BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

IN THE MATTER OF:	)	
	)	
WATER QUALITY STANDARDS AND	)	
EFFLUENT LIMITATIONS FOR THE	)	**R08-9 Subdocket C**
CHICAGO AREA WATERWAY SYSTEM	)	**(Rulemaking – Water)**
AND THE LOWER DES PLAINES RIVER:	)	
PROPOSED AMENDMENTS TO 35 Ill.	)	
Adm. Code Parts 301, 302, 303 and 304	)	

NOTICE OF FILING

TO: John Therriault, Assistant Clerk
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Attached Service List

PLEASE TAKE NOTICE that I have today filed with the Illinois Pollution Control Board Midwest Generation L.L.C.'s Reply to Pre-First Notice Final Comments, a copy of which is herewith served upon you.

Dated: March 19, 2012

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CERTIFICATE OF SERVICE

The undersigned, an attorney, certifies that a true copy of the foregoing Notice of Filing and Midwest Generation L.L.C.'s Reply to Pre-First Notice Final Comments was filed electronically on March 19, 2012 with the following:

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and that true copies were mailed by First Class Mail, postage prepaid, on March 19, 2012 to the parties listed on the foregoing Service List.

/s/ Susan M. Franzetti

ILLINOIS POLLUTION CONTROL BOARD

IN THE MATTER OF:	)	
	)	
WATER QUALITY STANDARDS AND EFFLUENT LIMITATIONS FOR THE CHICAGO AREA WATERWAY SYSTEM AND LOWER DES PLAINES RIVER PROPOSED AMENDMENTS TO 35 ILL. ADM. CODE 301, 302, 303, AND 304	)	**R08-9 Subdocket C (Rulemaking-Water)**

MIDWEST GENERATION L.L.C.'S REPLY
TO PRE-FIRST NOTICE FINAL COMMENTS

INTRODUCTION

The Final Comments submitted by the Illinois Environmental Protection Agency ("Illinois EPA") and the Environmental Groups underscore that one of the main disputed issues in this rulemaking is whether or not the conditions in the Upper Dresden Island Pool ("UDIP") satisfy one or more of the six Use Attainability Analysis ("UAA") Factors. However, their Final Comments attest to the strength and persuasiveness of the Upper Dresden Island Pool ("UDIP") record evidence showing that one or more of the UAA Factors is satisfied. Their arguments do not succeed in refuting the substantial scientific data and opinions provided by well-qualified expert witnesses which support that finding.

The Illinois EPA's Final Comments succeed only in nipping at the edges of the substantial proof presented. Upon closer scrutiny, the Agency's comments amount to no more than taking an isolated statement out of context and distorting its meaning, misconstruing the scientific data presented, offering its interpretation of journal articles not presented for independent scrutiny during the hearings, and introducing unsupported, novel Qualitative Habitat Evaluation Index ("QHEI") data interpretations which rely only on untested and invalid exercises in data extrapolation. None of these comments rise to the level of reliable evidence to guide the

Board's findings. Moreover, the eleventh-hour introduction of these allegations in final comments, well after the close of the exhaustive Subdocket C hearings, creates a strong suspicion that their substance would not have withstood the scrutiny of a hearing cross-examination.

The Environmental Groups challenge not only the UDIP appropriate use designations, but also inject a lone contention that the Brandon Pool and the South Branch of the Chicago River should both be a higher aquatic life use ("ALU"), ALU A, than the proposed ALU B. For the UDIP and South Branch, they do not introduce any new arguments, and the old arguments revisited are fatally flawed because they are not supported by any scientific evidence or qualified expert opinions introduced into this record. For the Brandon Pool, the Environmental Groups place heavy reliance on a high QHEI score that it misconstrues as being in the Brandon Pool when in fact it is for wholly unrelated, non-UAA river segments located in a portion of the nearby Upper Des Plaines River that runs parallel to the Brandon Pool.

The issues presented here are indeed complex and challenging. Midwest Generation does not envy the Board's burden in sifting through the extensive record evidence presented in Subdocket C. But it is precisely due to the complexity and breadth of the issues that it is possible to isolate pieces, and pick along the edges, of the mountain of evidence presented and potentially succeed in creating doubt about whether the necessary evidentiary showing regarding one or more of the six UAA Factors has been made. Accordingly, Midwest Generation presents here a detailed review and analysis of the arguments advanced by the Illinois EPA and the Environmental Groups. This detailed review will clearly show that their comments fail to rebut the findings and supporting evidence presented in Midwest Generation's Final Comments that

- The preponderance of the UDIP record evidence shows that it cannot attain the Clean Water Act ("CWA") goals because UAA Factors 3 (unremediated human caused conditions or sources of pollution), 4 (dams and other hydrologic modifications which cannot be feasibly modified) and/or 5 (physical habitat conditions) have been satisfied; and
- The Brandon Pool and the South Branch of the Chicago River should properly be classified as ALU B and not ALU A.

Midwest Generation has considered the minor revision the Agency proposed to its UDIP ALU use designation language, one of which was already included in Midwest Generation's proposed language, and has incorporated it into Midwest Generation's proposed UDIP ALU use designation language, along with an additional sentence that references the applicability of water quality standards for the UDIP which are part of the pending Subdocket D rulemaking. The revisions are as follows:

302.237 Upper Dresden Island Pool Aquatic Life Use Waters

Lower Des Plaines River from the Brandon Road Lock and Dam to the Interstate 55 Bridge **is** designated for the Upper Dresden Island Pool Aquatic Life Use. These effluent-dominated, urban-impacted waters are capable of maintaining warm water aquatic-life populations consisting primarily of lentic species of tolerant and intermediately tolerant types that are adaptive to the impounded, channelized and artificially-controlled flow and widespread siltation conditions created by the operation of the locks and dams that are necessary to maintain the existing navigational use and upstream flood control functions of the waterway system. **These waters must meet the water quality standards of 35 Ill. Adm. Code 302, Subpart D.**

A revised proposed section 303.237 UDIP ALU use designation language is attached hereto as Exhibit A.

ARGUMENT

The approach taken by the Illinois EPA's Final Comments is particularly troubling due to its significant failure to responsibly review the substantive scientific evidence introduced in this rulemaking by Midwest Generation. Plainly stated, the Illinois EPA did not cause to be conducted a scientifically rigorous UAA of the UDIP. It instead mistakenly assumed that because the UDIP conditions were somewhat better than those in the Brandon Pool area, the UDIP should be capable of attaining the CWA's fishable goal. The Agency failed to recognize the substantial evidentiary gaps which accompanied its proposed ALU for the UDIP.

In contrast, when faced with a proposed ALU use for the UDIP that was not consistent with and unsupported by scientific evidence, Midwest Generation acted to bring to this Board a review of existing scientific data and collected additional scientific data necessary for a thorough UAA that properly addresses key issues presented by the conditions in the UDIP. This unrefuted, extensive scientific evidence clearly satisfies one or more of UAA Factors 3, 4 and 5.

With regard to habitat conditions, Illinois EPA mistakenly relied upon only 3 QHEI site survey scores for the 9-mile long UDIP, prepared by those unfamiliar with the UDIP, which did not present an adequate and representative survