; 6 crew**	6 hours total; 12 runs @ 30 min. per run	2 partial days; three 30-min. runs/boat/day
Commercial fishers - trammel/gill nets @ 8‟ x 600‟; 3-5 in. mesh	2 boats; 4 crew, and 2 IDNR observers	1,000 yards of net set and run/boat/day	2 nights; 13-14 hour set
Experimental gill nets 6 @ 6‟ x 300‟; 0.75-5.0 in. mesh 3 @ 10‟ x 150‟; 0.75-2.0 in. mesh	1 boat, 3 crew*	6 nets set overnight in off channel areas	1-2 nights; 13-14 hour set
Mini fyke nets (10)	1 IDNR boat, 3 crew**	10 nets set overnight	2 partial days; 13-14 hour set
Telemetry	2 boats, 4 crew	NA	1-2 days

*Same boat doing different sampling.

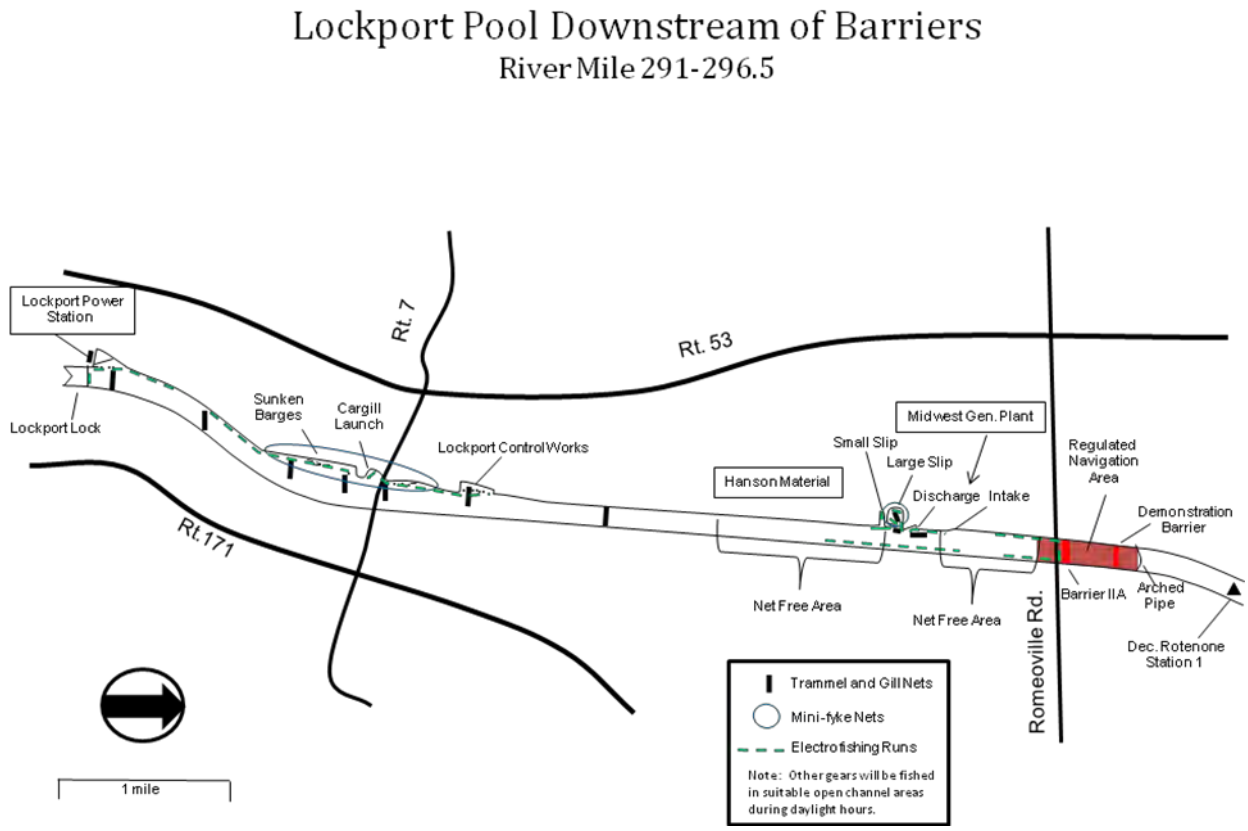

Figure 10. Lockport Pool downstream of the Dispersal Barrier showing target areas for fish sampling operations.

waterway. Any captured Asian carp will be held and immediately reported to the operations coordinator.

Sampling will require eight open deck aluminum boats that range in size from 18-24 feet long. The staging, boat launch, and overnight boat storage area will be located at the Cargill Launch site on the west bank of the canal just south of the Route 7 (9th Avenue) Bridge (a.k.a. Carp Camp 1). Mini-fyke nets and experimental gill nets will be fished in shallower near shore areas away from the navigation channel and in a portion of Hanson Material Services large slip during day and night hours. Daytime trammel net sets will be of short duration (15-20 minutes) and will have fish driven into the nets by "pounding," a method commonly used by commercial netters. Short term sets will always be attended by a net boat and crew and target areas throughout the reach known to hold concentrations of fish. Trammel nets may be set overnight in backwater and off channel areas to increase chances of catching fish.

Safety and Communication - Safety is a primary objective when operating in the electric field created by the barrier. Boats will be equipped with required safety equipment and floatation devices. Operators and crews will wear personal flotation devices while working on the water. For fish sampling operations, no work is scheduled to take place in or upstream of the barrier RNA. However, all requirements of the RNA will be adhered to should a crossing be necessary. The RNA extends from the arched pipe downstream to a point 450 feet below the Romeo Road Bridge (designated by Sampson post #2 on the west bank).

First, any vessel crossing the Dispersal Barrier or entering the RNA will provide advance notification to the Coast Guard Captain of the Port Representative on scene at (630) 336-0296 or VHF-16. Additional RNA requirements include:

a. The vessel cannot be less in than 20 feet in length.

b. The vessel must proceed directly through the RNA, and may not conduct any fishing operations, loiter, or moor within the RNA boundaries. Special permits will be requested for remote sensing surveys and mechanical fish suppression operations planned to take place within the RNA (see below).

c. All personnel must remain inside the cabin, or as far inboard as practicable. If personnel must be on open decks, they must wear a Coast Guard approved Type I personal floatation device.

The CSSC is a working ship canal and sampling crews should be aware of potential hazards in the waterway. Note that no boats should operate near barges that are being loaded. In addition to the hazard of being hit by material that misses the target, there are cables that move barges along the wall during loading. These cables may be under the water surface when slack, but can rapidly rise 4-5 feet above the water when tightened. A rising cable could cause severe bodily injury or catch and easily flip a sampling boat. Crews should be aware of their surroundings and avoid potential safety hazards while sampling.

Communication among boats, staff, security, and shore command will be by marine radio or cell phone. A briefing before any crew enters the water will be held and will include a handout of

crew leaders and cell phone numbers for each participating boat/crew. This handout will include a map of the sample reach. All boats will be equipped with numbered flags for identification on the water and hand-held marine radios operating on Channel 12 for the operation, unless emergency communication with USCG or Lockmaster is necessary (Channel 16, 14). Emergency contact numbers (local ambulance, fire/rescue service, Lockmaster, USGC contact information, and MWRD) will be included on the handout if needed for unforeseen reasons, yet the primary communicator to these services will be the operations coordinator or Incident Commander.

Sampling Schedule: Barrier maintenance may be required every six months to a year. The USACE determines the need for barrier maintenance and when maintenance will occur. The IDNR has requested that USACE provide a notice of maintenance dates 60 days in advance to allow time for planning and preparation. The USCG requires that Safety Zone applications be submitted 45 days prior to requested canal closure dates. By law, mariners must be informed about any non-emergency canal closures 30 days before the closure is to occur. Canal closures are required for the safety of mariners and operation crews and whenever both Barrier 2A and 2B are operating simultaneously.

Deliverables: Results of fish sampling events will be compiled for weekly sampling summaries. Fish suppression updates will be provided daily during operations. Data will be summarized for an annual interim report and project plans updated for annual revisions of the MRRP.

Barrier Defense Asian Carp Removal Project

Participating Agencies: IDNR (lead)

Location: The Barrier Defense Project includes the area between the Starved Rock Lock and Dam up to the Dispersal Barrier at Romeoville. Primary areas that will be fished include Starved Rock, Marseilles and Dresden Island pools, though effort will be expended in Brandon Road, Lockport pools, if needed.

Introduction and Need: This project uses controlled commercial fishing to reduce the numbers of Asian carp in the upper Illinois and lower Des Plaines rivers downstream of the Dispersal Barrier. By decreasing the number of Asian carp in this area, we anticipate a lowering of propagule pressure at the barrier and reduced chances of carp gaining access to upstream waters in the CAWS and Lake Michigan. Trends in harvest data over time also may contribute to our understanding of Asian carp population abundance in and movement between river pools. The project was initiated in 2010 and continued through 2011. It utilized ten contracted commercial fishing crews to remove Asian carp with large mesh trammel nets and gill nets primarily and with other gears on occasion (e.g., seines and hoop nets). The target area is closed to commercial fishing by Illinois Administrative Rule; therefore an IDNR biologist or fisheries technician is required to accompany commercial fishing crews working in this portion of the river.

Objectives: Ten commercial fishers will be employed to:

1) Harvest as many Asian carp as possible in the area between the Starved Rock Lock and Dam and the Dispersal Barrier. Harvested fish will be picked up and utilized by private industry for purposes other than human consumption; and
2) Gather information on Asian carp population abundance and movement in the Illinois Waterway downstream of the Dispersal Barrier as a supplement to fixed site monitoring.

Status: Harvest of Asian carp from the Des Plaines and Illinois rivers by contracted commercial fishers occurred from June through September 2010 and April through December 2011. Most of the sampling effort was concentrated in the Marseilles Pool, although some netting took place in the Dresden Island and Starved Rock pools. Contracted commercial fishers and assisting IDNR biologists deployed 350 miles of net in the upper Illinois Waterway during 2010 and 2011. A total of 28,098 Bighead Carp, 18,842 Silver Carp, and 187 Grass Carp were removed by contracted netting. The total weight of Asian carp removed was 414.2 tons (62.4 tons in 2010 and 351.8 tons in 2011). For more detailed results see the 2011 interim summary report document (MRRWG 2012).

Methods: Contracted commercial fishing will occur from March through December 2012 in the Dresden Island, Marseilles, and Starved Rock pools. Five commercial fishing crews with assisting IDNR biologists will be deployed 1-2 weeks each month of the field season. Down weeks are usually scheduled between fishing weeks to allow the fish to repopulate preferred habitats. Constantly fishing the same area has been shown to drive the fish out and greatly reduce catches. Commercial fishers typically arrive on Monday of each sampling week and fish Tuesday through Friday. Each boat will set a minimum of 1,000 yards of 3.0- to 4.25-inch mesh

trammel or gill nets each day. Whereas most fishing will occur in backwater areas known to hold Asian carp, main channel and side channel habitats also will be targeted. Specific netting locations are at the discretion of the commercial fisher with input from assisting IDNR biologist assigned to each boat. Set duration typically will be from 20-30 minutes long and fish will be driven to the nets with noise (e.g., pounding on boat hulls, hitting the water surface with plungers, running with motors tipped up). Nets occasionally may be set overnight in off channel locations with no boat traffic. Biologists will enumerate the catch of Asian carp and by-catch species and check the catch for ultrasonically-tagged Asian carp and Common Carp designated by metal jaw tags, Floy tags near the dorsal fin, or suture wounds located ventrally and anterior to the anal pore.

Each week, a representative sample of up to 30 of each Asian carp species (Bighead, Silver, and Grass Carp) from each pool will be measured and weighed to estimate total weight harvested. Common Carp will be the only other species removed. Other by-catch species will be released immediately to the water where taken. At the end of the day the catch will be transported to the boat ramp and transferred to a refrigerated truck for temporary storage. Harvested fish will be taken to a processing plant where they may be used for non-consumptive purposes (e.g., converted to liquid fertilizer).

Suggested Boat Launches for Barrier Defense Harvesting:
Lockport Pool – Cargill Launch – Inform Martin Castro of MWRD.

Brandon Road Pool –Ruby Street Launch in Joliet on the west side of the river.

Dresden Island Pool – Big Basin Marina under the I-55 Bridge on north side of the river. Contact Russ to get let in without paying. Take the receipt to marina office to get reimbursed.

Marseilles Pool – Stratton State Park Launch in Morris on the north side of the river.

Starved Rock Pool – Allen Park Launch in Ottawa off Route 71 on the south side of the river or Starved Rock Marina off of Dee Bennett Road on the north side of the river.

Sampling Schedule: A tentative sampling schedule for 2012 is shown in the table below.

Week of	Agency	Week of	Agency	Week of	Agency
Mar 5	IDNR	Jun 4	IDNR	Oct 15	IDNR
Mar 19	IDNR	Jun 18	IDNR	Oct 29	IDNR
Apr 9	IDNR	Jul 9	IDNR	Nov 12	IDNR
Apr 23	IDNR	Aug 6	IDNR	Nov 26	IDNR
May 7	IDNR	Sep 10	IDNR	Dec 3*	IDNR
May 21	IDNR	Sep 17	IDNR		

* Weather permitting.

Deliverables: Results of each sampling event will be reported for weekly sampling summaries. Data will be summarized for an annual interim report and project plans updated for annual revisions of the MRRP.

Monitoring Asian Carp Population Metrics and Control Efforts: Preventing Upstream Movement in the Illinois River

Participating Agencies: SIUC (lead); INHS, IDNR, USACE, USFWS, and WIU (field support and coordination)

Location: Estimates of Asian carp abundance, biomass, size structure, demographics (e.g., growth and mortality), natal origin, and rates of hybridization will take place in the Alton, LaGrange, Peoria, Starved Rock, Marseilles, and Dresden Island pools of the Illinois and Des Plaines Rivers. Although estimation of these Asian carp population metrics are not currently scheduled to occur north of the Dresden Island Pool, we will incorporate upstream areas barring the discovery of Asian carp populations as indicated by workgroup sampling and monitoring. Immigration and movement will be monitored by SIUC in the Alton, LaGrange, Peoria, Starved Rock, and Marseilles pools of the Illinois River; coordination with the USACE, USFWS, and INHS will allow for assessment of upstream movement in the Dresden Island, Lockport, and Brandon Road pools of the Illinois and Des Plaines Rivers via an extensive VR2/VR4 stationary receiver network. In support of barrier maintenance operations, evaluation of fish suppression methods with remote sensing technology will take place in the CAWS.

Introduction and Need: Bighead Carp and Silver Carp (hereafter, Asian carp) invaded the Illinois Waterway over a decade ago. Populations of these fishes have grown dense in the lower and middle Illinois River and both species are approaching the CAWS and the defensive electrical barrier. Control efforts of Asian carp directed in part by SIUC and partners are underway in the Illinois River (>350 tons removed in 2011). Removal should affect density, size, biomass, age structure, and movement of Asian carp throughout the river. As such, a consistent estimate of Asian carp abundance, biomass, size structure, species composition, demographics (e.g., growth and mortality), and propensity for upstream movement needs to be determined past the edge of the invasion wave (e.g., in CAWS and Brandon Road Pool) reaching down to the purported "source" of Asian carp near the confluence of the Mississippi River to evaluate the success of ongoing removal efforts.

Abundance, Biomass, Size Structure, Demographics, and Hybridization - During 2010-2011, SIUC and its partners successfully completed a survey of Asian carp abundance, biomass, size structure, and demographics (e.g., growth and mortality) in the Illinois River below Starved Rock Lock and Dam to the confluence with the Mississippi River as well as in a portion of Marseilles Reach (i.e., the east pit of the Hanson Material Service Corporation). The results indicated that Asian carp dominated fish biomass in the three lower reaches, yet abundance and biomass estimates were conservative given the sampling limitations of using down-looking hydroacoustic surveys. Therefore, we will refine the methodology established in 2010-2011 by incorporating side-looking split-beam hydroacoustics to sample near-surface Asian carp in both main channel and backwater habitats. These estimates will not only provide a more accurate depiction of Asian carp standing stock, but will also allow us to determine correction factors for the 2010-2011 estimates if needed. These estimates along with typical demographic information of Asian carp (e.g., growth, mortality, condition, size structure) will assist in evaluating how these populations are responding to removal efforts.

During last-year‟s effort Asian carp were identified as Bighead or Silver Carp, although some of the fish were likely intermediates (hybrids). Hybridization may influence the movement, spawning, and feeding ecology of fish, with implications for invasibility in the CAWS and the Great Lakes. As such, the rate of hybridization baseline information regarding population demographics needs to be determined along the entire Illinois River.

Immigration and Movement - Immigration and upstream movement of Asian carp was quantified with telemetry in 2010-2011, which indicated that 30% of Asian carp immigrated into the Illinois River from the Mississippi River and subsequently made long distance trips up the Illinois River, but did not extend past Starved Rock Lock and Dam. Immigration and upstream movement corresponded with elevated flow in the river during spring through summer. However, Asian carp that moved upstream returned to downstream locations as water levels dropped in late summer. Examining how immigration and movement rates of Asian carp change in relation to seasonal and annual changes in river flow as well as determining how changes in Asian carp density affect these rates are important considerations for forecasting population responses to removal efforts and predicting how this will affect the probability of movement toward or away from the CAWS. Lastly, determining how Asian carp interact with the locks and dams of the Illinois River is an important consideration for parameterizing spatially explicit models as the type of dam (e.g., wicket dams on the lower Illinois River compared to the gated lock and dams at Brandon Road) may affect the probability for successful passage.

Natal Origin - Asian carp are known to be reproducing in the Illinois, middle Mississippi, and lower Missouri Rivers. During 2010-2011 sampling, we have generated initial estimates of the extent to which the Asian carp stocks in the Illinois River are derived from recruits from within the Illinois River vs. immigrants from the Mississippi and Missouri Rivers. We have also estimated the contribution of floodplain lake habitats to Asian carp recruitment in the Illinois River. Continued monitoring of the relative importance of different environments as recruitment sources that support Asian carp stocks in the Illinois River will provide valuable information regarding: 1) whether removal in the upper Illinois River and enhanced commercial harvest of Asian carps in the lower Illinois River are effectively reducing recruitment of these species within the upper Illinois River (as indicated by a decrease in the relative abundance of Illinois River-origin fish near CAWS), 2) the degree to which Asian carp stocks in the Illinois River may be replenished by immigrants from other rivers (immigration rates are an important component of population models) and the potential need to expand the geographic scope of enhanced commercial harvest efforts (e.g., are CAWS fish being replenished by carp produced in the lower Illinois River or the Mississippi River?) and 3) to direct commercial fishing and other control efforts to target locations that are supporting Asian carp populations that threaten the CAWS.

Efficacy of Contracted Removal Efforts - SIUC estimated total fish abundance via hydroacoustics and Asian carp abundance via mark-recapture methods in the east pit of the Hanson Material Services Corporation, near Morris, Illinois to assess the efficacy of contracted removal efforts in this area. The results indicated that changes in harvest catch rates may be partly due to seasonal trends in movement in and out of this area. Therefore, there is a need to quantify both changes in abundance as it relates to not only harvest, but also immigration and emigration rates to determine the efficacy of these removal efforts. A better understanding of where emigrating Asian carp move to is also important for determining whether these “holding areas” actually

represent “stepping stones” by which Asian carp use for creeping further upstream toward the CAWS.

Electric Barrier Maintenance Remote Sensing Surveys - Given the increased potential threat of inter-basin transfer of aquatic nuisance species (ANS) during maintenance of the electric barriers, the IDNR supports maintenance operations by providing fish suppression at the barrier site. Fish suppression can vary widely in scope and may include application of piscicide (rotenone) to keep fish from moving upstream past the barriers when they are down. However, the efficacy of these fish suppression efforts needs to be evaluated. In October 2011, SIUC crews showed that remote sensing technology (i.e., side-looking split-beam hydroacoustic and side-scan sonar) is an effective evaluation method for scanning the barrier channel for the presence of fish. As such, there is a need to continue evaluations of fish suppression efforts using remote sensing technology in support of barrier maintenance operations to reduce the potential of Asian carp gaining access through the CSSC.

Objectives:

1) Determine the efficacy of Asian carp removal efforts in the upper river at the detectable population front near the CAWS (i.e., Starved Rock, Marseilles, and Dresden Island pools) by providing density estimates through time;
2) Determine whether complementary removal efforts in the remainder of the river (i.e., Alton, LaGrange, and Peoria pools) are having an impact on population densities and reducing the number of fish moving toward the CAWS;
3) Examine whether removal efforts are linked to changes in Asian carp population structure and their propensity to move toward the CAWS to determine whether there are benchmark control pressures (e.g., harvest) that managers might set to quantify success;
4) Determine whether removal efforts encourage downstream movement toward the Mississippi River away from the CAWS;
5) Determine whether Asian carp movement is related to lock and dam structures, leading to a partially isolated population in the upper Illinois River;
6) Determine the relative density of Asian carp in the Dresden Island Pool down to the confluence with the Mississippi River along the main channel of the Illinois Waterway and shallow, off-channel areas;
7) Determine how hybridization rates between Silver Carp and Bighead Carp change with removal efforts and affect population dynamics; and
8) Evaluate the efficacy of fish suppression efforts during electric barrier maintenance.

Status: This is a new MRRP project, although similar efforts have been ongoing in the lower Illinois River as part of a separate ACRCC Framework research project (ACRCC 2012, Garvey et al. 2011). During an October 2011barrier maintenance fish suppression action, SIUC conducted remote sensing surveys with hydroacoustics and side-scan sonar between the high field array of Barrier 2A and 2B before and after fish clearing with pneumatic water guns. No fish ≥30 cm TL (12 inches) were detected within the between-barrier area after the clearing operation allowing Barrier 2A to be brought up to normal operating parameters and Barrier 2B to be taken down for maintenance. For more details see the 2011 Barrier Maintenance Fish Suppression Final Report in the 2011 interim report document (MRRWG 2012).

Methods:

Abundance, Biomass, Size Structure, Demographics, and Hybridization - During both years, we will use methods developed in 2010-2011 to quantify Asian carp density and biomass throughout the entire Illinois River system. To quantify targets in the main river, we will use the same echosounding technique used to quantify main-channel densities within the Alton, LaGrange, and Peoria Pools. This involved running eight down-looking parallel transects through the entire channel with a 200 kHz Biosonics DTX system. Coverage was limited to water > 1.5 m, potentially missing fish in shallow-water areas as well as channel borders, side channels, backwater lakes, and tributaries. Using distributions of fish quantified in our comprehensive survey in 2010-2011, during summer 2012, we will randomly stratify sampling across main channel habitats at 30-kilometer intervals throughout the river starting in the Peoria Pool down to the confluence of the Mississippi River; the smaller Starved Rock, Marseilles, and Dresden Island pools will be sampled in their entirety. We also will sample the main channel, shallow water tributaries, side channels, and connected backwater lakes using side-looking hydroacoustics (70-kHz BioSonics DTX). This system has rotators that will allow us to precisely quantify the angle of the beam and assess target density and volume of water sampled. These data combined with down-looking split-beam hydroacoustics will give us a complete, comprehensive estimate of density and size distribution to evaluate the efficacy of removal efforts in the entire river. No less than eight transects will be conducted at each sampling site to ensure complete coverage of the area. To determine the relative species composition and size distribution of Asian carp and other species at the sampling sites, standardized electrofishing and trammel netting will be conducted at each site in collaboration with the IDNR removal effort. These data will be combined with multi-gear data being deployed and tested in the upper Illinois River (D. Wahl, unpublished data) as well as ongoing long-term monitoring programs being conducted by the INHS (i.e., LTRMP and LTEF).

Each year, a subsample (at least N=150 per species if possible) of Asian carp from each reach of the Illinois River will be returned to SIUC and used for estimation of sex ratio, gonadal condition, body condition (lipid content), and age (with sectioned post-cleithra). A subset of ages will be compared to sectioned vertebrae for older fish. A subset of Asian carp will also be vouchered and tissue samples sent to Western Illinois University where genetic tests will be used to determine the rate of hybridization. The project involves identification, quantification, and maternal contribution of parental Bighead Carp, Silver Carp, and their hybrids through DNA extraction, genotyping, and data processing. We will be using a 60 SNP nuclear DNA assay for parental and hybrid assignment and 1 mitochondrial SNP to determine maternal contribution to the hybrids. All genotypes will be assigned by posterior probabilities computed by NewHybrids hybrid assignment algorithm. Resulting products will be genetic identities, allele frequencies, and maternal contribution of 400 Asian carp per year for two years from the Illinois Waterway from the CAWS down to the confluence with the Mississippi River. These fish will be obtained from many ongoing efforts in the river (e.g., contracted removal upstream and commercial harvest downstream as well as our own sampling).

Immigration and Movement- During spring of each year we will implant Silver Carp and Bighead Carp with Vemco acoustic transmitters in Pool 26 Mississippi River and in Lower Starved Rock Pool/Upper Peoria Pool of the Illinois River. In both locations, we will tag 105

adult Silver Carp and 70 Bighead Carp (total of 175 fish in the north and 175 in the south reaches; tag life about 2 years). An additional 50 fish will be tagged in the upper river reaches extending to Dresden Island Lock and Dam. Movement of these fish along with those tagged in 2010 will be quantified during each year with stationary VR2W receivers emplaced at roughly 20-km intervals throughout the river reaching up past Dresden Lock and Dam (in collaboration with USACE and USFWS efforts). We also will emplace a VR2W in the lock chamber of Starved Rock Lock and Dam (and others) to assess movement through locks versus gates. At least four VR2Ws will be placed above and below the dams to evaluate the frequency of passage, based on our experience in the Upper Mississippi River. Another series of VR2Ws available from a related project will be used to quantify three dimensional locations of tagged fish around Starved Rock Lock and Dam during spring 2012. Whole-channel discharge will be quantified twice each month at three fixed locations (Starved Rock Pool, Alton Reach, and Pool 26 Mississippi River below the confluence) using an acoustic current Doppler profiler (ADCP). This will allow us to determine how flow conditions in the two rivers influence movement of the fish through the river. These data will be compared to gage data collected by the Army Corps. Temperatures also will be logged with stationary loggers at 10 locations throughout the river.

Natal Origin - Bighead and Silver Carp will be collected from each of four reaches of the Illinois River (Alton, LaGrange, Peoria, and upper river). Both lapilli otoliths will be extracted from each fish; one otolith per fish will be sectioned and analyzed for strontium:calcium ratio (Sr:Ca) using laser ablation-ICPMS and the second otolith will be analyzed for stable oxygen and carbon isotope ratios (δ18O and δ13C) using a micromill to obtain subsamples of from the otolith core. Sr:Ca, δ18O and δ13C of the otolith core (which reflects early life history) will be used to infer natal environment for individual fish; changes in Sr:Ca across sectioned otoliths will be used to assess timing and long-term patterns of inter-river movement.

Efficacy of Contracted Removal Efforts - As we have done in the Marseilles Reach in 2011, we will conduct another mark-recapture estimate in the Marseilles Pool in 2012 in conjunction with the IDNR removal effort. We will quantify movement through the channel connecting this quarry to the river with 24-hour echosounding surveys at least three times each year (spring, summer, fall). The expectation is that overall movement should be greater during periods when densities in the east pit of Hanson Material Services Corp decline. In addition to the VR2 network described above, additional fixed station receivers will be placed near the entrance of the east pit at the main channel of the Illinois River, in the east pit and in the west pit to examine immigration and emigration. We will implant an additional 40 Asian carp with acoustic tags during spring 2012 to quantify movement with VR2Ws placed in the river channel and the pits. These immigration and emigration data will be combined with telemetry and harvest data to assess the efficacy of removal efforts there.

Electric Barrier Maintenance Remote Sensing Surveys - Sampling will include regular remote sensing monitoring of the area within the defensive electrical barrier as part of the regular barrier maintenance effort. This effort will include a combination of side-looking split-beam hydroacoustic surveys and side-scan sonar surveys, which has been shown to be effective in identifying the presence/absence of fish. Each survey will consist of three transects, which will provide an estimated 97.6% water column coverage. Hydroacoustics will be carried out using two multiplexed BioSonics, Inc. side-looking split-beam transducers (either 200 kHz or 70 kHz

transducers, depending on availability of the newly purchased 70 kHz system) set at 15 cm below the surface; each transducer will be set to 5 pings/s with a 0.40-ms pulse duration and data will be collected from 0 to 50 m. Acoustic transducers will be off-set in angle to maximize coverage across the CSSC. A Marine Sonics 1200 kHz HDS side-scan sonar tow fish will be towed at 1-m depth to detect and measure potential fish targets as well as to provide detailed imagery of the Dispersal Barriers.

Sampling Schedule: Work will take place from March – December 2012. Specific sampling dates are yet to be determined, but will be made available for weekly scheduling reports to stakeholders.

Deliverables: Summaries of each sampling event will be reported as conducted and progress reports will be provided as needed. Data will be summarized for an annual interim report and project plans updated for annual revisions of the MRRP.

Telemetry Monitoring Plan

Participating Agencies: USACE (lead); USFWS, SIUC, and IDNR (field support and coordination)

Location: Telemetry monitoring will take place in the CAWS and upper IWW upstream of Dresden Island Lock and Dam. The CSSC at and near the barrier site will be a primary focus area, although mobile tracking will extend to the Dresden Island Pool to monitor movement of the leading Asian carp population front.

Introduction and Need: The Asian Carp Regional Coordinating Committee developed the Asian Carp Control Strategy Framework to protect the Great Lakes from two species of Asian carp present in the Illinois Waterway. As part of this Framework, the ACRCC formed a sub-committee, the Asian Carp MRRWG, to develop and implement a Monitoring and Rapid Response Plan for these invasive species. The plan consists of a series of scientific studies to detect, monitor, and respond to the invasion before reproducing populations of Asian carp become established in Lake Michigan. Telemetry has been identified as one of the primary tools to assess the efficacy of the barrier.

By mid-summer 2010, an acoustic telemetry sampling strategy was initiated using a network of acoustic receivers supplemented by mobile surveillance to track the movement of tagged Bighead Carp, Silver Carp and associated surrogate fish species in the area around the Aquatic Nuisance Species Barrier in the CSSC and IWW. This network has been maintained to date through a partnership between the USACE, USFWS, MWRD and IDNR as part of the MRRWG‟s monitoring plan. Although the telemetry monitoring plan is scheduled as a five year program, it is important to note that a certain level of monitoring should be maintained throughout the life of the barrier project. This work plan will outline the major goals of the telemetry program and identify key objectives for the 2012 sampling season.

The telemetry monitoring plan includes the tagging of fish with individually coded ultrasonic transmitters in the upper IWW. The acoustic network proposed is comprised of stationary receivers and supplemented by a mobile hydrophone unit to collect information from acoustic transmitters (tags) implanted into free-swimming Asian carp (Bighead Carp and Silver Carp) and surrogate species. As of December 2011, a total of 16 acoustic receivers have been deployed at sites shown in green in Figure 10. An additional five receivers are proposed for deployment in 2012 throughout the upper IWW and CAWs (locations shown in yellow on Figure 10) for the purposes of monitoring alternative dispersal routes (i.e. tributaries) and identifying habitat utilized by the principal population of Asian carp. The primary goals of the telemetry monitoring plan are to 1) monitor fish movements in the immediate vicinity of the Dispersal Barrier to determine if fish are able to challenge and/or penetrate the Dispersal Barrier; 2) determine if Asian carp are able to navigate through lock structures in the Upper IWW; and 3) to determine the leading edge of the Asian carp population. For the 2012 field season, we will target 60 Asian carp from the Marseilles and Dresden Island pools for acoustic telemetry monitoring.

Goals and Objectives: The overall goal of this telemetry monitoring plan is to assess the effect and efficacy of the Dispersal Barrier on tagged fish in the CAWS and upper IWW using ultrasonic telemetry. The goals and objectives have been identified as:

Goal 1: Determine if fish are able to approach and/or penetrate the Dispersal Barrier (Barrier Efficacy)

- **Objective** Monitor the movements of tagged fish (large and small) in the vicinity of the Barrier using receivers (N=8) placed immediately upstream, within, and immediately downstream of the Dispersal Barrier, in addition to mobile tracking.
- **Objective** Determine if there is adequate detection coverage to effectively assess efficacy of Dispersal Barrier.
- **Objective** Assess the possibility of barge traffic shadowing acoustic transmissions.

Goal 2: Determine if and how Asian carp pass through navigation locks in the Upper IWW;

- **Objective** Monitor the movements of tagged fish at Marseilles, Dresden Island, Brandon Road, and Lockport locks and dams using stationary receivers (N=8) placed above and below each dam.
- **Objective** Determine if there is adequate detection coverage to effectively assess fish passage through lock structures.

Goal 3: Determine the leading edge of the Asian carp population and habitat use.

- **Objective** Determine if the leading edge of Asian carp invasion; currently, RM 281.5 is the upstream location of Asian carp population.
- **Objective** Describe habitat use and movement in the areas of the Upper IWW and tributaries where Asian carp have been captured and compare to areas in the CAWS where Asian carp are not currently present.

Additional objectives of the telemetry monitoring plan:

- **Objective** Integrate information between related acoustic telemetry studies.
- **Objective** Download, analyze and post telemetry data for information sharing.
- **Objective** Expand existing acoustic network in Dresden Island and Marseilles pools to support USFWS and SIUC telemetry network and maintain capability to rapidly deploy to areas of interest in response to new information (see Distribution and Movement of Small Asian Carp and Monitoring Asian Carp Population Metrics projects above).

Status: Since 2010, a limited number of Asian carp have been collected and tagged from the Dresden Island Pool in the IWW while a larger number of surrogate species have been collected and tagged from the Lockport and Brandon Road pools closer to the Dispersal Barrier. A total of 152 large fish have been implanted with ultrasonic transmitters from as far south as the Dresden Island Pool below the barrier and as far north as the Bubbly Creek turning basin above the barrier. In 2011, 30 juvenile and/or small bodied surrogate fish species have been tagged and released within the vicinity of the barriers. Tagged surrogate fish have been released above and below the Barrier; however, no tagged Asian carp have been released above the barrier. For more detailed results see the 2011 interim summary report document (MRRWG 2012).

Methods:

Sample Size – To determine if the current number of tagged fish in the CAWS is representing the behavior of an entire population, a power analysis needs to be conducted to ensure an accurate number of fish have been tagged to address the objectives. However, constraints and confounding factors such as semi-open system, unknown immigration/emigration rates, use of surrogates, and directed overharvest prevent the implementation of a power analysis.

Instead sample size was selected through review of similar studies, past catch data and expert opinion from the MRRWG. In 2010, the MRRWG recommended that 200 tags be implanted for large fish telemetry monitoring. An existing resource of 110 tags was implanted in 2010; and another 90 tags were procured to enhance monitoring capability in 2011. This recommendation however did not account for a report published later (Holliman, 2011), suggesting small bodied fish may have a greater chance of penetrating the Barriers. In response to this report, USACE procured an additional 30 tags for implantation into small fish that were released in the vicinity of the Barriers in 2011. For 2012, an additional 30 small fish will be tagged and monitored within the vicinity of the barrier for data comparison.

Additional tagging is required to sustain recommended levels of the large fish sampling size as battery life expires in previously tagged fish. At the conclusion of the 2011 sampling season, 140 tags remained active in the study area with sufficient battery life for the 2012 season. During the 2012 field season, an additional 60 fish will be captured and tagged to maintain the recommended sample size.

Species Selection (primary and surrogate) - Asian carp (Bighead and Silver Carp) are the primary species of concern, and their behavioral response to the barriers is of the greatest importance. However, as mentioned previously, populations of both species are present although in low abundance in Dresden Island Pool, none have been captured in Brandon Road Pool, and one Bighead Carp has been captured in Lockport Pool (2009 rotenone event). In June of 2010, one Bighead Carp was also captured from upstream of the barrier in Lake Calumet. Therefore, in order to test the direct response of fish, surrogate species have been tagged and monitored within the Brandon Road and Lockport pools. Dettmers and Creque (2004) cited the use of Common Carp (*Cyprinus carpio*) as a surrogate species for use in telemetry in the CSSC because, "Common carp are naturalized and widespread throughout the CSSC and Illinois water bodies in general. Common carp are known to migrate relatively long distances and they grow to large sizes that approximate those achieved by invasive carps. Based on these characteristics, tracking of Common carp should provide a good indicator of how Asian carp would respond to the dispersal barrier if they were in close proximity to this deterrent." These characteristics could also justify the use of other species such as Buffalo spp. (Smallmouth and Black), Grass Carp (another species of Asian carp), and Freshwater Drum.

Recent testing of voltage parameters by ERDC indicated voltage settings may not be as effective on smaller fish (Holliman 2011). To investigate this in the field setting, 30 small bodied fish (TL 4 to 7 inches) were tagged in the vicinity of the Barrier in 2011 and their movement monitored. Due to the constraints associated with tagging smaller fish, tagging took place in the spring and fall to ensure compatible sizes and reduce stress by waiting for cooler water temperatures. Additionally, battery life of tags is sacrificed (smaller tags to accommodate smaller fish have less

battery life), so it may be prudent to implement continuous mobile tracking (i.e., 12 hours from time of release) on these fish. Small fish species selected have largely been dependent on available populations within the lower Lockport and upper Brandon Road pools. Species tagged in 2011 included Largemouth Bass, Crappie spp., Sunfish spp., Common Carp and Skipjack Herring. Repeated studies in 2012 will concentrate efforts on young-of-year Common Carp but will again rely on the resources available in the field.

Location Selection – The primary objective of the telemetry monitoring plan has been to assess the efficacy of the Barriers, so previous tagging efforts have been concentrated in the upper pools of the study area with focus near the Barriers. A total of 124 tags have been implanted into surrogate species and released within the Brandon Road and Lockport pools both above and below the barriers. A limited number of Asian carp have been tagged within the Dresden Island (*N*=18) and Marseilles pools (*N*=10) in the southern half of the study area. A breakdown of the distribution of active tags (*N*=140) currently released by pool is provided here:

- Lockport Pool (Upstream of Barriers) = 40
- Lockport Pool (Downstream of Barriers) = 64
- Brandon Road Pool = 19
- Dresden Island Pool = 17

The allocation of effort and resources for 2010 and 2011 followed the strategy outlined in the priority areas nearest to the barriers. Tagged surrogate fish were released both above and below the barriers at or near their point of capture; however, no tagged Asian carp were captured or released within the Lockport or Brandon Road pools. The USACE, USFWS, MWRD, and IDNR assisted in fish tagging by supplying electrofishing crews to capture and return fish to release points.

For the 2012 field season, 60 tags will be evenly distributed between the Dresden Island (*N*=30) and Marseilles (*N*=30) pools and implanted into Asian carp species (Silver and Bighead Carp). We will attempt to split the tags evenly between each species but ultimate distribution will depend upon capture success. The proposed distribution is influenced by several factors including the carrying capacity for the receiver network array per pool, the small number of previously tagged Asian carp and available source populations of the target species. In 2011, the receiver network in the upper pools (especially lower Lockport) was observed reaching a saturation point for transmitter (tag) density, hence releasing additional tags here in 2012 will not occur since it may decrease the detection efficiency of the array.

Tag Specifications and Implantation Procedure – Tagging efforts will be focused May-June and October-November and will follow the surgical and recovery procedures outlined in *Telemetry Master Plan Summary of Findings* (MRRWG 2012). Adult Asian carp will be collected from the IWW; in the Marseilles (RM 247 to 271.5) and Dresden Island (RM 271.5 to 286) pools. Surrogate species for the small fish study will be collected from the Brandon Road Pool (RM 286 to 291) and Lockport Pool below the Barrier (RM 291 to 296). The primary method of capture will be electrofishing; although supplemental gear such as nets may also be used to harvest fish for tagging. Fish collected will be weighed, measured, and sex will be identified if

possible. Water quality parameters such as dissolved oxygen, pH, and conductivity will be taken at each release site using a water quality probe (Pro Plus Instrument, Yellow Springs Inc.)

In an attempt to reduce the amount of tagged fish losses due to harvesting, all Asian carp undergoing surgery will also be fitted with two external Floy anchor tags (provided by USFWS). Commercial fishermen and action agencies working with the MRRWG will be made aware of the project and will be requested to release any floy tagged Asian carp if they are suitable for release, otherwise they will be requested to save the fish and return it to USACE so we can save the transmitter and tag another fish.

No Asian carp caught in Lockport Pool will be tagged and returned as this may result in the distortion of eDNA surveillance. Any Asian carp captured in Lockport or Brandon Road pools will be turned over to the IDNR for species voucher.

Acoustic Network Array

Stationary Receivers – In 2010 and 2011, a system of passive receivers (Vemco VR2W and VR4 Receivers) was placed throughout the IWW in order to monitor movement. The receivers log data from tagged fish when they swim within the detection range of the receiver (typically at least one quarter mile from the receiver). The detection limits of each receiver were tested with a test tag. VR2W‟s were placed from below Dresden Island Lock and Dam (RM 271 of Marseilles Pool, Illinois Waterway) to above the barrier in the CAWS. In some areas, two VR2W‟s were placed to increase the detection capability in high noise or wider riverine settings, or to duplicate monitoring efforts in high risk environments (where receivers may be subject to damage or loss). VR2W‟s were deployed using a variety of methods: stationary deployment using a lead line or marked buoy, or deployment on fixed structures (canal walls, mooring cells, lock guide walls), and will use chain instead of cable to eliminate loss due to vandalism. In the immediate vicinity of the barrier, receivers were placed inside the canal walls in manhole covers constructed for previous telemetry studies for protection against barge traffic. For the 2012 field season, 5 additional VR2W‟s will be deployed within the study area for the purposes of monitoring alternative dispersal routes (i.e. tributaries) and identifying habitat utilized by the principal population of Asian carp. The new receiver locations will expand the study area south to the Marseilles Lock and Dam (RM 247, Illinois River). The expanded study area will facilitate the understanding of the leading edge of Asian carp populations while also filling an information gap between this USACE telemetry plan, a proposed USFWS telemetry monitoring plan, and an expanded SIUC monitoring plan for 2012.

Emergence of a new technology enabled USACE to deploy Vemco VR4 model receivers. These receivers work together as a Vemco Positioning System (VPS) to triangulate the position of the fish in the water to give precise location and movement data. They are submersible for at least 5 years and data is downloaded via wireless modem, thus eliminating the need for manual retrieval (which is optimum for the electrical field environment created by the barrier). These receivers are deployed to the bottom of the canal using a specialized float collar to keep them upright and protected from passing vessels. Currently, we have 8 VR4 receivers covering the areas around Barrier 2A and 2B. VR4 data is sent to Vemco for processing. Data processing typically takes about 3-4 weeks for full analysis.

Figure 11 shows the general strategy of VR2W placement for 2012 (N=21 receivers, reduced from 32 in 2011 as the MWRD study in Bubbly Creek has been completed). Figure 12 depicts a close up view of VR2W and VR4 receivers at the Dispersal Barrier. The priority is to achieve the most coverage (detection capacity) in the immediate vicinity of the Barrier, where most fish will be tagged, to determine if fish are challenging or passing through (upstream or downstream directional movement) the Barrier. The network will expand throughout the system to track overall movement, and to determine what type of movement occurs from fish negotiating lock structures. Receivers will also be deployed at possible escape routes from the telemetry network such as tributary confluences. Movement through lock structures will be compared to USACE lockage data from Marseilles, Dresden Island, Brandon Road, Lockport, T. J. O'Brien, and Chicago locks. Leading edge movements will be monitored by the downstream receivers. Other significant movement patterns will also be compared to river stage and temperature data.

Receivers will be downloaded monthly to retrieve data for analysis, and for maintenance of the acoustic network (i.e. decrease risk of vandalism, ensure operation of device, check battery life, replacement if necessary). Receivers may be downloaded more frequently if needed. All receivers can be downloaded with either a serial port and/or Bluetooth-USB capability. The software is available free online from the Vemco website (http://www.vemco.com/support/vue_dload_form.php). Water quality parameters (DO, pH, conductivity, and temperature) will be recorded at each station during downloads.

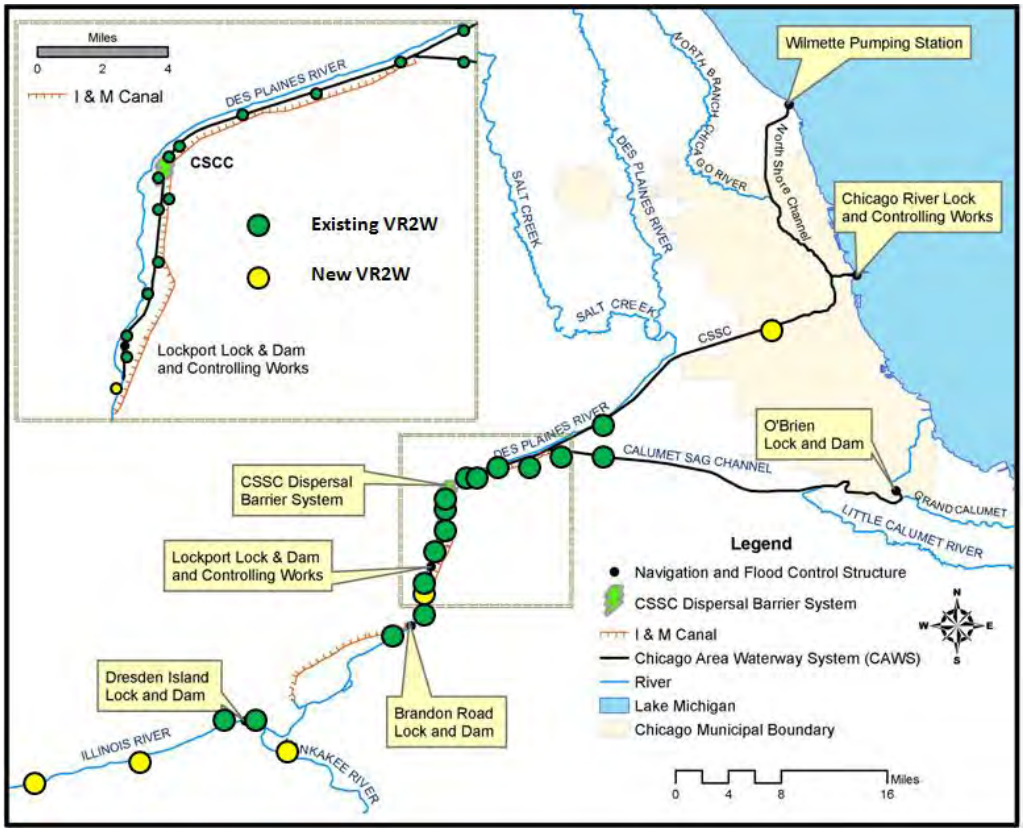

Figure 11. VR2W receiver network within the upper IWW and CAWS.

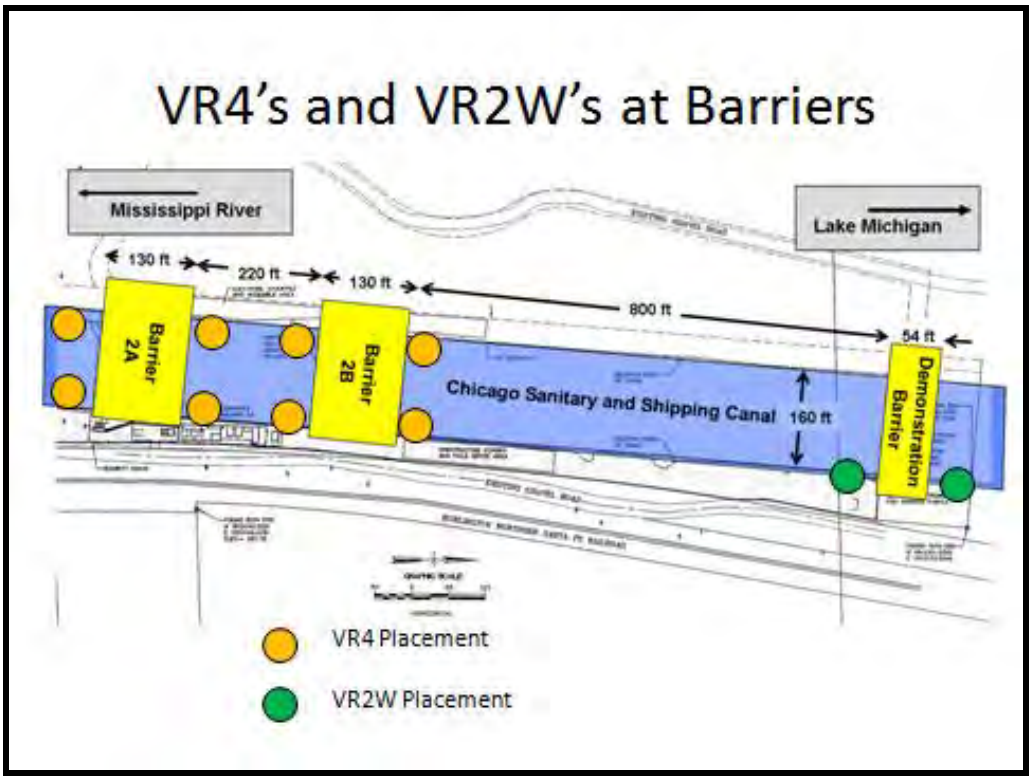

Figure 12. VR2W and VR4 receiver network at the Dispersal Barrier.

Mobile Tracking – The use of a mobile unit (Vemco VR-100 unit with a portable directional and omni-directional hydrophone operated out of a boat) enables a crew to manually locate any tagged fish using the signal emitted from the transmitter inside the fish. The mobile unit will be used to occasionally locate all fish in the study area to ensure an adequate number of active tags in the system are being monitored. Since the stationary receivers give an approximation of where a tagged fish is, the mobile unit can identify the exact location of any fish. This is useful if the stationary receiver data indicate a tagged fish has crossed the barrier, or to locate a fish the receivers have not been able to detect (can confirm viability of fish). The mobile unit will also be used when tagging small fish with the decreased battery life tags, and to monitor fine scale movements. The mobile unit may also be used to locate fish in an area where other monitoring tools (commercial harvest, sonic barriers, etc) are planned to be used that may impact a tagged fish.

Contingency Measures

Tagged fish crossing barrier – As described above, any suspicion (indicated by stationary receiver data) of a tagged fish crossing the barrier can be confirmed by the mobile tracking unit. This will enable crews to locate the exact location of a fish, instead of the approximation detected by a stationary receiver. All agency leads involved with the telemetry plan, as well as the MRRWG, will be notified immediately of any suspected barrier breach. In some cases, it may be necessary to implement a 24-hr track to confirm if the fish of interest is indeed viable.

Other Relevant Studies

An ancillary benefit of this project will be the enhancement of the regional capability of fish tracking at a basin scale. This project will complete the IWW basin acoustic receiver network which extends from the Mississippi River to Lake Michigan and will enable cooperating researchers to document large scale movements of Asian carp and other fish species within the system. The information gathered from this system will enhance the understanding of systemic movement in the basin. Additionally, any fish tagged from this effort that disperse outside of the USACE telemetry network detection area have the probability of being detected on another researcher or agencies network. A list of tagged fish will be available to other researchers, and will be registered with the Great Lakes Acoustic Telemetry Observation System.

Points of contact for other studies in the region using the Vemco acoustic telemetry system include:

- Drs. Jim Garvey and David Glover, Southern Illinois University. Species tagged in Illinois and Mississippi Rivers include: Silver Carp, Paddlefish, Shovelnose Sturgeon, Blue Catfish, White Bass, Walleye, Sauger, and hybrid Striped Bass. Additional Bighead and Silver Carp will be tagged in the Starved Rock and Marseilles pools of the Illinois River during 2012.
- Doug Bradley, LimnoTech, Tom Minarik, MWRD, Dr. Dave Wahl, University of Illinois. Species tagged in CAWS: Largemouth Bass. This study has immediately enhanced the acoustic network by deploying 14 VR2W receivers in the CSSC/Chicago River near Chicago Lock. The study was completed in 2011 but researchers continue to support USACE by leaving hardware in place for deployment of government receivers.
- Jeff Stewart and Sam Finney, USFWS Carterville Fish and Wildlife Conservation Office. Species to be tagged in middle IWW include: Silver Carp and Bighead Carp. This study is scheduled to start in early summer of 2012 and will focus on the early life stages of Asian carp (year-0 and year-1 age classes).
- Dr. Reuben Goforth and Alison Coulter, Purdue University. Species tagged in Wabash River: Silver Carp. The study is ongoing and tracks Silver Carp movements in the Wabash River, a tributary to the Ohio River.

Sampling Schedule: A tentative work schedule is presented below.

April-May 2012	VR2W network inspected and new receivers installed and tested
June 2012	Tagging efforts of Asian carp in the Dresden Island and Marseilles pools and surrogate small fish in Lockport pool at Barriers
October 2012	Tagging efforts repeated for small surrogate species in Lockport Pool
ONGOING	VR2W network maintenance, downloads and mobile tracking

Reporting of Results

All agency leads involved with the telemetry plan, as well as the MRRWG, will be notified immediately of any suspected barrier breach. Periodic updates will be given to the MRRWG in the form of briefings at regular meetings. Data will be summarized for an annual interim report and project plans updated for annual revisions of the MRRP.

Evaluation of Fish Behavior at the Electric Dispersal in the CSSC

Participating Agencies: USFWS Carterville Fish and Wildlife Conservation Office (lead); USACE Chicago District, USFWS Columbia and La Crosse Fish and Wildlife Conservation Offices (field and lab support), Southeast Missouri State University (statistical support).

Location: All work will take place in a 640 m length of the Chicago Sanitary and Shipping Canal north of 135th Street, near Romeoville, Illinois.

Introduction and Need: The electric dispersal barriers in the CSSC (Figure 13) are designed to prevent passage of fish from the Mississippi River Basin to the Great Lakes Basin. The first of these barriers, Barrier 1, has been operating since April, 2002. Information gathered from operating Barrier 1 led to the construction of Barrier 2 downstream of Barrier 1. Barrier 2 is a more robust, dual barrier system, capable of producing electric fields of greater intensity than those created by Barrier 1. The individual barriers comprising Barrier 2, Barriers 2A and 2B, were completed in 2009 and 2011, respectively. Currently, Barrier 1 and Barrier 2B are in operation while Barrier 2A remains in a „warm stand-by" mode.

Barrier 1 has a single, high-field electrode array, while both Barriers 2A and 2B consist of two arrays: a low-field and a high-field array (Figure 14). The low-field array creates a low-intensity electric field at the downstream side of the barrier; the high-field array creates a high-intensity electric field at the upstream side of the barrier. This design creates a gradual increase in electrical intensity, from downstream to upstream, aimed at stimulating avoidance behaviors in fish (Holliman 2011).

Laboratory experiments that mimic the Dispersal Barrier and study fish behavior related to various electrical settings were used to determine the optimum operating parameters for the barriers subsequent to the installation of Barrier 1 based on Smith Root"s patented design (Holliman 2011). Research and testing has included exposing juvenile Silver Carp 5.4 to 11 inches in length to barrier electric fields in a tank at various combinations of the three operating parameters (pulse frequency, pulse duration, and voltage). Results indicated that all of the fish tested were immobilized by the electric field currently in use since August of 2009 at Barrier 2A. Subsequent phases of testing have focused on smaller carp to determine whether small fish, 2-3 inches in length, will be immobilized or deterred by the current Barrier 2A settings (field strength: 2.0V/in, pulse frequency: 15 Hz, pulse length: 6.5ms). As a result of that study, new operating parameters (field strength: 2.3 V/in, pulse frequency: 30 Hz, pulse length: 2.5 ms) were implemented at Barrier 2 in 2011, and are expected to effectively incapacitate very small Asian carp (Holliman 2011). Results of these tests will be fully analyzed and presented in USACE"s Interim II Efficacy Study, in combination with other relevant information, such as information regarding the safety implications of operating the Dispersal Barrier at higher parameters.

While the results of initial laboratory trials are sound, additional field trials are warranted, particularly with the new operational parameters in place. We will conduct surveys with Dual-Frequency Identification Sonar (DIDSON) to examine abundance and behavior of fishes located

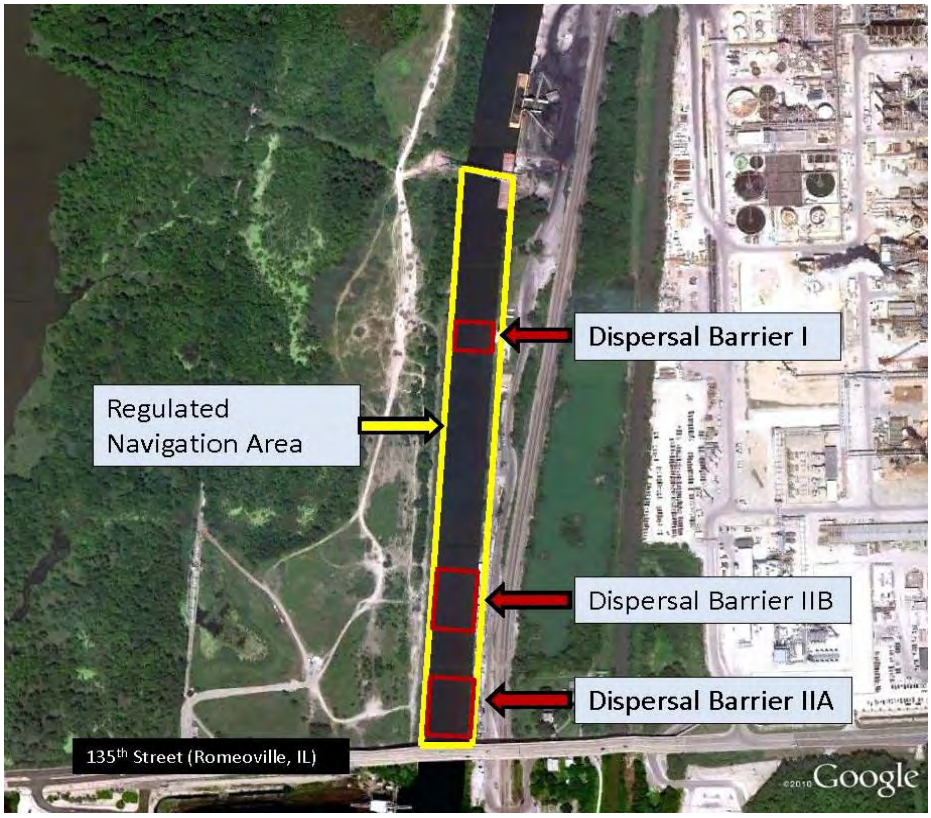

Figure 13. Aerial image of the Chicago Sanitary and Ship Canal showing the approximate locations of the electric dispersal barriers.

in and around the Dispersal Barrier. In addition, DIDSON will be used to monitor the behavioral response to the barrier of various-sized fish (not Asian carp) placed in non-conductive cages dragged through the barrier field. These *in situ* assessments will add to our understanding of the effectiveness of the Dispersal Barrier in preventing fish passage between the Mississippi and Great Lakes basins.

Objectives: Our goal is to add to the body of information on the interaction of fish and electric barriers by observing fish behavior at the barrier, particularly given the difference in scale between the barriers used in laboratory studies and the barriers in the CSSC. Specific objectives of this field study are:

1) Describe the behavior of caged-fish that are forced to swim through the low and high-intensity fields of Barrier 2 along a fiberglass-hull boat (This represents fish that attempt to penetrate the barrier in open water with no metal hull boats present, as the fiberglass hulls have no effect on the electrical currents.);
2) Describe the behavior of caged-fish that are forced to swim through the low and high-intensity fields of Barrier 2 along a metal-hull boat (This represents fish that attempt to penetrate the barrier along metal-hulled boats or barges that have an effect on the electric field.);
3) Describe the behavior of wild fish (i.e., any free-roaming fish) within and around the electric fields;

4) Determine the relative abundance of wild fish in the barrier area versus adjacent areas of similar habitat; and
5) Describe chemical/physical characteristics of the CSSC throughout different seasons and in event that either caged-fish are observed passing through the barrier or wild fish are observed swimming normally in the barrier.

Status: Data for both caged and wild fish observations were collected from June to November 2011 under the original operational parameters (field strength: 2.0 V/in, pulse frequency: 15 Hz, pulse length: 6.5 ms) at the following times:

- Week of June 28 – 48 wild fish site observations
- Week of August 8 – 80 wild fish site observations
- Week of August 16 – 30 caged-fish runs with metal-hull boat
- Week of August 30 – 80 wild fish site observations
- Week of September 13 – 30 caged-fish with metal-hull boat
- Week of November 15 – 30 caged-fish runs with non-conductive-hull boat

On November 29, 2011, new operating parameters (field strength: 2.3 V/cm, pulse frequency: 30 Hz, pulse length: 2.5 ms) were implemented at Barrier 2 and field work was completed at the following times:

- Week of November 30 – 30 caged-fish runs with non-conductive-hull boat
- Week of December 13 – 30 caged-fish runs with non-conductive-hull boat
- Week of January 9, 2012 – 80 wild fish site observations
- Week of January 30, 2012 – 80 wild fish site observations
- Week of February 6, 2012 – 80 wild fish site observations

Review and analysis of DIDSON footage from these wild and caged-fish observations is ongoing and will be summarized and presented at a later time.

Methods: All work will be conducted in or adjacent to the part of Barrier 2 that is electrified at the time of our field work. Sampling will take place five weeks out of each season, for a total of twenty weeks of sampling per year (actual number of weeks may vary as the unit of effort is based on the number of observations). Each season, two weeks will be devoted to caged-fish trials and three weeks to wild fish observations. The first week of sampling will be dedicated to wild fish observations. This will be followed by two weeks in a row of caged-fish observations (see below for detailed rationale), followed by two separate weeks dedicated to wild fish observations. Actual weeks sampled will depend on crew and equipment availability. Seasons will follow astrological guidelines. In 2012, the seasons will encompass the following dates: spring: March 20 – June 19, summer: June 20 – September 21, fall: September 22 – December 20, and winter: December 21 – March 19.

Many fishes in the Great Lakes and Mississippi basins increase movement and spawn in the spring (Smith 1979; Becker 1983; Kwak 1988; Hubbs et al. 2004) thus we may see increased fish activity near the barrier at that time. Riverine fishes, including Asian carp, tend to move upstream in the spring when water flows increase (DeGrandchamp et al. 2008). Often times, fish

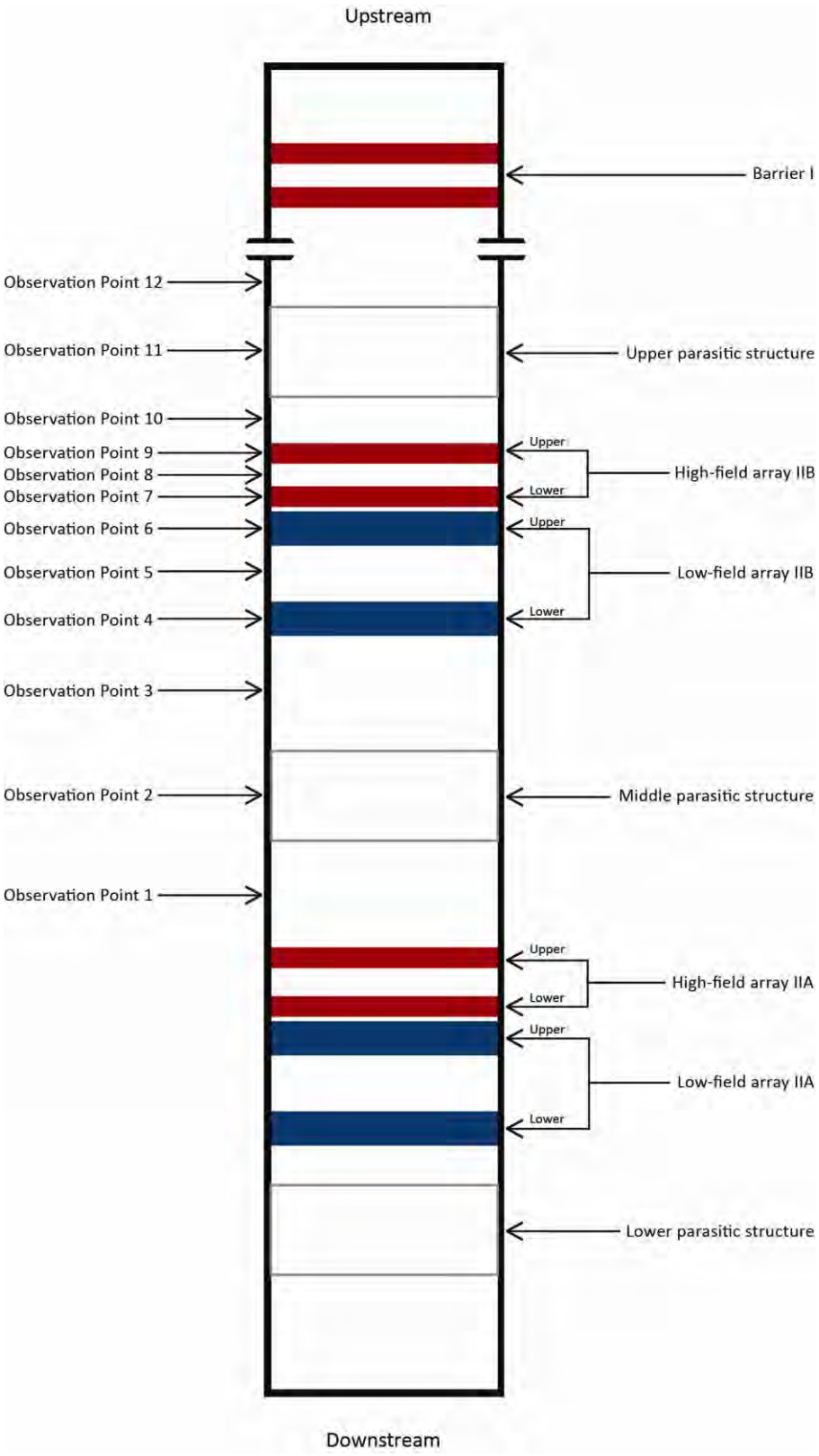

Figure 14. Schematic of the electric dispersal barrier system and the 12 observation points for the caged-fish trials.

will move upstream until they reach an impassable barrier. December through March is when the highest conductivity readings have occurred in the CSSC (MWRD, unpublished data), most likely from road salt run-off. High conductivity weakens the effect of electrical barriers on fish (Holliman 2011). Because the early spring period is when fish activity may be high and the electrical field of the barrier may be weakened by increased conductivity, we propose that spring sampling begin as soon as possible in 2012.

Caged-Fish Behavior Study

For caged-fish trials, an aluminum-hull boat will be used for one week of tests and a fiberglass-hull boat will be used for the other week of testing. The two fish trials will take place during two consecutive weeks. This will be to control for temporal variation in environmental variables, such as conductivity in the CSSC that may affect fish behavior and/or electrical conductivity in the water. Dettmers et al. (2005) found that metal-hulled boats interfere with the electric fields in the CSSC electrical barrier and therefore influence fish behavior. Metal-hull boats and barges traverse the barriers regularly. Dettmers et al. (2005) found that when large metal barges passed through Barrier 1 that the electrical field warped toward the hull of the barge and created voids along the sides and rear parts of the barge where fish could swim and not be affected by electricity. Because of these voids, some fish were able to pass through the entire length of Barrier 1 unaffected by electricity (Dettmers et al. 2005). Furthermore, there has been at least one documented instance of a tagged Common Carp passing through Barrier 1, from downstream to upstream, concurrently with the passage of a barge (Sparks et al. 2011). These previous findings at Barrier 1 helped to inform the design and operation of Barrier 2. Telemetry studies are currently underway to test the efficacy of Barrier 2 (see Telemetry Monitoring Plan above), with caged-fish trials using metal and fiberglass-hulls providing additional information.

Once in the cage, a mounted video camera in the boat will record fish behavior as the boat travels through the canal. The use of an above-water video camera has several advantages over the DIDSON. Because the DIDSON can only record the fish from a side profile, fish that are swimming next to the fish that is closest to the DIDSON will be obscured from view, whereas the video camera views the top profile of all the fish and their behavior can be easily observed throughout the entire trial. Also, debris and bubbles that pass under the boat, between the DIDSON and the cage, can obscure behavioral observations. Lastly, each marked site that the cage passes (Table 14) can be clearly spoken into the video recorder by a designated boat crew member. This makes observational data collection easier later (reviewers in the office will record fish behavior at the point where they hear a verbal cue), whereas, with DIDSON recordings, more data collection is necessary because the DIDSON recording times must be recorded at each site, which workers must reference later when viewing the videos.

As the boat passes each marked site, a worker will verbally announce the site number loudly and clearly enough for the video camera to record their voice. A voltage meter that continuously reads electrical voltages will be attached to the side of the boat and voltage readings will be recorded by boat personnel at each site. Other data gathered during each test or recording will include size of fish, season, weather conditions, location across the canal, and barrier output. Conductivity, salinity, discharge, turbidity, and depth will also be collected using a Hach Quanta Hydrolab from the safety boat positioned downstream of the barrier. A Swoffer Instruments Model 3000 flow meter will be attached to the boat to track cumulative current velocity (canal

current and boat speed combined) during caged-fish trials and canal current velocity will be recorded from the safety boat during wild fish observations. Continuous canal discharge data will be obtained from a USGS-operated hydrologic unit located in the CSSC at the Lockport Controlling Works approximately five river km downstream of the barrier (http://waterdata.usgs.gov/il/nwis/). Continuous conductivity data will be obtained from a USGS station located approximately 10.5 river-km upstream of the barrier (http://waterdata.usgs.gov/il/nwis/). Additional chemical/physical data such as nutrients will be obtained from the MWRD website (http://www.mwrd.org/). The MWRD makes weekly water collections at stations throughout the CAWS. The closest collection stations to the barrier are located approximately 6.25 river-km upstream and 5 river-km downstream of the barrier. Hydrology and water quality data from USGS and MWRD will be used along with *in situ* chemical/physical measurements taken by USFWS field staff for descriptive statistics (described below).

Fish observation data will be saved on a laptop computer while working in the field. Data will then be backed up to an external hard drive each night after sampling is complete. Upon return to the Carterville Office, all data collected during the sampling trip will be backed up to an additional external hard drive. Three copies of the data will be maintained on separate devices at all times to prevent any accidental loss of information. Two external hard drives will be stored at the Carterville Office and a third will be stored at the Crab Orchard National Wildlife Refuge office in Marion, Illinois.

Study Sites - Trials will be performed at three sites in the canal. Sites were selected to test for differences in fish behavior between fish forced to pass through the canal at mid-channel, in close proximity to a canal wall, and through a control section:

- **Mid-channel test area -** Extends from observation point 1, downstream of the electrified barrier, to observation point 12 upstream of the electrified barrier (Figure 14) in the middle of the CSSC.

- **West-wall test area -** Extends from observation point 1, downstream of the electrified barrier, to observation point 12 upstream of the electrified barrier (Figure 14) along the west wall of the CSSC. The west wall was selected based on the design of the work boat and cage mount. The cage is mounted to the port side of the boat. Therefore, when traveling upstream, it can be deployed closer to the west wall than the east wall.

- **Control site:** Located outside the electrified area of water, and covers the same distance as the test sites. Because there is no electricity in the control site, there is no benefit to performing controls both near the canal wall and in mid-channel; control runs will be performed mid-channel only (Figure 15).

Surrogate fish - The use of Asian carp for this study is prohibited due to concern a fish may escape from the cage, necessitating the use of a surrogate species. Gizzard shad (*Dorosoma cepedianum*) was determined to be the best surrogate species available for this study. Gizzard shad have a similar morphology to that of small Asian carp, occupy similar pelagic habitats, and are readily available in the CSSC. Also, gizzard shad was one of two species that was able to

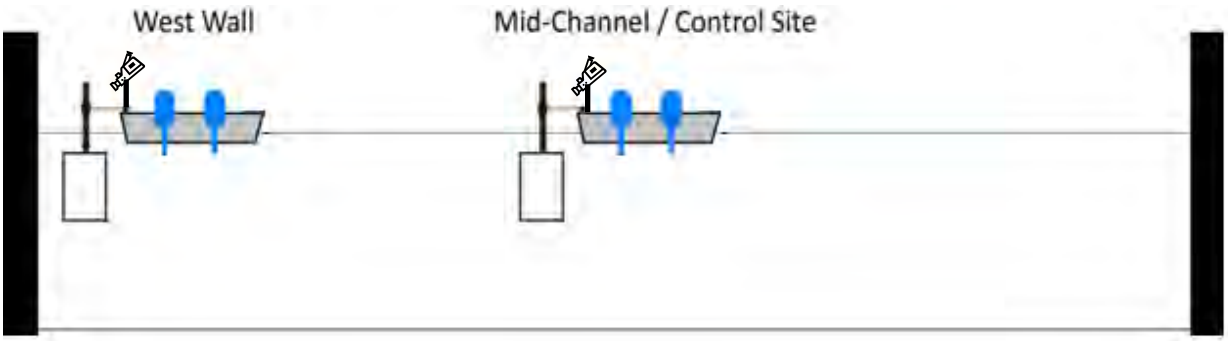

Figure 15. Cross sectional diagram of the CSSC depicting the fish cage apparatus with mounted video camera and the three sites used for caged-fish trials. The control site is located mid-channel, outside the electrified area of water. The west wall and mid-channel test sites extend through the electrified barrier.

maintain position in the test cage while being towed upstream during pilot studies. Also, based on very limited references, small Asian carp and gizzard shad appear to have similar maximum sustained swimming abilities. Katzenmyer and Hoover (2011) found that individual Asian carp (36-69 mm TL) exhibited maximum sustained swimming speeds of 20 cm/s, and Barnes (1977) found that gizzard shad (25-50 mm TL) exhibited maximum sustained swimming speeds of 23 cm/s. Common Carp (*Cyprinus carpio*) also tested well in the cage, but their morphology is not as similar to Asian carp and they are bottom-oriented. Also, small specimens (50-100mm TL) are difficult to locate in the wild with traditional sampling gear.

Ideally, surrogate fish will range in size from 50-100 mm. These sizes of fish encompass those used in laboratory testing performed by Holliman (2011; 51-76 mm TL). The actual size of fish used will depend on capture success in the field. Every attempt will be taken to keep test fish in the desired range, but sizes of fish will likely increase throughout the growing season. Also, in order to reduce fish stress prior to cage trials, length and weight measurements will not be done until after the fish have been forced to swim through the length of either the test or control portions of the canal.

Fish will be collected several hours prior to the cage trials using a cast net. Electrofishing will be used to collect additional fish if cast netting proves unproductive. To prevent additional stress on test fish, handling will only occur twice before a trial: once to capture the fish and place in a live well, and again to move them from the live well to the test cage. The live well will have air circulation and remain in the boat at all times to prevent excessive handling of fish. Only fish that appear to have fully recovered from capture will be used in a trial. This determination will be made by biologists in the field prior to testing fish.

Fish trials - Thirty test groups consisting of five fish per group will be used in each week of testing. No fish will be used in more than one test. Ten groups will be tested along each of the three sites. All test fish will be placed in a cage that is attached to the side of the boat with custom-made mounting yolks (Figure 16). Fish will be given one minute to acclimate to the cage before they are moved through the sites. During this time, fish will be allowed to swim freely in the cage. Fish will be observed with an above-water video camera to ensure they exhibit a relaxed or normal behavior within the cage before testing begins.

Fish will be moved upstream through the length of the electric fields. The speed of the boat shall not exceed the maximum swimming ability of the fish being tested. If fish are incapacitated during tests, they will be brought completely through the electric field and observed for a maximum of 5 minutes to see if they recover from the electric shock. Each trial will consist of 12 observations. Observations will be taken at on-shore landmarks representing areas on top of barrier hardware and areas in between barrier hardware (Figure 14). These observations will allow us to analyze fish behavior as they are progressively moved through the barrier from downstream to upstream.

Data review and analysis - Fish behaviors will be recorded by documenting observations into four categories: no response, flight, incapacitation, and recovery. A "no response" observation means that the fish does not deviate from its normal swimming behavior documented at the beginning of the trial. "Flight" is defined as a fish deviating from its normal swimming behavior without being incapacitated. Deviations can include the following from Dettmers et al. (2007): short bursts of rapid swimming, circling, darting, zigzagging, vibrating, and erratic swimming. "Incapacitation" occurs when a fish is no longer able to maintain position and becomes impinged on the back side of the test cage. "Recovery" indicates that a fish resumes normal swimming behavior after being incapacitated during the trial.

Recordings will be reviewed at the Carterville Office. Fish behaviors for all five fish will be recorded when the reviewer hears the verbal cue given by the field worker at each site. Reviewers will be allowed to pause and replay videos as much as necessary to accurately record

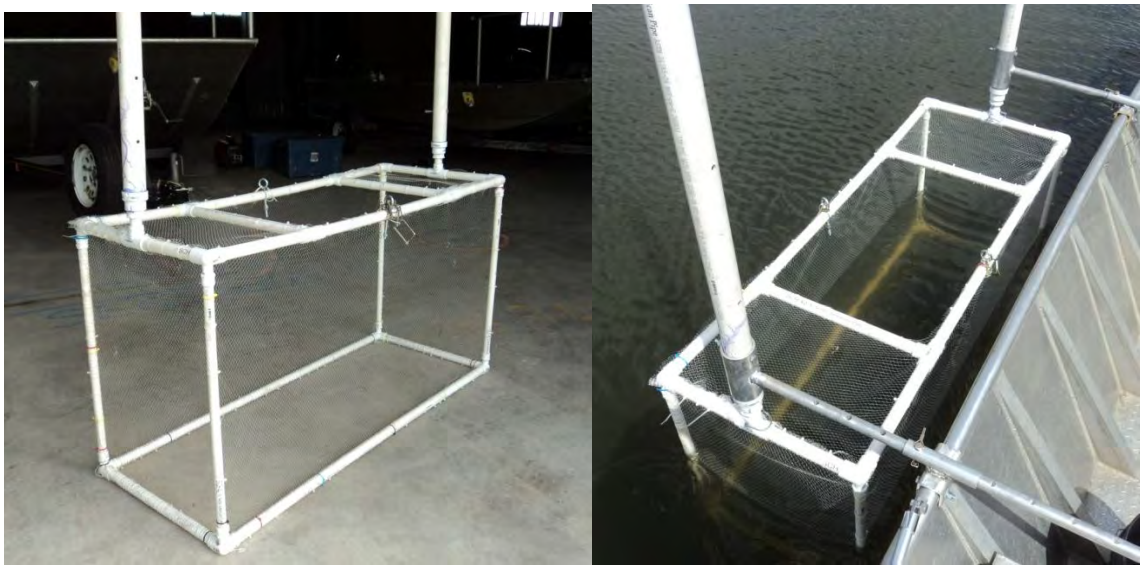

Figure 16. Fish cage used for the caged-fish study. The cage frame is constructed of non-conductive 1.9 cm and 2.5 cm diameter polyvinyl chloride (PVC) piping. Cage dimensions are 160 cm long x 58 cm wide x 89 cm deep. The opening on top of the cage is 50 cm wide by 76 cm long, and can be covered with a lid. To mount the cage, two PVC pipes, 152 cm long and 7.6 cm in diameter, are attached to the top of the cage and slide through a custom-made apparatus for mounting and depth adjustments. The cage mesh is 0.95 cm bar monofilament netting.

behaviors. Caged-fish videos will be reviewed by two workers upon return from the field site. Each reviewer will be trained and given a list of the four different fish behaviors possible (described above) to record. If there is disagreement between the two reviewers about caged-fish behavior a third person will review the footage. If the third reviewer agrees with one of the previous two reviewers, those behavior data will be used for the analysis. If there is disagreement between all three reviewers, those data will not be included in any analysis. Principal Components Analysis (PCA) will be used to determine proportions of fish exhibiting each of the recorded behaviors at all observation points. These particular behavioral observations are typically dependent upon one another. PCA will allow us to analyze each behavior independently. A stepwise regression will detect influences from environmental variables on the principal components.

Binary logistic regression will model the probability of a behavior of interest with increasing voltage. The slopes of the regressions from different trials (mid-channel, wall and control) can then be compared with a t-test. Principal components analysis will also be used to summarize chemical/physical characteristics for each week using *in situ* data collected near the barrier at the time of the fish trials, USGS discharge data, and MWRD data collected that week. Principal components analysis bi-plots will be produced of principal component scores and chemical/physical variable eigenvectors will be plotted. The main value of the PCA bi-plots will be in the event that fish are able to successfully swim through the entire length of the barrier without becoming incapacitated or further through the barrier than usual before becoming incapacitated. In this case, PC scores will be labeled according to whether a fish successfully penetrated the barrier/delayed incapacitation or not that week in order to examine what the chemical/physical characteristics in the CSSC were that week.

Wild Fish Observations

The DIDSON is a non-intrusive acoustic camera that can be used in turbid water to observe fish behavior and location in real time. The DIDSON can be set in a variety of ways to gather high quality images in close proximity to the unit, or images of decreasing quality at greater distances. Recent pilot studies have shown that the electric barriers have no effect on the electronic components of the DIDSON (Cornish et al. 2010). The DIDSON has some technical limitations. A single unit will not provide complete cross-sectional coverage in the CSSC. Also, a DIDSON can be used to measure the length of a fish (Burwen et al. 2010), but it generally cannot be used to identify species (Zeigler et al. 2009). Given this, any wild fish observed during field studies will be considered a surrogate for similarly-sized Asian carp when describing fish behavior. The DIDSON will only be used for underwater wild fish observations.

Three weeks of wild fish observations will take place each season. Eight sites are designated for sampling and sites were selected to incorporate a range of electrical intensities from no electrical input below the electric barriers, to the highest electrical input, and continuing to no electrical input above the electric barriers (Figure 17). Each site is sub-divided into ten sections to provide the best coverage possible across the canal, including the canal walls, which have been a potential concern for weakening the electrical fields (ACRCC 2012; Figure 18). Only one week per season will be spent observing all eight sites. This will be referred to as the "standard" fish observation week. During those observations, sites and subsections within sites will be observed

in a random order. Each subsection will be recorded for ten minutes (100 minutes total recording for each site, 800 minutes total recording for entire study area).

Two weeks per season will be spent concentrating an equal amount of effort observing fish behavior over sites 5 and 6 where the high-field electrical barriers are operating (referred to as "concentrated site observations"). More effort is going to be focused within the high-field barriers because fish behavior in those areas is a primary interest. The two sites and ten subsections will again be randomly selected, however, each subsection will be observed four different times for ten minutes (800 total observation minutes). The eight sites are described as follows:

Site #1 - Immediately downstream of all electric barrier structures. This site is an area with no electrical input downstream of the barriers.
Site #2 - Over the downstream edge of the lower parasitic structure. This site is the last non-electrified water just below the electric fields, where upstream migrating fish may potentially accumulate.
Site #3 - Over the lower parasitic structure. This site is the first area where fish are likely to detect electrical input.
Site #4 - Over the downstream edge of the lower electrode bank in the low-field array. This site is the beginning of the low-field array, and was selected because it is the first area of significant electrical input and also a location where fish may potentially accumulate.
Site #5 - Over the downstream edge of the upper electrode bank in the low-field array. This site has greater electrical input than site 4 and leads into the high-field array.
Site #6 - Center of the upper high-field array. This site has the highest electrical input.
Site #7 - Over the upper parasitic structure. This site is the last area of electrical input above the barrier.
Site #8 - Upstream of all electric barrier structures. This site is an area with no electrical input upstream of the barriers.

Within the eight wild fish sites, subsections are as follows (see Figure 18):

Section A: upper west wall
Section B: lower west wall
Section C: western third of the channel looking west at the channel bottom
Section D: western third of the channel looking east at the channel bottom
Section E: mid-channel looking west at the channel bottom
Section F: mid-channel looking east at the channel bottom
Section G: eastern third of the channel looking west at the channel bottom
Section H: eastern third of the channel looking east at the channel bottom
Section I: lower east wall
Section J: upper east wall

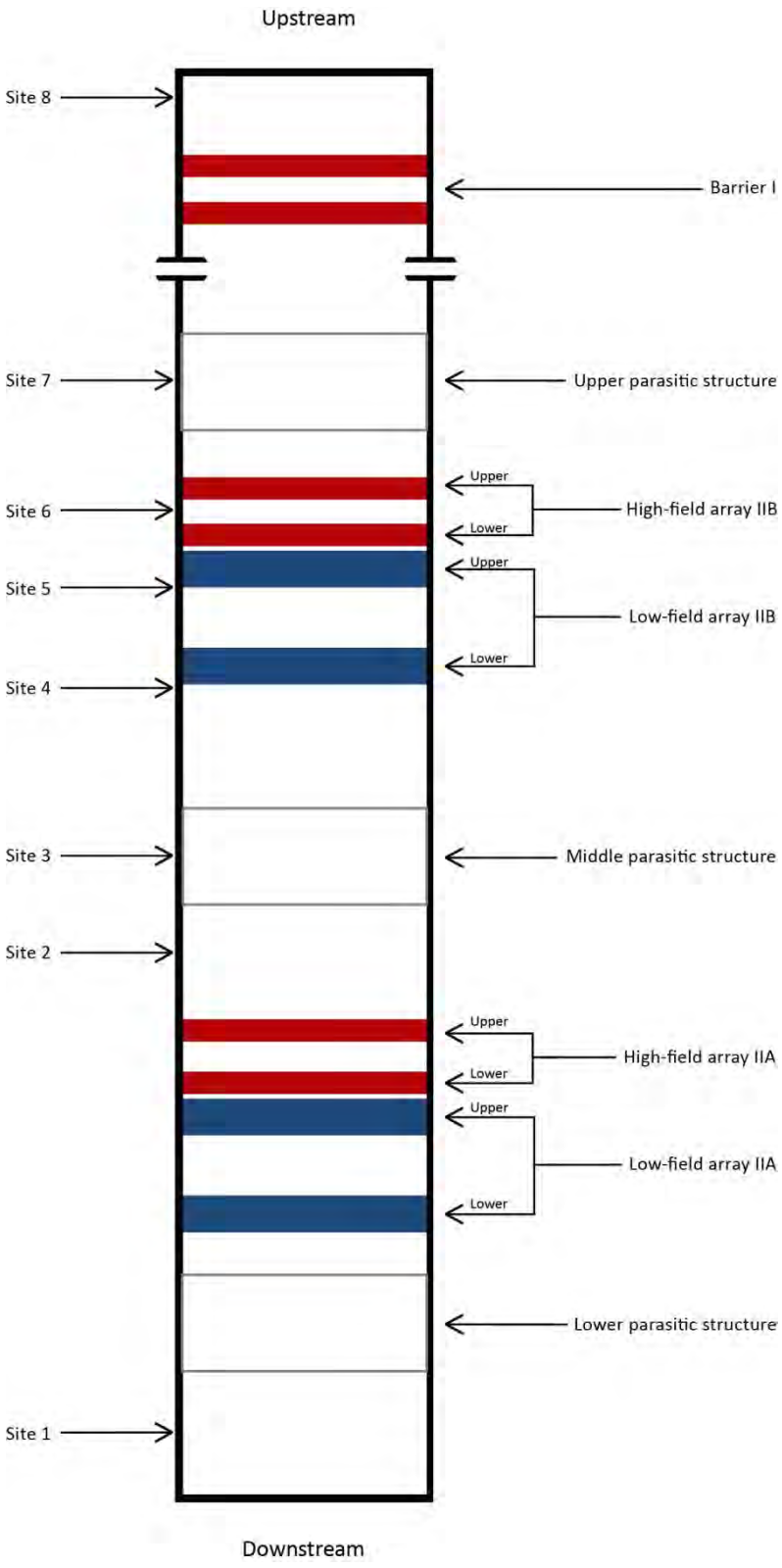

Figure 17. Schematic of the electric dispersal barrier system and the sites for wild fish observations.

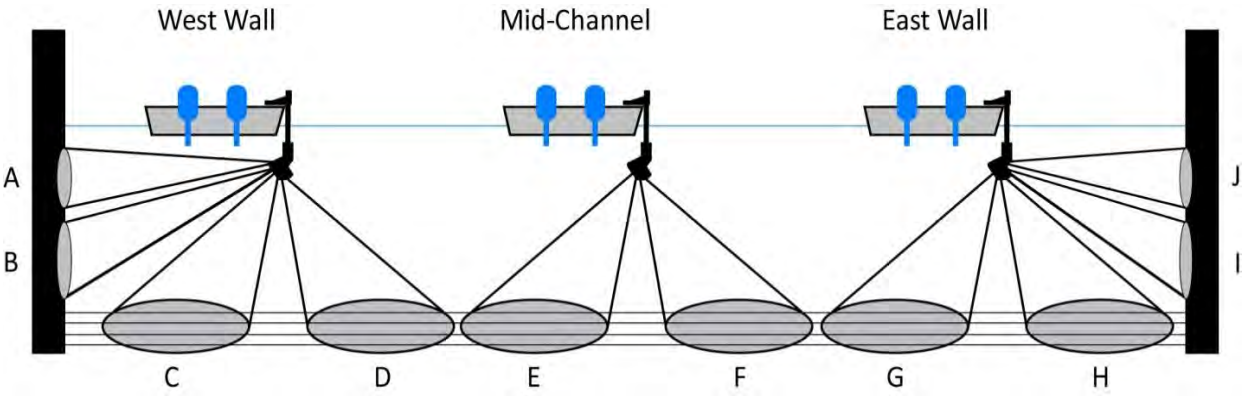

Figure 18. Diagram of the ten subsections (A-J) across the canal at each wild fish study site. The black figure shows the DIDSON mounting apparatus and camera. The cones represent the DIDSON field of view, and the shaded gray ovals represent the view of the canal floor.

The DIDSON deployment angles will vary slightly among sections and with fluctuating water levels. At sections C through H the DIDSON will have a downward tilt of 45 degrees. At sections A and J the DIDSON will be deployed at a 0 degree downward angle and at sites B and I at a 25 degree downward angle. These angles will be adjusted slightly at each section in order to obtain the best possible image.

Limitations to the DIDSON data are that maintaining the field boat in position at the canal sites for a ten-minute recording time can be difficult, especially when weather conditions are windy and/or the canal current is flowing fast. This in turn, makes reviewing footage recorded during these conditions difficult as well. Other limitations to the DIDSON recordings are that the entire width of the electrical barriers often cannot be viewed. Therefore, even if a fish is seen swimming normally through the electric barrier, it will be very difficult to discern whether or not it was able to traverse the entire length of the barrier or not. However, even if a fish is observed maintaining position directly over a barrier, that will still be a cause for concern. Reviewing barrier footage over subsections C-H (Figure 18) is not as difficult because the barrier structure is clearly visible and can be easily used as a reference marker for where fish should be counted. However, subsections A, B, I, and J (wall footage; Figure 18) are difficult to tell where the barrier begins and ends. Therefore, we propose hanging non-conductive markers that are visible with the DIDSON, such as plastic bottles full of sand off of the walls above the barrier edges. These markers would then serve as a guide for reviewers to observe fish.

Field personnel who have been stationed on shore as safety spotters adjacent to the barrier have observed Common Carp that were swimming upstream to areas with electric current and then swimming east and west along the width of the barrier. Field personnel have also observed Freshwater Drum (*Aplodinotus grunniens*) and White Perch (*Morone americana*) float downstream at the barrier surface and recover after passing the barrier. No wild fish have been directly observed by field personnel successfully swimming upstream through the barrier. Because wild fish have been observed lingering below the barrier and the DIDSON does not give a full view of the entire length of the barrier, we propose that a shore-based video camera(s) be positioned above the barrier on a tripod(s) for the entire field day to record fish behavior at the surface near sites 4, 5, and 6, while DIDSON footage is being recorded from the boat. This will

provide us with video documentation of notable events and will provide additional "eyes" on the water to capture events unnoticed by the spotter when the spotter is watching the boat in the barrier area. In the event that the safety spotter observes fish near the barrier he can adjust the camera and focus on specific fish or groups of fish as necessary. This will only be done when the field boat is not in the canal, so as not to preclude the main duty of the safety spotter.

Data review and analysis: Sonar recordings will be reviewed at the Carterville Office. Two workers will review each video together and record data. If the two reviewers disagree about whether a fish is present, or about behavior, a third reviewer will be consulted. Reviewers will be allowed to pause and replay DIDSON images as much as necessary to accurately count fish and observe behavior. Absolute numbers of individual (non-schooling) fish will be counted and their behavior recorded (swimming normally, no response to barrier, flight, probing the barrier, incapacitation) in each sample. Obtaining accurate counts of individual small fish (<100 mm TL) that are schooled is extremely difficult with DIDSON images (Becker et al. 2011). Because of this difficulty, the number of fish occurring in schools will be estimated. The sizes of the schooled fish will be measured on a subset of fish and the average size will be applied to individuals in the school, since similarly-sized fish tend to school together (Becker et al. 2011). Fish sizes will be measured using the measurement tool in the DIDSON software program.

If the reviewers record seeing any fish exhibiting normal swimming behavior in the high-field barrier (areas meant to repel fish, such as directly over the arrays), chemical/physical data will then be further analyzed as described above. Counts of individual small (<100 mm TL) and large (>100 mm TL) fish will be analyzed separately. An ANOVA test will be used to test for significant differences in fish abundance among sites, sub-sections, and seasons. In the absence of the electrical barrier we would assume that fish numbers would be homogenous throughout the 640 m stretch of canal that is being studied. Therefore, the null hypothesis is that fish abundances are homogenous across sites 1-8. The alternative hypothesis is that fish abundances will be different among sites. Fish count data will be transformed [$\log_e(n + 1)$] prior to analyses to normalize data. If an overall significant difference is found ($\alpha < 0.05$), Tukey's HSD tests will be performed post hoc in order to identify which sites were different. Frequencies of the schooled-fish categories will be compared using chi-square contingency tests (tests of independence) among the canal sections (Becker 2011).

If field crews should make any observations that would indicate fish in DIDSON experimental cages or wild fish are not being deterred by the electrical barrier, these observations will be reported immediately to Todd Turner, USFWS Assistant Regional Director-Fisheries or Charlie Wooley, USFWS Deputy Regional Director - Region 3. Information also will be shared with MRRWG agency representatives, as appropriate.

Deliverables: Data will be summarized for an annual interim report and project plans updated for annual revisions of the MRRP. A final report for this project will be completed by approximately summer 2013. The final report will be distributed to interested parties upon completion of four seasons (approximately one year) of sampling. A separate, smaller report will be produced for data recorded at the old operating parameters (field strength: 2.0 V/in, pulse frequency: 15 Hz, pulse length: 6.5 ms) once the data are fully analyzed.

Monitoring for Asian Carp in the Upper Des Plaines River and Upper Des Plaines River Overflow

Participating Agencies: USFWS – La Crosse Fish and Wildlife Conservation Office (lead): IDNR (as needed field support)

Introduction and Need: Fish can freely move into and out of the upper Des Plaines River via the confluence with the CSSC, and Asian carp have been observed in the Brandon Road Pool near the confluence. Asian carp eDNA also has been detected in the Des Plaines River above the confluence. There is potential risk that Asian carp could gain access to the CSSC upstream of the dispersal barrier during certain high-water events when water from the upper Des Plaines River flows laterally into the CSSC, although that possibility has been reduced by the construction of a physical barrier described below.

A physical barrier made of concrete barriers and small-meshed fencing was erected by USACE along 13.5 miles of the upper Des Plaines River to prevent Asian carp from infiltrating the CSSC and then Lake Michigan. The barrier/fence was designed to prevent adult and juvenile Asian carp from moving between waterways, but eggs and fry could pass through the 0.25 in mesh fencing with flood waters. During a July 2011 flooding event, the fence was breached and small fish about 30 mm TL moved under the fence and were collected on the CSSC side of the fence. Knowing the population status of Asian carp and if they are spawning in this reach of the Des Plaines River, and determining the effectiveness of the physical barrier, will inform management decisions and direct fish removal actions.

Objectives: There are two major objectives for this study plan:

1) Monitor Bighead and Silver Carp and their spawning activities in the upper Des Plaines River above the confluence with the CSSC; and
2) Monitor Bighead and Silver Carp around the physical barrier when water moves laterally from the upper Des Plaines River into the CSSC during high flows.

Status: This project was proposed in 2010 and initiated in 2011, and was reviewed and accepted by the MRRWG. Sampling in 2011 on the upper Des Plaines River included 10.4 hours of electrofishing and 40.3 hours of trammel netting (1,452 yards) and captured 1,178 fish. No Asian carp were captured or observed during sampling. For more detailed results see the 2011 interim summary report document (MRRWG 2012).

Methods: For Objective 1, three sites on the Des Plaines River will be monitored: downstream from the Hofmann Dam; the Columbia Woods Forest Preserve area; and in the vicinity of the Lemont Railroad Bridge landing. Monitoring will include electrofishing and short-term sets of gill and trammel nets.

For Objective 2, critical USGS and USACE gauges will be remotely monitored to help determine pending high flow events, as well as coordination with USACE personnel. The barrier itself will be utilized as a sampling device by serving as a hardened gill net. Staff will walk along the barrier after the water has receded to collect and identify impinged fish and also sample on the CSSC side of the fence if the fence has been breached.

Sampling Schedule: Monitoring will be initiated in the upper Des Plaines River in the April-May period to determine Asian carp status and again in the May-July period to look for spawning fish. Additional sampling will be conducted if: Asian carp eggs are collected at the confluence of the upper Des Plaines River and CSSC; if tagged fish are tracked in this reach of the Des Plaines River; or if there are two consecutive eDNA sampling trips in the Des Plaines River with positive detections for either Bighead or Silver Carp. All over-topping events will be monitored.

Deliverables: Results of each sampling event will be reported for weekly sampling summaries. Data will be summarized for an annual interim report and project plans updated for annual revisions of the MRRP.

Asian Carp Gear Efficiency and Detection Probability Study

Participating Agencies: INHS (lead), Western Illinois University and Eastern Illinois University (field and lab support)

Location: Evaluation of sampling gears will take place in three segments of the Illinois Waterway and CAWS. Five sites in the middle Illinois River (LaGrange and Peoria pools), three sites in the upper Illinois/lower Des Plaines rivers (Starved Rock, Marseilles, and Dresden Island pools), and two sites in the CAWS upstream of the electric barrier will be sampled as part of this evaluation.

Introduction and Need: Multi-agency sampling and removal efforts are currently ongoing in the Illinois River and the CAWS to monitor and control the spread of Asian carp. A variety of traditional sampling gears (electrofishing, gill nets, trammel nets) are being employed by various agencies to capture Asian carp, but the relative efficiency of each of these gears, and the amount of effort required to detect Asian carp when they are present in low densities, has not been evaluated. Determining detection probabilities for Asian carp, and examining factors that contribute to variation in detection probabilities, would allow for determination of appropriate levels of sampling effort and help improve the design of existing monitoring regimes. Additionally, testing new techniques for detecting the presence of Asian carp is warranted in order to enhance monitoring efforts. A variety of alternative sampling gears (hydroacoustics, midwater trawls, purse seines, trap nets, mini-fyke nets, hoop nets, cast nets, seines) are available that may potentially be more effective at detecting Asian carp than methods currently being used. Evaluating the ability of these methods to detect both juvenile and adult Asian carp will allow managers to customize monitoring regimes and more effectively determine abundances of Asian carp. Several new gears devised for sampling in the unique conditions present in the CAWS (large hoop nets, surface-to-bottom gill nets, Great Lakes trap nets) have also been developed that may aid in the detection of Asian carp in this system. Testing these and other new gears as they become available will allow Asian carp monitoring efforts to better adapt to the challenges of sampling in the CAWS. Results of this study will help improve Asian carp monitoring and control efforts in the Illinois River and the CAWS, and will contribute to a better understanding of the biology of these invasive species in North America.

Objectives: We will use a variety of sampling gears to:

1) Determine site characteristics and sampling gears that are likely to maximize the probability of capturing Asian carp;
2) Estimate the amount of effort required to detect Asian carp at varying densities with each gear;
3) Evaluate the effectiveness of new and alternative sampling gears at detecting both juvenile and adult Asian carp;
4) Supplement Asian carp sampling data being collected by other agencies; and
5) Gather data on abundances of other fish species found in the Illinois River and CAWS to further assess gear efficiency, and examine potential associations between Asian carp and native fishes.

Status: Seven sites were sampled with electrofishing and small mesh gill nets in summer and fall 2010, and once with small mesh purse seines, large mesh purse seines, and midwater trawls in fall 2010. A total of 2,563 fish were captured, comprising 53 taxa (including hybrids). Eight Bighead Carp and 174 Silver Carp were captured, with peak abundance at Havana (LaGrange Pool). No Asian carp were caught upstream of Ottawa (Starved Rock Pool) in 2010. In 2011, all gear types were utilized at ten sites on three sampling trips from May 1 - October 5. Overall, 48,637 fish were captured, comprising 99 taxa (including hybrids). Sampling in 2011 captured 1,451 Asian carp: 916 Silver Carp, 397 Bighead Carp, and 138 hybrids. All Asian carp taxa were most abundant at Henry (Peoria Pool). The furthest upstream site where Silver Carp were captured was Ottawa (Starved Rock Pool), whereas Morris (Marseilles Pool) and I-55/Treat‟s Island (Dresden Island Pool) represented the upstream limits for hybrid and Bighead Carp, respectively. The majority of Silver Carp were captured with electrofishing gear (60% of Silver Carp), followed by hoop nets (17%) and gill nets (11%). Hoop nets (55%) and trap nets (32%) were the most effective gears for sampling Bighead Carp, whereas hoop nets (43%), electrofishing (33%), and trap nets (13%) were the most effective gears for capturing hybrid Asian carp. Gears targeting juvenile Asian carp (beach seines, small mesh purse seines, midwater trawls, cast nets, and mini-fyke nets) were generally effective at capturing small fishes, but few Asian carp were captured, likely due to poor recruitment of Asian carp during 2010 and 2011. For more detailed results see the 2011 interim summary report document (MRRWG 2012).

Methods: The design of this project involves evaluating sampling gears at multiple sites in three segments of the Illinois River and the CAWS: the middle Illinois River (where Asian carp are present in high densities), the upper Illinois/Des Plaines River (where Asian are present in low to moderate densities), and the CAWS (where Asian carp are either absent or present in very low densities). All sampling gears will be tested seasonally (spring, summer, and fall) at each site, and gears will be evaluated for their ability to detect both juvenile and adult Asian carp.

Site	Waterbody	Navigation Pool
Lily Lake	Illinois River backwater	LaGrange
Matanzas Lake	Illinois River backwater	LaGrange
Havana	Illinois River	LaGrange
Peoria Lock & Dam Tailwater	Illinois River	LaGrange
Henry	Illinois River	Peoria
Ottawa	Illinois River	Starved Rock
Morris	Illinois River	Marseilles
I-55 / Treat‟s Island	Des Plaines River	Dresden Island
Western Ave.	Chicago Sanitary and Ship Canal	Lockport
O‟Brien Lock & Dam Tailwater	Calumet / Little Calumet River	Lockport

- Six 15-minute electrofishing transects will be conducted at each site on each sampling date using a pulsed-DC electrofishing boat.
- Both surface (45.8 m long x 6.1 m deep, 1.9, 2.5, 3.2, 3.8, and 5.1 cm mesh panels) and bottom experimental gill nets (45.8 m long x 3.05 m deep with experimental mesh panels of 9.1 m length) with either small experimental mesh (1.9, 2.5, 3.2, 3.8, and 5.1 cm mesh panels) or large experimental mesh (6.4, 7.6, 8.9, 10.2, and 12.7 cm mesh panels) will be

used at all sites, with a minimum of four sets with each net type at each site on each sampling trip (4 hour sets).

- Trammel nets (91.4 m length, 10.2 cm mesh with 0.46 m walling #139 twine) will be deployed to supplement IDNR efforts. Four sets will be conducted at each site on each sampling trip.
- A midwater trawl (5 m x 1 m with 6 mm mesh) is being evaluated for its ability to capture fish in the middle of the water column. Four 5-minute trawls will be conducted at each site by towing the trawl from the bow of the boat with the boat running in reverse, with various depth ranges and towing speeds being evaluated in the process.
- Both large- (100 m x 5 m with 6 mm mesh) and small-mesh (122 m x 3.05 m, with 2.5 cm mesh) purse seines will be employed at each site. Four hauls with each purse seine size will be performed at each site by encircling the area to be sampled by boat and then cinching the net at the bottom before pulling it into the boat.
- Trap nets (15 m x 1.3 m lead, 0.9 x 1.8 m frame, 1.8 cm mesh) and hoop nets (1.2 m x 4.8 m, 3.7 cm mesh) are being evaluated for their ability to capture Asian carp in various habitats. Eight net-nights with trap nets, and twelve net-nights with hoop nets are being performed at each site on each sampling trip.
- Cast nets (2 m), Wisconsin type mini-fyke nets (4.5 m x 0.6 m lead, 0.6 m x 1.2 m trap, 3 mm mesh) and seines are being used to sample for juvenile Asian carp in tributaries, backwaters, and other shallow-water habitats. Four cast net throws, eight net-nights with mini-fyke nets, and four seine hauls are being used at each site on each sampling trip.
- Hydroacoustic surveys will be conducted during each season at each site. A 200 kHz split-beam transducer will be mounted to the front of the boat and connected to a computer with acquisition software. Multiple 15-minute transects will be driven into the river current, and the entire width of the river will be surveyed.
- In 2012, we will begin evaluating the effectiveness of large hoop nets (2 m diameter, 6.4 cm mesh), surface-to-bottom gill nets (91.4 m long x 6-9 m depth; 6.4, 7.6, 8.9, and 10.2 cm mesh panels), and Great Lakes trap nets (100 m lead, 6.1 x 3.0 x 3.0 m pot, 7.6-9.1 m wings, 3.8-7.6 cm mesh) for capturing Asian carp and other fishes at a subset of sites in the upper Illinois River and the CAWS. Additional new gears may also be incorporated into gear evaluation efforts as they become available.

All captured fish will be identified to species, and measured for total length and weight. Catch-per-unit-effort data will be used to evaluate relative gear efficiency. In 2012, detection probability and occupancy modeling will also be a focus of data analyses.

Sampling Schedule: In 2012, gear evaluation sampling will occur seasonally (spring, summer, and fall) at all sites.

Deliverables: Preliminary results will be reported for weekly sampling summaries. Data will be summarized for an annual interim report and project plans updated for annual revisions of the MRRP.

Exploratory Gear Development for Use in Detection, Monitoring and Control of Asian Carp Populations

Participating Agencies: USFWS – Columbia Fish and Wildlife Conservation Office (lead); IDNR (as needed field support); USFWS - Carterville Fish and Wildlife Conservation Office(DIDSON support)

Location: Testing of newly developed gears will be done in the Missouri, Illinois and Mississippi rivers.

Introduction/Background: In 2008, the Columbia Fish and Wildlife Conservation Office contracted a net designer to develop a 125 foot surface trawl pulled between two large boats. The adult carp were corralled by the net but were too quick to be captured in the bag. Concluding the fish were not vulnerable to trawls due to speed and response to touching the net, our designer modified the net on location to be tested as a small purse-seine. When this pseudo-purse seine was used behind dikes on the Missouri River it effectively herded dozens of carp in each haul while also capturing rarely seen juvenile paddlefish. This field testing provided valuable feedback for net modification and future design. Conceptually tested, the net designer has been working on a purse seine prototype that can be used by researchers and commercial fishermen to target Asian carp. In addition, he has introduced many more designs that he feels will work with these fish based on his experience in oceanic fisheries around the world and in the Gulf of Mexico.

In 2011 we worked with electrofishing consultants to determine effective settings that would cause taxis in carp. There is a narrow threshold for taxis occurring between fright and stun that was not available in our previous electrofishing control unit. These tests helped us to determine an effective duty cycle and power to target carp. Our continued efforts will capitalize on our current knowledge. Additional contract work will be done to help us further understand taxis thresholds in different sizes and species of carp over a wider range of water chemistry.

Objectives:

1) Develop new gears to be used in the commercial fishery that will increase efficiency and reduce by-catch of sport fishes; and
2) Develop gears to be used for scientific monitoring.

Status: Purse seine and paupier nets are completed and being tested. The net designer is currently modifying nets as they are tested. All other nets will be modified on-site in the spring when the designer is contracted to come assist in additional testing of gears. For more detailed results see the 2011 interim summary report document (MRRWG 2012).

Methods: We will continue with current paupier (butterfly) net design and boat configuration. Nets are being designed to capture juvenile and adult carps over a range of habitats including shallow backwaters (2- to 3-foot deep) and within the Illinois River. We will convert an existing 125-foot dual boat surface trawl (which failed as a carp capture technique) to a modified purse seine with a bottom for proof of concept. This will enable a single boat and 3-person crew to sample distinct and small areas behind dikes and below dams and may be manageable as a spot

monitoring tool as well as commercial removal. Testing of the custom purse seine will continue in the Illinois River and design modifications will be made with help of a contracted net designer and use of DIDSON technology. We will evaluate carp interactions with pound net configurations and cab design using DIDSON technology and will develop a compartmentalized pound net. Finally, we will continue laboratory studies with juvenile carp and similar-sized fish of different species to better understand suitable surrogates for barrier defense tests while also systematically documenting best electrofishing settings for carp species.

Sampling Schedule: Testing of gears will be ongoing throughout the year.

Deliverables: A video log of deployment efficacy will be used to describe gear fishing effectiveness and each method of deployment. Catch rates and species capture will be summarized for each gear deployment in an annual interim report and information will be presented at annual basin river meetings. Project plans will be updated for annual revisions of the MRRP.

Unconventional Gear Development Project

Participating Agencies: IDNR (lead), INHS and USFWS (workgroup participants, field assistance as needed, and co-developers of alternative gears),

Location: Gear prototypes will be evaluated in the Marseilles and Dresden Island pools and in the CAWS, as part of the ongoing gear effectiveness study (see project plan above).

Introduction and Need: Successful control or eradication of Asian carp requires that the rate of removal exceeds the rate of increase and that there is an ability to target individuals from low density populations. The use of piscicides, such as rotenone and Antimycin, is the best method to capture or kill low densities of Asian carp that are likely present upstream of the leading edge of an invasion front. However, high cost, chemical availability, regulatory requirements and non-target impacts limit piscicide use to occasional applications over short sections of the CAWS. Traditional sampling tools, like static nets, seines and electrofishing are less effective especially in deep (>2 m depth) and flowing waters characteristic of much of the CAWS and other rivers in the Great Lakes basin where Asian carp may successfully spawn. There is a need to develop new methods that can capture low densities of Asian carp in the canal and river habitats of the CAWS, lower Des Plaines and upper Illinois rivers, and possible Great Lakes spawning rivers.

Objectives: To enhance sampling success for low density Asian carp populations, we will:

1) Investigate alternative techniques to enhance capture of rare Asian carp in deep-draft canals, such as in the CAWS;
2) Evaluate gear and combination system prototypes in areas with low to moderate Asian carp population densities (will occur as part of the gear effectiveness study);
3) Encourage local bow fishing clubs to schedule a night-time carp tournament targeting Brandon Road Pool or the CAWS upstream of the barrier (e.g., Lake Calumet, the Little Calumet River, and the Calumet-Sag Channel); and
4) Conduct a pilot study to assess the effectiveness of corn or soybean meal/chaff as a water surface born attractant for Asian carp;

Status: A committee of scientific experts was convened to identify potential new gears to capture Asian carp where population densities are low and aquatic habitats are unique, such as the deep-draft channels of the CAWS. Three professional commercial fishers were brought to Chicago for a tour of the CAWS and discussions of new and modified sampling gears for Asian carp monitoring and removal. The committee decided to move forward with purchase and evaluation of three gears: six-foot diameter hoop nets, 30-foot deep tied-down experimental gill nets, and Lake Michigan style pound (trap) nets. For more detailed results see the 2011 interim summary report document (MRRWG 2012).

Methods: Large hoop nets, surface-to-bottom experimental gill nets, and Lake Michigan-style pound (trap) nets will be evaluated by INHS along with other conventional gears so that comparisons of catch effectiveness can be made among gears (see Asian Carp Gear Efficiency and Detection Probability Study above).

The pilot corn/soy attractant study also will be conducted by INHS in conjunction with gear effectiveness evaluations at two locations in the Illinois Waterway where carp are abundant, and then one site in the CAWS if earlier trials are successful. Corn or soybean meal/chafe will be obtained from a local agriculture supply company or grain elevator and will be spread on the water surface in quite area and observations of feeding carp will be recorded. Additional trials will consist of observations below grain elevators where Asian carp have been known to feed on material transported by wind when commodities are loaded into barges or trains. Natural attractants, such as corn or soybean meal may prove useful in enhancing detection of Asian carp in areas where they are rare or to lead fish into entrapment gears.

Bow fishing has become a popular outdoor activity and bow fishing clubs and tournaments are becoming more common in Illinois. Bow fishers often harvest Asian carp during nighttime tournaments targeting Common Carp and Gar, and sometime target jumping Silver Carp during daytime tournaments (e.g., The Director‟s Tournament in Spring Valley, Illinois). A carp bow fishing tournament in Brandon Road Pool or the CAWS might prove to be an effective method to educate the public about Asian carp, generate interest and support in carp eradication, and develop into a rare-fish detection and removal technique, if any Asian carp are present in the areas of the waterway targeted by bow fishers. The IDNR will contact Chicago area bow fishing clubs to gauge interest in a night-time carp tournament in the CAWS or Brandon Road Pool. If interest is there, IDNR can help encourage and facilitate tournament development in the Brandon Road Pool or the Lake Calumet/Little Calumet River/Calumet-Sag Channel portion of the CAWS.

Sampling Schedule: Hoop and gill nets will be evaluated seasonally in 2012 beginning in the spring sampling period. Pound net evaluations will begin during the summer sampling period and continue during fall and the following spring. Contacts with local bow hunting clubs will be made this spring with a targeted tournament date of midsummer 2012 or spring 2013. The attractant pilot study will occur this summer along with gear evaluations.

Deliverables: Any preliminary results will be reported for weekly sampling summaries. Data will be summarized for an annual interim report and project plans updated for annual revisions of the MRRP.

Water Gun Development and Testing

Participating Agencies: USGS (lead); IDNR (field support); USACE, USCG, and MWRD (project coordination)

Location: Water guns are being considered for use in fish suppression activities in the CSSC associated with maintenance of Barrier 2A. Evaluations of the technology are being planned for the Illinois River near Morris and Havana, IL and possibly in the CAWS near T. J. O'Brien Lock.

Introduction and Need: There is an immediate need to develop and implement control strategies to prevent the migration of Asian carp from entering the Great Lakes Ecosystem from the Mississippi River. Seismic technology may provide one possible solution by emitting high pressure underwater sound waves as a physical deterrent. These sound waves are produced by a pneumatic water gun that compresses water with a piston through a cylinder inducing cavitations of water, whereas upon the cavities collapse a pulsed sound pressure wave is generated. The sound wave may deter fishes or kill them if they are in close enough proximity to the wave source. The water gun may be operated as either a stationary or mobilized barrier as a means to deter invasive fishes.

Status: Water gun evaluations with Asian carp took place during September 2010 at the Hanson Material Services backwater near Morris, IL. While studies have not definitively answered all questions concerning the use of water gun technologies scientifically, this technique was shown to have negative consequences on fish health and behavior. Based on initial trials, water guns were used successfully as a tool for fish suppression management during barrier maintenance in October 2011. Prior to maintenance, research examining the effects of water guns on canal walls and structures took place in the CSSC. Preliminary results indicated that, in general, seismic energy from the water gun is approximately an order of magnitude or greater than background energy for land and in water data. In addition, video surveillance identified no visible scalloping or removal of rock from the canal wall or any visible disturbance to green vegetative growth on wall. For more detailed results see the 2011 interim summary report document (MRRWG 2012).

FY2011 Objectives

1) Further Assess Structural Effects of Water Guns: Any potential impact of the deployment of a water gun(s) within the CAWS on structures, such as the controlling works, and lock gates and walls is unknown. USGS has proposed an assessment of the seismic energy emitted when the water gun(s) is used within the CAWS at T. J. O'Brien Lock so that engineers can determine potential impacts on lock physical structures and walls, and advise management on safe water gun usage.

2) Provide Electric Barrier Shutdown Support: As part of the MRRP fish suppression project plan, water guns have been identified as the principal tool to remove fish from the area between Barriers 2A and 2B and to keep fish from moving upstream past the barrier during electric barrier maintenance. The water guns can be strategically deployed to repel and/or herd all fish in the canal between Barriers 2A and 2B in a downstream direction. Methods for verifying the effectiveness of the water guns in removing fish from between barriers 2A and 2B have been developed and may include the use of split-beam hydroacoustics, side-scan sonar, and DIDSON

sonar technology to view fish movement under the water and acoustic tagging of fish to track movement.

3) Water Gun Calibration FY2012: Experiments to assess the effects of water guns on Asian carp behavior are planned for May 2012 at an Illinois River backwater site near Morris, Illinois. Fish response to water guns will be evaluated with acoustic telemetry and fixed location split – beam hydroacoustics technology.

Questions to be addressed include:
- Do the water guns repel fish (chase them away)?
- What is the minimum acoustic energy that keeps fish away?
- Do Bighead and Silver Carp act similarly in the presence of the pulse pressure application?

Sampling Schedule: Assessment of structural effects will take place after May experiments are completed. Coordination with USACE is required. Water gun monitoring support during any barrier maintenance shutdowns will be scheduled in collaboration with IDNR and other partners. As much advance notice as possible is required to set up needed contracts and prepare boats and equipment.

Deliverables: Any preliminary results will be reported for weekly sampling summaries. Data will be summarized for an annual interim report and project plans updated for annual revisions of the MRRP. A final report of experimental results will be prepared and submitted to the MRRWG.

Long Term Objectives (1-3 years)

1) Continue calibration to maximize water gun efficiency: Develop guidelines for potential use of a permanent array of water guns for defending the locks in the CSSC to keep Asian carp from moving into the Great Lakes. For example:
   - Setting up a permanent array facing downstream of Barrier 2B that would provide the first line of defense against Asian carp and other invasives.
   - This strategy could also be used at Lockport Lock with water guns facing both upstream and down to keep invasives from moving into or out of both Lake Michigan and the CSSC.

2) Continued examination and documentation of physiological impacts of water guns on fish in order to address NEPA regulations and other environmental impact concerns

3) Apply technology to other invasive species such as zebra mussels, round gobies and other invasive fish and invertebrate species.

4) Find novel uses for this technology for other aquatic invasive species.

5) Conduct engineering studies of acoustic energy on canal walls and lock and dam structures.

Alternative Pathway Surveillance in Illinois

Participating Agencies: IDNR (lead); University of Notre Dame (project support)

Location: Surveillance efforts will take place in the Chicago metropolitan area including Cook and Collar counties.

Introduction and Need: Juvenile Asian carp have been included in the live bait trade in the past, and are similar in appearance to species used as bait (e.g., gizzard shad and threadfin shad), which may be inadvertently transported along with more typical bait fish species (i.e. fathead minnows, golden shiners, and white suckers). Given that sources of many bait stocks are from regions of the United States where Bighead and Silver Carp have established populations, the possibility exists that fisherman are unintentionally distributing Asian carp throughout the Great Lakes region through contaminated bait stocks. One potential source for Asian carp presence in the CAWS is through unintentional release of Asian carp in contaminated bait stocks when fisherman discard unused bait into rivers and streams. Other anthropogenic distribution pathways also exist, including the unintentional transport and stocking of Asian carp with introduced sport species and/or the deliberate transport of carp to live fish markets and retail food establishments.

Screening of fish tanks at wholesale and retail bait supply facilities and increased enforcement activities related to fish hauling and stocking are direct approaches to evaluating alternative introduction pathways. In addition to continuing surveillance efforts at bait shops, IDNR staff and Conservation Police Officers (CPOs) will perform education and enforcement activities at sport fish production/distribution facilities, fish processors, and fish markets/food establishments known to have a preference for live fish for release or food preparation.

Objectives: To create a more robust and effective enforcement component of IDNR‟s invasive species program, we propose to:

1. Continue visual and eDNA surveillance of fish tanks at wholesale and retail bait suppliers in the Chicago metro region;
2. Increase surveillance of fish haulers stocking local water bodies, area fish production facilities, and live fish markets and food establishments;
3. Perform administrative import and export audits and inspections to ensure compliance with the federal Lacey Act and Illinois Injurious Species Rule; and
4. Monitor Chicago area urban fishing ponds for the presence of Asian carp with eDNA (in cooperation with University of Notre Dame) and conventional sampling gears.

Status: This project is on-going and has been expanded for 2012 to include monitoring for Asian carp at urban fishing ponds in the Chicago area**.** In 2010, 57 wholesale and retail establishments that sold live minnows were identified in Cook, Lake, McHenry, Kane, DuPage, Kendall, Kankakee, Will, and Grundy counties. The list included all known live-bait shops in the Chicago metro area. IDNR staff and CPOs inspected shops operating over winter ($N = 43$ shops; February/March) and again during summer ($N = 52$ shops; August/September). No Asian carp were identified in visual inspections of minnow tanks made during both seasons. Additionally, 2-L water samples taken from minnow tanks during August ($N = 139$ samples) for eDNA screening produced no positive detections for Bighead or Silver Carp DNA. A

questionnaire completed by bait shop owners/operators indicated all minnows were purchased from one of three regional minnow distributors and no live wild-caught bait was collected or sold. Asian carp education and outreach literature was disseminated to bait shop personnel to increase awareness and reduce chances of future contamination.

Acting on reports of large fish, IDNR sampled four urban fishing ponds in the Chicago area during 2011 and removed 20 adult Bighead Carp weighing between 48 and 80 pounds. It was determined that these fish likely were contaminants in shipments of catchable-sized Channel Catfish during the late 1990s or early 2000s. No Silver Carp and no juveniles of either species were found in the ponds sampled to date. For more detailed results of bait shop surveys and urban pond monitoring see the 2011 interim summary report document (MRRWG 2012).

Methods:

Surveillance of Bait Trade and Commercial Markets - IDNR Fisheries staff and CPOs will continue inspections of bait shops and/or wholesale distributors and expand inspections to include truck inspections of minnow haulers. Administrative audits of import, export, and transport permits will be undertaken by program staff and potential violators will be targeted for field inspections by CPOs. Visual inspections of live fish sales and brokers will be conducted in northeastern Illinois (Chicago/Chinatown) to identify any illegal transport of live Asian carp that may be occurring. Administrative rules associated with Asian carp import, transport, and use in Illinois will be reviewed and field inspections of commercial fisher catch and reporting will take place to ensure compliance with contracting and administrative rules.

Environmental DNA Surveillance – Throughout the summer of 2011, the University of Notre Dame (UND) collected 284 water samples from 38 ponds in the Chicago area. Using a general Asian carp marker, positive detections for Grass Carp occurred in 15 ponds. Further testing is underway to evaluate the samples for presence of Bighead and Silver Carp. As part of the ongoing Great Lake Restoration Initiative (GLRI) funding (FY10-S-T024-O169-2), approximately 25-50 additional samples will be collected from Chicago ponds in 2012 and the archived eDNA sample collection will be screened for other invasive species, namely Black Carp and Northern Snakehead. Collection of remaining samples will be coordinated between UND and IDNR. As part of additional GLRI funding (FY2011) to UND, over 400 bait shops in the Great Lakes region will be screened for presence of Asian carps using eDNA. The effort in Illinois is expected to be approximately 40 bait shops and will be coordinated between UND and IDNR.

Small Pond Monitoring – IDNR will intensively sample for Asian carp in all ponds in the Chicago area urban fishing program that were not sampled in 2011 (Figure 19). Sampling will include DC electrofishing and trammel/gill netting and it will take place from spring through fall 2012. Sampling will begin with ponds closest to Lake Michigan and the section of the CAWS above the Dispersal Barrier, followed by those that have reports of Asian carp in the past. Any ponds with positive eDNA detections for Bighead or Silver Carp will be given highest priority. The first ponds to be targeted will be Commissioners Park Pond, Jackson Park Lagoon, Washington Park Lagoon, Garfield Park Lagoon, McKinley Park Lagoon, and Humboldt Park Lagoon.

Electrofishing Protocol - All electrofishing will use DC current and include 1-2 netters (two netters preferred). The operator may switch the pedal on and off at times to prevent pushing fish in front of the boat and increasing the chances of catching an Asian carp.

Netting Protocol –Nets used will be large mesh (3.0-4.0 inches) trammel or gill nets 8 feet high or greater and in lengths of 100 or 200 yards. Sets will include driving fish into the nets with electrofishing gear or noise (e.g., plungers on the water surface, pounding on boat hulls, or racing tipped up motors).

Otolith Microanalysis and Aging- Asian carp captured in urban fishing ponds will have head, vertebrae, and post-cleithra removed and sent to SIUC for otolith microchemistry analysis and aging.

Sampling Schedule: Surveillance activities will take place at yet to be determined times throughout the year. Pond sampling will occur periodically from spring through fall 2012.

Deliverables: Results of inspections, enforcement activities, and pond monitoring will be summarized and reported to the MRRGW, as they become available. Data will be summarized for an annual interim report and project plans updated for annual revisions of the MRRP.

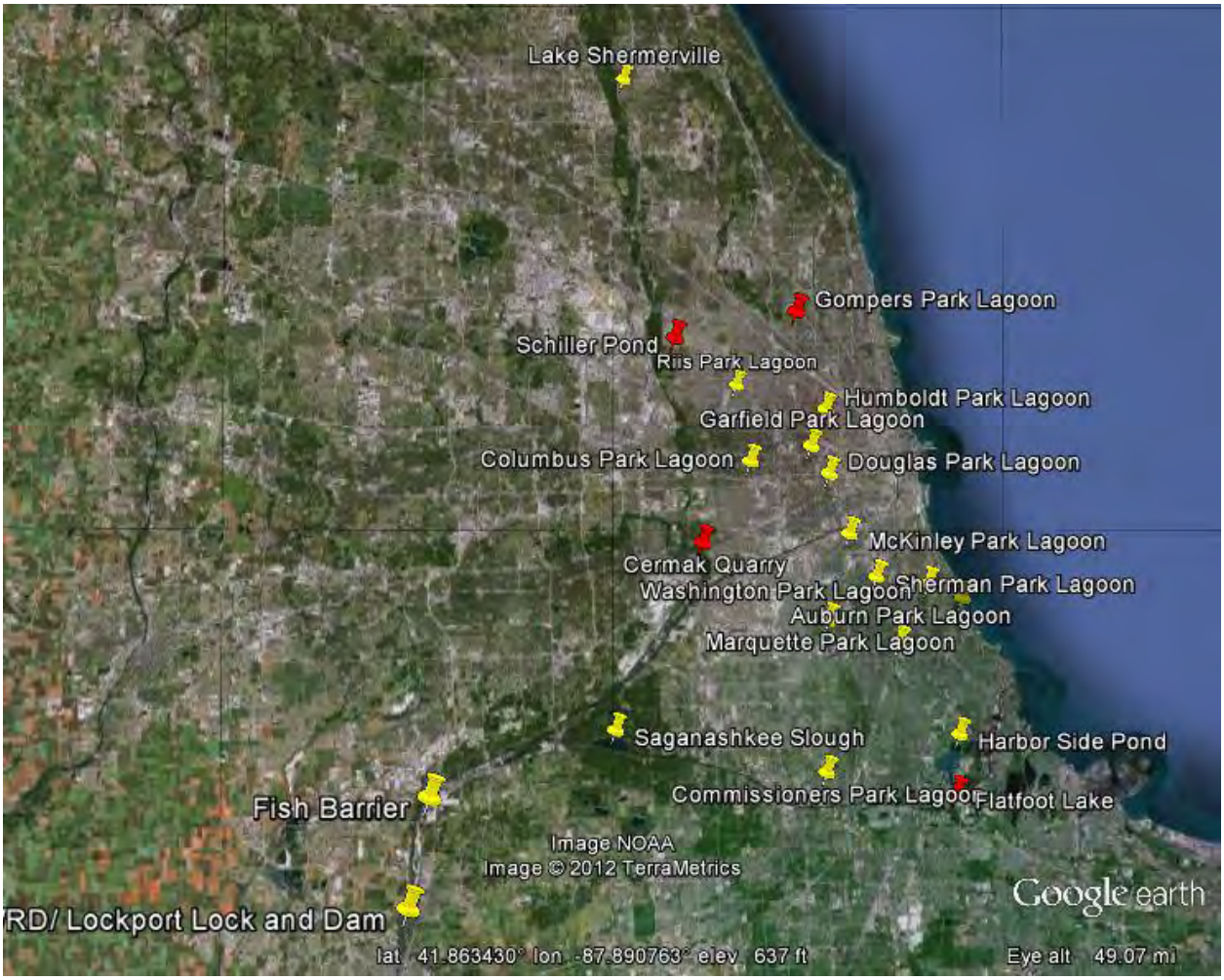

Figure 19. Map of urban fishing pond locations in the Chicago region. Red pins indicate ponds that were sampled in 2011; Yellow pins indicate ponds to be sampled during 2012.

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Appendix A. Participants of the Monitoring and Rapid Response Workgroup, including their roles and affiliations.

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Pam Thiel, USFWS
Mike Hoff, USFWS
Aaron Woldt, USFWS
Jeff Stewart, USFWS
Janet Pellegrini, USEPA

Appendix B. Detailed Maps of Fixed and Random Site Sampling Locations.


Fixed Site 1
= Electrofishing Run Start
= Commercial Netting Spot
= Run Direction
= Site Border Line
Run 6
Net 7
Net 6
Run 5
Net 8
Run 4
Net 5
Run 3
Lake Calumet
Net 4
Run 2
Net 9
Net 3
Net 2
Net 10
Run 1
Net 1
Dead Stick Pond
E-114th-St
E-120th-St
E-122nd-St
S-Stony-Island-Ave
S-Stony-Ave
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Fixed Site 2
= Electrofishing Run Start
= Commercial Netting Spot
= Run Direction
= Site Border Line
Lake Calumet
S-Wentworth-Ave
S-State-St
S-Michigan-Ave
S-Stony-Ave
E-122nd-St
W-127th-St
E-127th-St
W-Vermont-Ave
E-130th-St
Net 8
Run 3
Run 2
Run 1
Net 7
S-Indiana-Ave
Run 5
Run 4
Run 6
Net 6
E-138th-St
W-138th-St
Lincoln-Ave
Net 5
Net 4
Net 1
Net 2
Run 7
Run 8
Net 3
E-142nd-St
Thornton-Rd
S-Halsted-St
W-144th-St
E-144th-St
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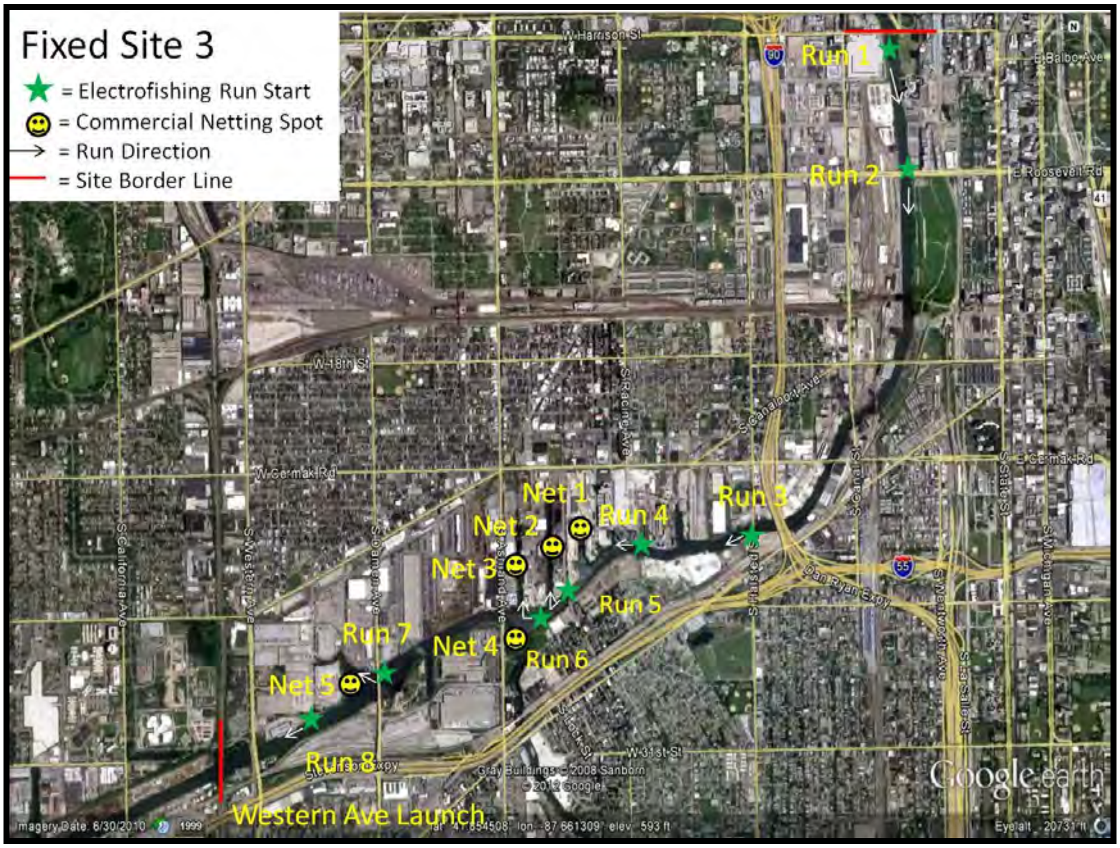
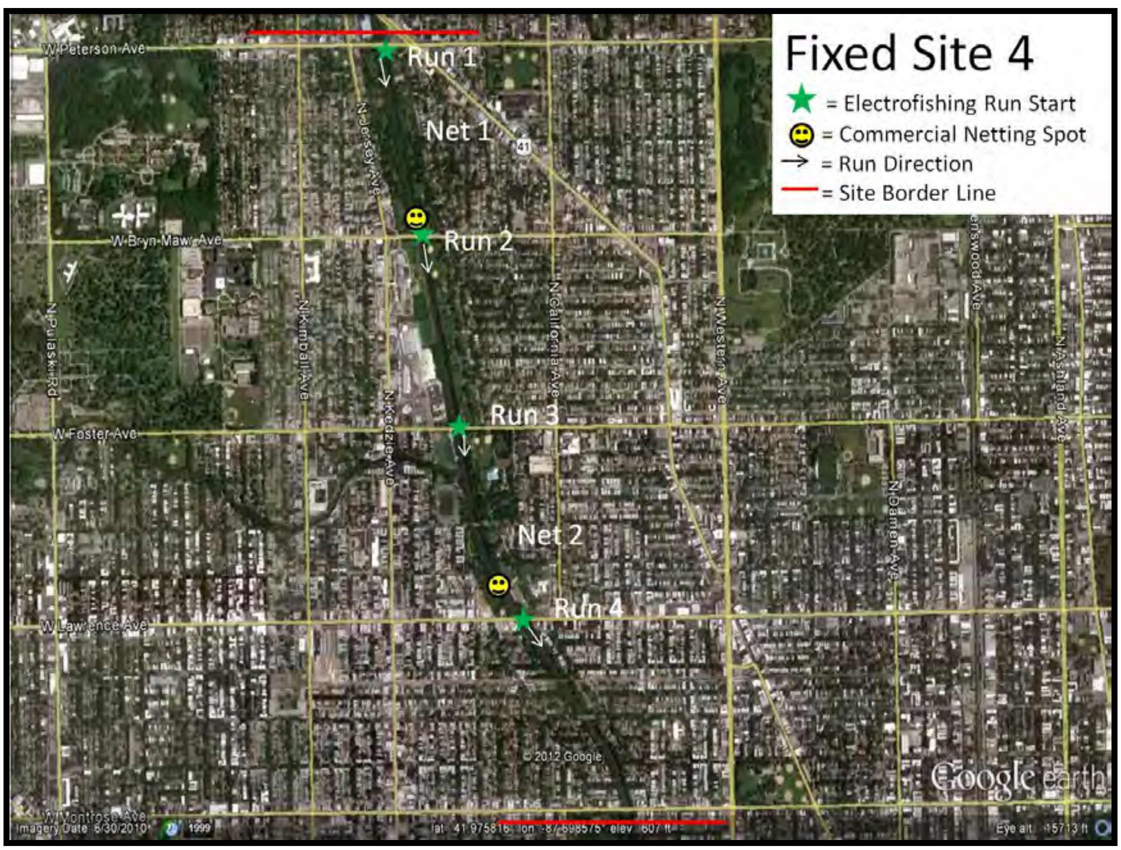

Fixed Site 3
= Electrofishing Run Start
= Commercial Netting Spot
= Run Direction
= Site Border Line
Run 1
Run 2
Run 3
Run 4
Run 5
Run 6
Run 7
Run 8
Net 1
Net 2
Net 3
Net 4
Net 5
Western Ave Launch
W Harrison St
W 18th St
W Cermak Rd
S California Ave
S Western Ave
S Racine Ave
S Canal St
S State St
W 31st St
Google earth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= Commercial Netting Spot
= Run Direction
= Site Border Line
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Run 2
Run 3
Run 4
Net 1
Net 2
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W Bryn Mawr Ave
W Foster Ave
W Lawrence Ave
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N Kimball Ave
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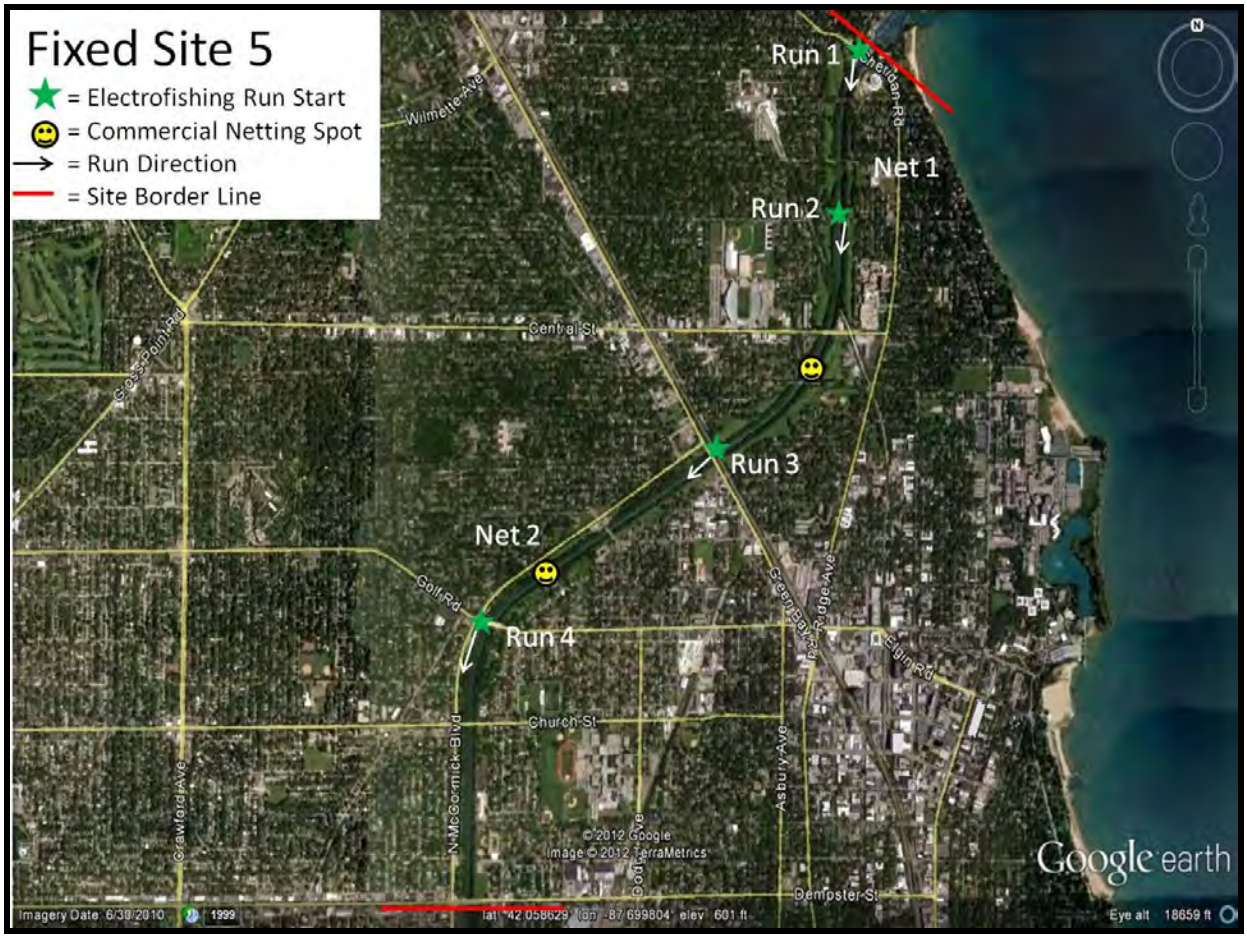
Fixed Site 5
= Electrofishing Run Start
= Commercial Netting Spot
= Run Direction
= Site Border Line
Run 1
Run 2
Net 1
Run 3
Net 2
Run 4
Wilmette Ave
Sheridan Rd
Central St
Cross Point Rd
Golf Rd
Church St
Crawford Ave
N McCormick Blvd
Asbury Ave
Dodge Ave
Green Bay Rd
Elgin Rd
Dempster St
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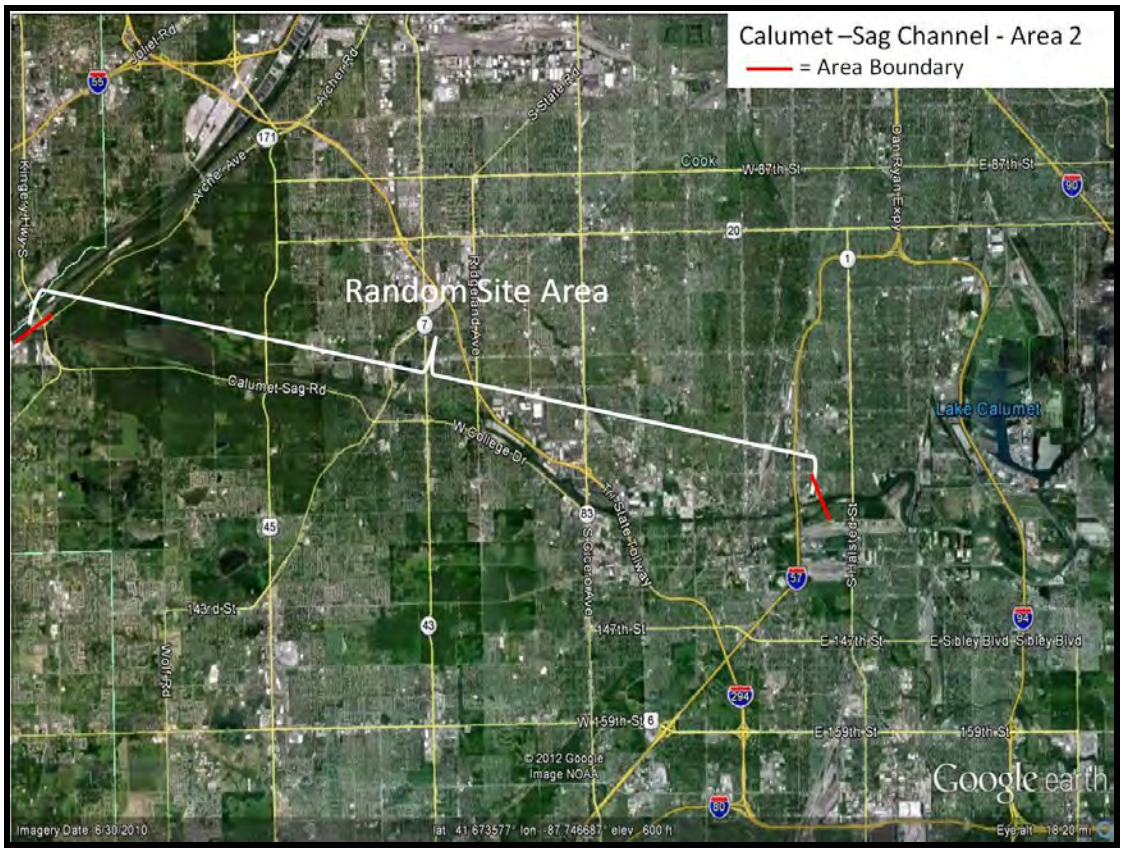
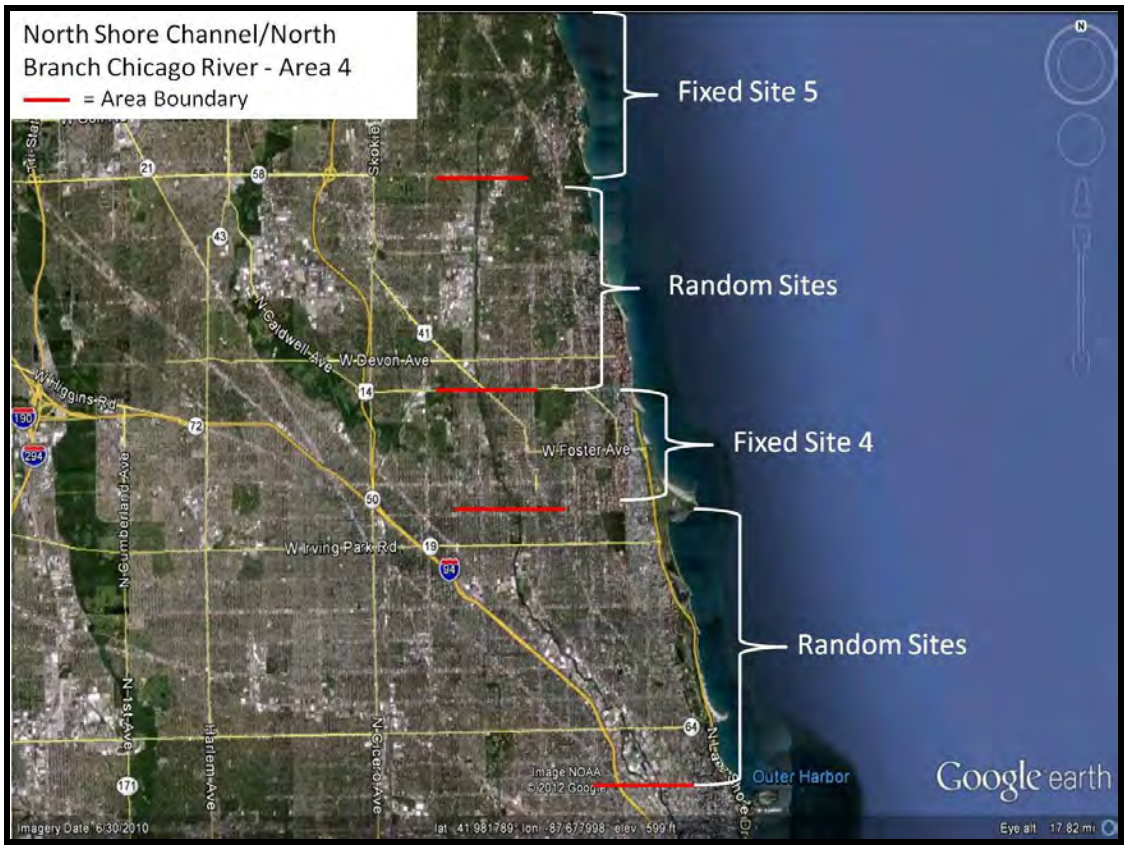
Image © 2012 TerraMetrics
Google earth
Imagery Date: 6/30/2010
1999
lat 42.058629 lon -87.699804 elev 601 ft
Eye alt 18659 ft


Calumet River - Area 1
= Area Boundary
Random Site Area
Lake Calumet
Wolf Lake
Google earth

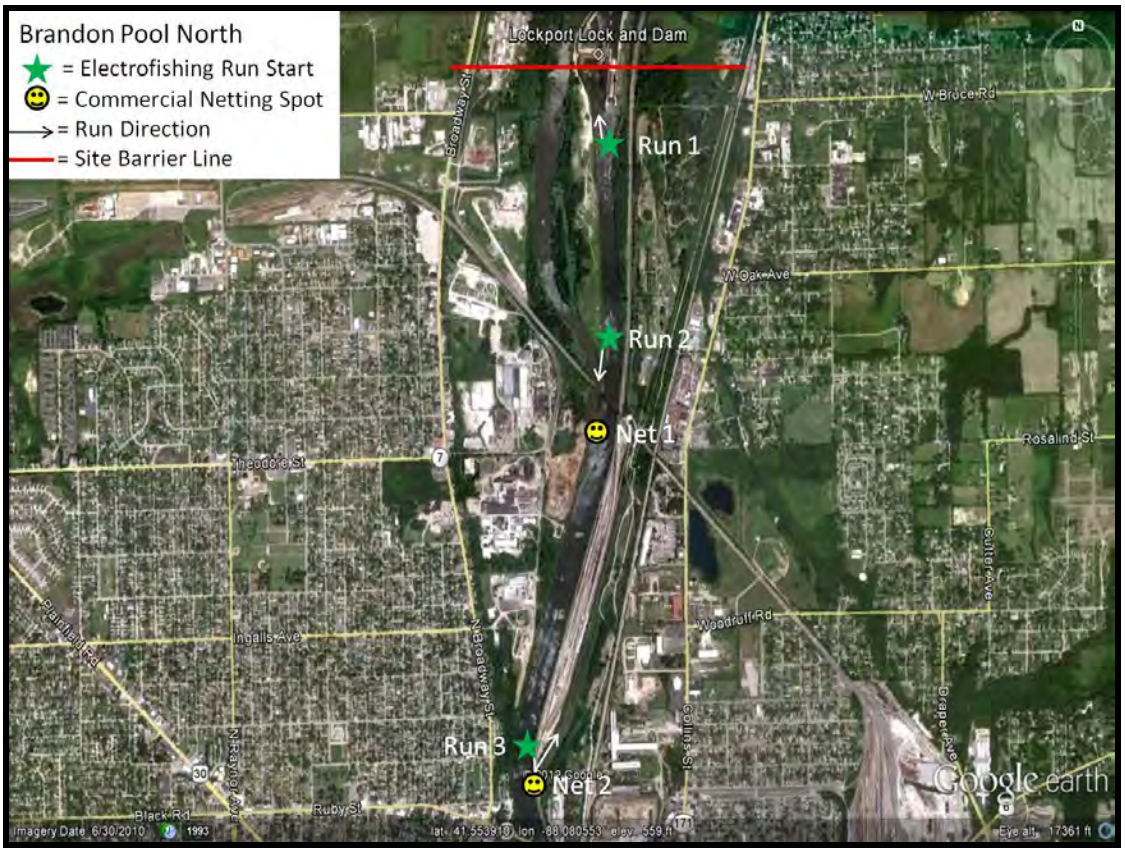

Calumet –Sag Channel - Area 2
= Area Boundary
Random Site Area
Lake Calumet
Google earth

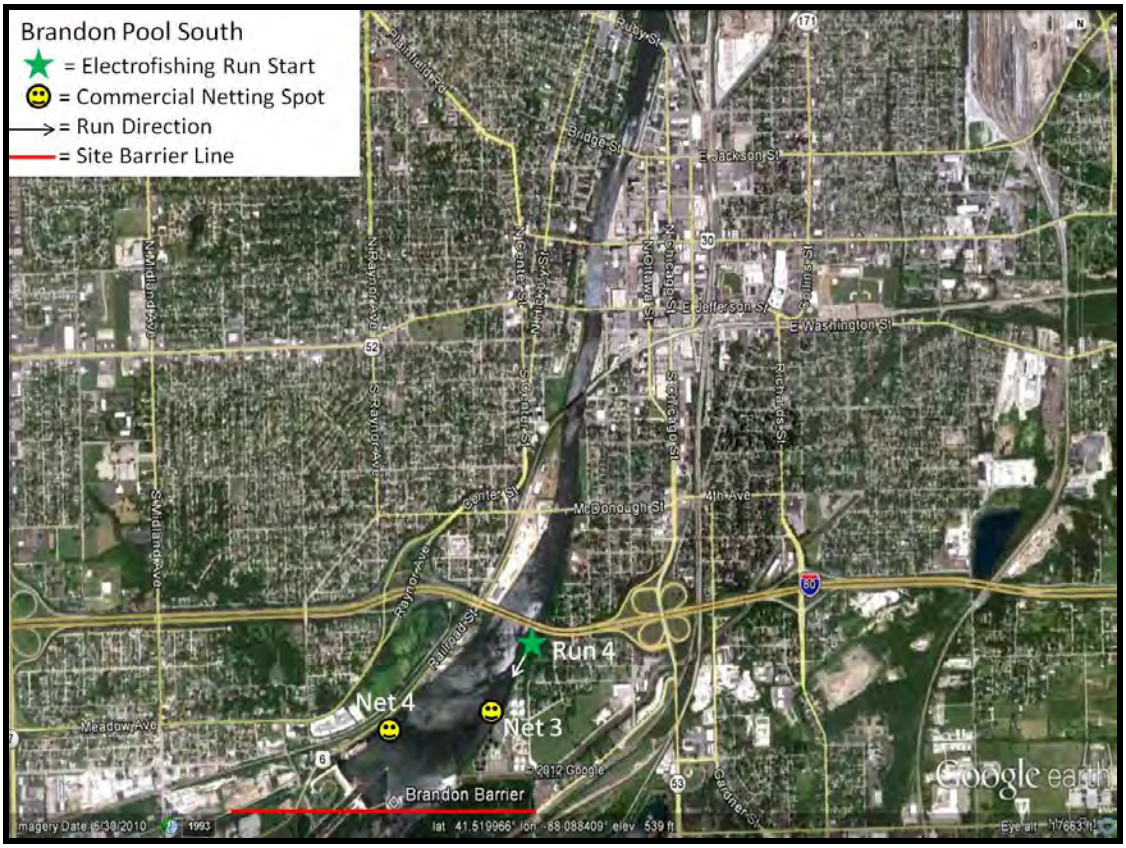

CSSC - Area 3
= Area Boundary
Random Sample Area
Roosevelt Rd
Butterfield Rd
DuPage
E Ogden Ave
W Ogden Ave
Stevenson Expy
Archer Rd
State Rd
W 87th St
Highway 12
Cook
Main St
Veterans Memorial Pkwy S
Lemont Rd
South La Grange Road
S Harlem Ave
Ridgeland Ave
S Cicero Ave
S Halsted St
© 2012 Google
Google earth
Imagery Date: 6/30/2010
lat 41.776242° lon -87.857290° elev 631 ft
Eye alt 22.58 mi

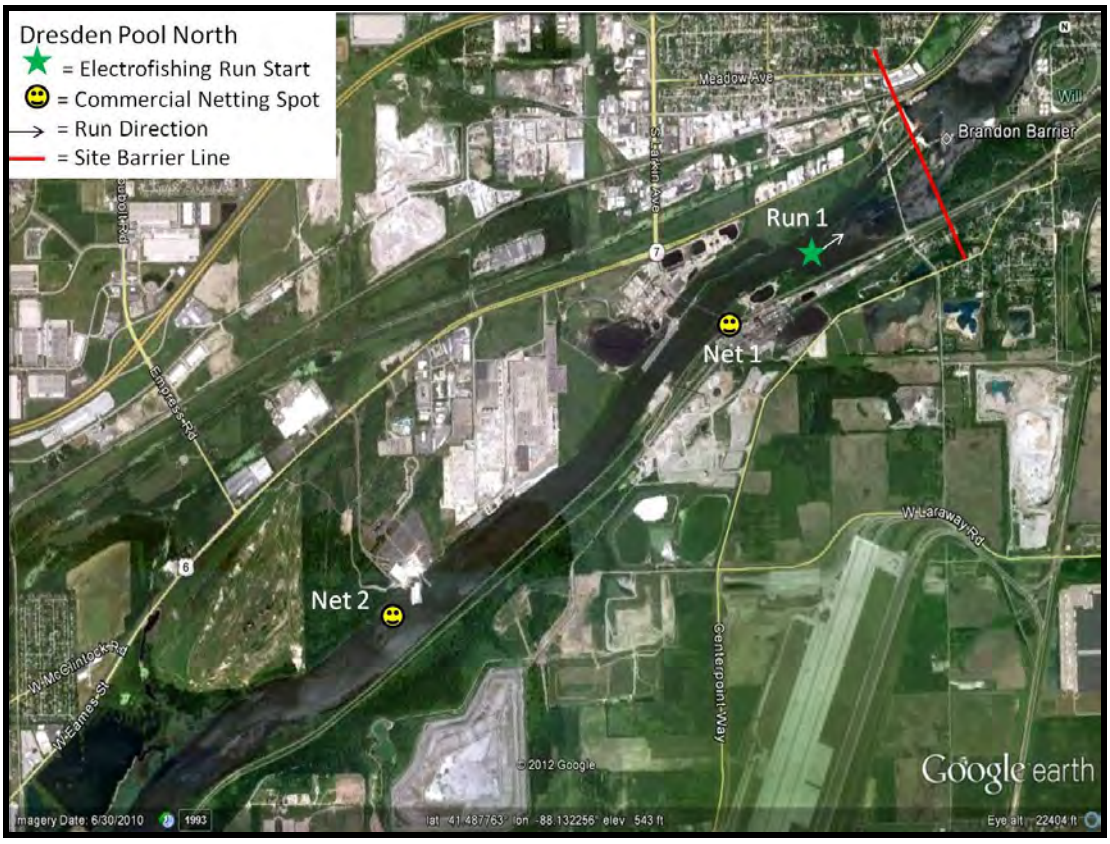

North Shore Channel/North Branch Chicago River - Area 4
= Area Boundary
Fixed Site 5
Random Sites
Fixed Site 4
Random Sites
Skokie
N Caldwell Ave
W Devon Ave
W Higgins Rd
W Foster Ave
W Irving Park Rd
N Cumberland Ave
N 1st Ave
Harlem Ave
Narragansett Ave
Outer Harbor
Image NOAA
© 2012 Google
Google earth
Imagery Date: 6/30/2010
lat 41.981789° lon -87.677998° elev 599 ft
Eye alt 17.82 mi


Lockport Pool North
= Electrofishing Run Start
= Commercial Netting Spot
= Run Direction
= Site Barrier Line
Dispersal Barrier
E Romeoville Rd
Run 1
Run 2
Net 1
S Independence Blvd
W 135th St
W 153rd St
Archer Ave
Google earth


Lockport Pool South
= Electrofishing Run Start
= Commercial Netting Spot
= Run Direction
= Site Barrier Line
Run 3
Net 2
Renwick Rd
Cargill
Net 3
Net 4
Run 4
Broadway St
S State St
E 9th St
E Division St
S Briggs St
Lockport Lock and Dam
W Bruce Rd
Google earth


Brandon Pool North
= Electrofishing Run Start
= Commercial Netting Spot
= Run Direction
= Site Barrier Line
Lockport Lock and Dam
Run 1
Run 2
Net 1
Run 3
Net 2
W Bruce Rd
W Oak Ave
Rosalind St
Theodore St
Ingalls Ave
Woodruff Rd
Sutter Ave
Grape Ave
Collins St
N Broadway St
N Raynor Ave
Ruby St
Black Rd
Google earth


Brandon Pool South
= Electrofishing Run Start
= Commercial Netting Spot
= Run Direction
= Site Barrier Line
Ruby St
Bridge St
E Jackson St
E Jefferson St
E Washington St
N Midland Ave
N Raynor Ave
N Center St
N Chicago St
N Ottawa St
S Center St
S Chicago St
S Ottawa St
S Raynor Ave
Richards St
McDonough St
4th Ave
Railroad St
Run 4
Net 4
Net 3
Meadow Ave
Brandon Barrier
Gardner St
Google earth


Dresden Pool North
= Electrofishing Run Start
= Commercial Netting Spot
= Run Direction
= Site Barrier Line
Meadow Ave
Brandon Barrier
Run 1
Net 1
Net 2
Empress Rd
W Laraway Rd
Centerpoint Way
W McGinnocky Dr
W E Ames St
© 2012 Google
Google earth
imagery Date: 6/30/2010
1993
lat 41.487763 lon -88.132256 elev 543 ft
Eye alt 22404 ft


Dresden Pool South
= Electrofishing Run Start
= Commercial Netting Spot
= Run Direction
= Site Barrier Line
Centerpoint Way
Craig Rd
E Ames St
S Frontage Rd
E Frontage Rd
W Bluff Rd
Net 3
Run 2
Run 3
Net 4
Big Basin Launch
Run 4
S Brandon Rd
W Manhattan Rd
Image U.S. Geological Survey
© 2012 Google
Google earth
imagery Date: 6/30/2010
1993
lat 41.439826 lon -88.159206 elev 532 ft
Eye alt 25931 ft


Marseilles Pool North
= Electrofishing Run Start
= Commercial Netting Spot
= Run Direction
= Site Barrier Line
Run 1
Run 2
Negro Slough
Net 1
Image U.S. Geological Survey
© 2012 Google
Google earth


Marseilles Pool South
= Electrofishing Run Start
= Commercial Netting Spot
= Run Direction
= Site Barrier Line
Net 3
Peacock Slough
Peacock Slough
Run 4
Net 4
Run 3
Net 2
Morris Launch
Image U.S. Geological Survey
© 2012 Google

Appendix C. Handling Captured Asian Carp and Maintaining Chain-of-Custody Records

Chain-of-custody is a legal term that refers to the ability to guarantee the identity and integrity of a sample from collection through reporting of the test results. The following are general guidelines to keep chain-of-custody intact throughout the fish collection process.

These procedures should be followed when any Bighead or Silver Carp is collected in the Chicago
Area Waterway (from Lockport Lock and Dam to Lake Michigan, but also areas where they have not previously been collected (e.g. Brandon Road Pool, Des Plaines River, or Lake Michigan).

1. Keep the number of people involved in collecting and handling samples and data to a minimum.

2. Only allow authorized people associated with the project to handle samples and data. Always document the transfer of samples and data from one person to another on chain-of-custody forms. No one who has signed the chain-of-custody form shall relinquish custody without first having the chain-of-custody form signed by the next recipient.

3. Always accompany samples and data with their chain-of-custody forms. The chain-of -custody form must accompany the sample.

4. Ensure that sample identification and data collected are legible and written with permanent ink.

Specific Instructions for Handling Asian Carp:

1. A. If the boat crew believes they have collected an Asian carp, they should cease further collection and take a GPS reading of the location at which the Asian carp was found or mark the location on a map provided.

   B. The boat crew leader should immediately notify a lead operations coordinator or chief, who will immediately notify the Incident Commander and the Conservation Police Commander, if present. If a command structure is not in place, then immediately contact an Illinois Conservation Police Officer (CPO) by contacting the IDNR Region 2 law office at 847-608-3100 x 2056.

   C. The boat crew will then take the fish to a staging area for identification by the fish biologist stationed at the site. If a staging area has not been designated, the boat crew should proceed to a predetermined meeting location and await the arrival of the CPO. The boat crew will not leave until the CPO arrives and they have recorded the GPS reading on a chain-of-custody form and signed the form over to the CPO. The CPO is to remain with the fish at all times.

   D. Once a fish biologist at the staging area makes a positive visual identification, he/she will identify the fish with a fish tag; take pictures of the tagged fish; measure its total

length (mm) and weight (g); determine the fish‟s gender; identify reproductive status and gonad development as immature, mature – green, mature – ripe, mature - running ripe, and mature – spent; place the fish in a plastic bag; and seal the fish in a cooler with wet ice. The fish biologist at the staging area will place evidence tape across the opening of the cooler and initial it. The fish biologist at the staging area or when no staging area has been designated, the boat crew leader will give the sealed cooler to the IDNR CPO. The fish is to remain under IDNR control at all times.

E. The CPO will then deliver the sealed fish and chain-of-custody form to the sampling laboratory on site or make arrangements for transport to the genetics laboratory at the University of Illinois (contact: Dr. John Epifanio). Soft tissue for genetic testing and hard tissue for aging and/or chemical analysis will be removed at the UIUC laboratory. Additional soft tissue samples will be collected for other cooperating genetics laboratories (e.g., ERDC), as needed. Hard tissue will be transported to SIUC for analysis (contact: Dr. Jim Garvey). Chain-of-custody will be maintained when transporting hard tissue between university laboratories.

2. Only authorized IDNR tissue samplers or persons designated by an operations coordinator or chief will unseal the fish and remove the tissue samples from the fish for preservation and delivery to the lab. The lab samples will maintain the same sample ID as the subject fish but will also include an additional sequential letter (AC 001a, AC001b, AC002a, AC002b, etc) for multiple tissue samples from one fish. While sampling is occurring, the fish and samples will remain under supervision of the IDNR CPO who will maintain the chain-of-custody form.

3. All Asian carp captured during rapid response actions should be treated with care, handled minimally (no photo ops prior to tissue sampling), and transported to the staging area where they will be stored on ice in a cooler (no plastic bags). Captured fish cannot be frozen or preserved with chemicals, as these techniques distort the DNA. The USACE Engineer Research and Development Center (ERDC) has been designated to obtain a tissue sample from any Bighead Carp or Silver Carp collected during a rapid response action. The preferred tissue for DNA analysis is a pectoral fin (the entire fin) removed with a deep cut in order to include flesh and tissue of the fin base. The fin and tissue sample will be stored in a vial containing ethanol preservative (USACE will provide vials and preservative). Samples will be transported to ERDC for sequencing and comparison to the eDNA found in the pool.

   Samples are to be collected following the protocol below:

   This procedure will utilize gloves, scalpel blades and preservation tubes filled with 95% ethanol to preserve genetic materials from individual Asian carp. Do not reuse instruments-change instruments with every fish.

   A. Wearing disposable latex gloves use a sharp, sterile scalpel blade to cut a small (~3cm) slit on the right dorsal side of the fish. This incision should be just to the right of the dorsal fin.

B. Using a pair of sterile forceps, tear a small piece of the muscle tissue from inside of the incision. The piece of tissue should be ~1 cm^3 in volume.
C. Place the tissue in a labeled vial (2 ml; vial size not important) that contains ample 95% or greater ethanol.
D. If muscle tissue is not desirable or if there are numerous fish to sample in a short amount of time, fin clips can be utilized. Using a sterile scalpel (scissors will also work), cut a fragment of any fin (dorsal, pectoral, pelvic, tail) that is approximately the size of a U.S. quarter and place it in a labeled collection tube containing 95% ethanol (or greater).
E. Measure the weight, length, fish condition and record with the photographs.
F. Record collected fish sample identification on the chain of custody form. Maintain the fish on wet ice until delivery to University of Illinois. The IDNR CPO will then reseal the cooler and secure both the fish and the samples.
G. Under the supervision of an IDNR CPO and after the tissue (or fin clip) has been in ethanol for >48 hours, an IDNR biologist will pour off all residual liquid in the tube and replace it with fresh 95% ethanol. This will ensure proper preservation of the genetic material. When the alcohol has been replaced, the CPO will reseal the containers and again secure both the fish and the samples. The fish is to be maintained on wet ice until it and the tissue sample can be delivered to University of Illinois.

4. The IDNR CPO will deliver the fish and samples to Dr. John Epifanio, Illinois Natural History Survey, University of Illinois, at 1816 South Oak Street, Champaign, IL 61820. Chain-of-custody will be maintained, and the CPO should retain the final signed custody form and leave a copy with Dr. Epifanio. The final form should be presented in person to the Incident Commander or on site coordinator.

	CHAIN OF CUSTODY RECORD	File No. Inv.

Date and Time of Collection:	River Reach:	Collected By:

Notes:

Collection No.	Description of Collection (include river reach, river mileage (if known), and any serial numbers):

Collection No.	From: (Print Name, Agency)	Release Signature:	Release Date:	Delivered Via:
	To: (Print Name, Agency)			□ U.S. Mail □ In Person □ Other:
Collection No.	From: (Print Name, Agency)	Release Signature:	Release Date:	Delivered Via:
	To: (Print Name, Agency)			□ U.S. Mail □ In Person □ Other:
Collection No.	From: (Print Name, Agency)	Release Signature:	Release Date:	Delivered Via:
	To: (Print Name, Agency)			□ U.S. Mail □ In Person □ Other:
Collection No.	From: (Print Name, Agency)	Release Signature:	Release Date:	Delivered Via:
	To: (Print Name, Agency)			□ U.S. Mail □ In Person □ Other:
Collection No.	From: (Print Name, Agency)	Release Signature:	Release Date:	Delivered Via:
	To: (Print Name, Agency)			□ U.S. Mail □ In Person □ Other:
Collection No.	From: (Print Name, Agency)	Release Signature:	Release Date:	Delivered Via:
	To: (Print Name, Agency)			□ U.S. Mail □ In Person □ Other:

Appendix D. Shipping and Handling of Grass Carp for Ploidy Analysis by Flow Cytometry.

Field Protocol

1. Record GPS Location (if available, otherwise a description of collection location), fish weight and total length, and date of capture.
2. Contact Dr. Whitledge"s lab (gwhit@siu.edu) to make overnight priority shipping arrangements for incoming sample. A pre-paid UPS shipping label can be e-mailed to you if we know the dimensions and weight of the package (see packaging instructions below). See also alternate contacts below if Dr. Whitledge is unavailable.
3. We"re interested in three structures: eyes for ploidy analysis, post-cleithra bones (for aging) and otoliths (for microchemistry). Removing the head from the freshly killed fish is preferred, cutting well behind the pectoral fin to avoid severing the post-cleithra. For small fish, the whole fish could be shipped, but removing the head is preferred to reduce weight and to help keep the sample cool during shipping.
4. Ship sample immediately after catch if possible. Otherwise, maintain the sample at refrigerator temperature (4°C-8°C) no more than 10 days. If shipping does not occur within that time frame, freeze the sample (see below options).
5. Options for sample handling (options a or b preferable):
    a. Remove both eyes without puncturing from fish and store in buffer (e.g. phosphate buffered saline, or saline, or contact lens solution) in a small container. Keep at 4°C - 8°C. Remove post-cleithra and lapilli otoliths and store in a small vial or coin envelope.
    b. Remove head from freshly killed animal and store at 4°C-8°C.
    c. Remove head from frozen animal and send frozen head. Do not use dry ice for shipping.
6. Place the eyes or fish"s head in a styrofoam cooler within a box. Use of ice packs is preferred to maintain 4°C-8°C; alternatively, wet ice may be used if put in double ziplock bags. Seal the cooler with tape to prevent leakage of fluid.
7. Ship priority overnight to address below.

Greg Whitledge
Associate Professor
Fisheries and Illinois Aquaculture Center
1125 Lincoln Drive
Southern Illinois University
Carbondale, IL 62901-6511
e-mail: gwhit@siu.edu

Alternate contacts in Dr. Whitledge"s lab:

Jake Norman – jake.norman@siu.edu
Matt Young – myoung2746@siu.edu
Neil Rude – nrude@siu.edu
Michael Franczyk – mfranczyk@siu.edu

Brennan Caputo is coordinating collection and shipment of grass carp heads to SIUC for fish sampled at MRRWG fixed sites upstream of the barrier. Contact Brennan at xxx-xxx-xxxx to arrange for pickup and shipment of grass carp heads.

Appendix E. Fish Species Computer Codes.

Species Codes For Fixed Sited Above and Below The Barrier

Alewife	ALE	Highfin Carpsucker	HFC	Spotted Sucker	SDS
				Spring Chinook Salmon	SCS
Banded Darter	BAD	Lake Trout	LAT	Suckermouth Minnow	SUM
Banded Killifish	BAK	Largemouth Bass	LMB		
Bigeye Chub	BGC	Logperch	LOP	Threadfin Shad	THS
Bighead Carp	BHC	Longear Sunfish	LOS	Trout Perch	TRP
Bigmouth Buffalo	BGB	Longnose Gar	LOG		
Black Buffalo	BKB			Walleye	WAE
Black Bullhead	BLB	Mosquitofish	MOF	Warmouth	WAM
Black Carp	BCP			White Bass	WHB
Black Crappie	BLC	Northern Hog Sucker	NHS	White Crappie	WHC
Blackside Darter	BLD	Northern Pike	NOP	White Perch	WHP
Blackstripe Topminnow	BLT			White Sucker	WHS
Bluegill	BLG	Orangespotted Sunfish	ORS		
Bluntnose Minnow	BLS	Oriental Weatherfish	OWF	Yellow Bass	YLB
Bowfin	BOW			Yellow Bullhead	YEB
Brook Silverside	BRS	Paddlefish	PAH	Yellow Perch	YEP
Brown Bullhead	BRB	Pumpkinseed	PUD		
Brown Trout	BRT				
Bullhead Minnow	BUM	Quillback	ULL		
Central Mudminnow	CEM	Rainbow Smelt	RAS		
Channel Catfish	CCF	Rainbow Trout	RBT		
Coho Salmon	CHO	Redear Sunfish	RSF		
Common Carp	CAP	Redfin Shiner	RDS		
Common Shiner	CMS	River Carpsucker	RVC		
Creek Chub	CRC	River Redhorse	RVR		
		River Shiner	RVS		
Emerald Shiner	EMS	Rock Bass	ROB		
		Round Goby	ROG		
Fall Chinook Salmon	FCS				
Fathead Minnow	FHM	Sand Shiner	SAS	**Hybrid Codes**	
Flathead Catfish	FCF	Sauger	SAR	Bluegill x Green Sunfish	BGH
Freshwater Drum	FRD	Shorthead Redhorse	SHR	Bighead x Silver Carp	BSH
		Shortnose Gar	SHG	Common Carp x Goldfish	CGH
Ghost Shiner	GHS	Silver Carp	SCP	Striped Bass x White Bass	SBH
Gizzard Shad	GZS	Silver Chub	SVC	Yellow Perch x White Bass	YWH
Golden Redhorse	GOR	Silver Redhorse	SVR	White Perch x Yellow Perch	WYH
Golden Shiner	GOS	Skipjack Herring	SKH		
Goldeye	GOL	Smallmouth Bass	SMB	**Other Codes**	
Goldfish	GOF	Smallmouth Buffalo	SAB	Unidentified Sunfish	SUN
Grass Carp	GRC	Spotfin Shiner	SFS	Unidentified Minnow	MIN
Grass Pickerel	GRP	Spottail Shiner	SPS	Unidentified Fish	UID
Green Sunfish	GSF	Spotted Gar	SPG	No Fish Code	NFH

Appendix F. Sample data sheets.

Asian Carp Monitoring Project - Electro

Date: _____

Area Surveyed: _____ Biologist (Crew): _____

Wisc Unit DC: Rate: _____ Duty:_____ Range: High or Low Volts:_____ Amps:_____

Smith Root DC: Percent of Setting:_____Pulse Per Second Setting:_____Amps:_____

Other (Describe): _____

Rate Gear Efficency (circle one): Good Moderate Poor

Air Temp: _____ Water Temp: _____ Conductivity: _____ Others: _____

	Run No._____ Lat._____ Lon._____ Start Time: _____ Shock Time: _____	Run No._____ Lat._____ Lon._____ Start Time: _____ Shock Time: _____	Run No._____ Lat._____ Lon._____ Start Time: _____ Shock Time: _____	
Fish Species	No. of Fish	No. of Fish	No. of Fish	Total No. Fish
Gizzard shad >6 in.				
Gizzard shad juv.<6 in.				
Alewife				
Common carp				
Goldfish				
Carp x Goldfish hybrid				
Freshwater drum				
Smallmouth buffalo				
Bigmouth buffalo				
Black buffalo				
River carpsucker				
Quillback				
White sucker				
Channel catfish				
Yellow bullhead				
Black bullhead				
Largemouth bass				
Smallmouth bass				
Bluegill				
Green sunfish				
Pumpkinseed				
Hybrid sunfish				
Rock bass				
White crappie				
Black crappie				
Golden shiner				
Bluntnose minnow				
Fathead minnow				
Spotfin shiner				
Emerald shiner				
Spottail shiner				
Round goby				
White perch				
White bass				
Yellow bass				

Asian Carp Monitoring Project - Nets

Date: _____

Area Surveyed: _____ Biologist (Crew): _____

Air Temp: _____ Water Temp: _____ Conductivity: _____ Others: _____

Set No._____ Lat._____ Lon._____ Total Yds._____	Panel No._____ Type (circle): Tra or Gill Length (yds.)_____ Height (ft.)_____ Mesh (in.)_____ Start Time: _____ End Time: _____	Panel No._____ Type (circle): Tra or Gill Length (yds.)_____ Height (ft.)_____ Mesh (in.)_____ Start Time: _____ End Time: _____	Panel No._____ Type (circle): Tra or Gill Length (yds.)_____ Height (ft.)_____ Mesh (in.)_____ Start Time: _____ End Time: _____	
Fish Species	No. of Fish	No. of Fish	No. of Fish	Total
Gizzard shad >6.0 in.				
Common carp				
Goldfish				
Carp x goldfish hybrid				
Freshwater drum				
Bighead carp				
Silver carp				
Grass carp				
Smallmouth buffalo				
Bigmouth buffalo				
Black buffalo				
River carpsucker				
Quillback				
Channel catfish				

Set No._____ Lat._____ Lon._____ Total Yds._____	Panel No._____ Type (circle): Tra or Gill Length (yds.)_____ Height (ft.)_____ Mesh (in.)_____ Start Time: _____ End Time: _____	Panel No._____ Type (circle): Tra or Gill Length (yds.)_____ Height (ft.)_____ Mesh (in.)_____ Start Time: _____ End Time: _____	Panel No._____ Type (circle): Tra or Gill Length (yds.)_____ Height (ft.)_____ Mesh (in.)_____ Start Time: _____ End Time: _____	
Fish Species	No. of Fish	No. of Fish	No. of Fish	Total
Gizzard shad >6.0 in.				
Common carp				
Goldfish				
Carp x goldfish hybrid				
Freshwater drum				
Bighead carp				
Silver carp				
Grass carp				
Smallmouth buffalo				
Bigmouth buffalo				
Black buffalo				
River carpsucker				
Quillback				
Channel catfish				

Asian Carp Monitoring Project

Date: _____

Area Surveyed: _____ Biologist (Crew): _____

Gear Type (circle one): DC, AC, Nets

Nets (Describe Nets): _____

Fish Species	TL mm	TL mm	TL mm	TL mm	TL mm	TL mm	TL mm	TL mm	TL mm	TL mm
Gizzard shad >6 in.										
Gizzard shad juv.<6 in.										
Alewife										
Common carp										
Goldfish										
Carp x Goldfish hybrid										
Freshwater drum										
Smallmouth buffalo										
Bigmouth buffalo										
Black buffalo										
Quillback										
White sucker										
Channel catfish										
Yellow bullhead										
Black bullhead										
Largemouth bass										
Smallmouth bass										
Bluegill										
Green sunfish										
Pumpkinseed										
Hybrid sunfish										
Rock bass										
White crappie										
Black crappie										
Golden shiner										
Bluntnose minnow										
Fathead minnow										
Spotfin shiner										
Emerald shiner										
Round goby										
White perch										
Yellow Bass										

eDNA Field Data Sheet

DATE_____ NAME_____ START TIME_____ SHEET ____of_____

ID	Volume	Latitude	Longitude	Temp	Depth	Habitat	Collect Time	Filter Time

Notes/Comments: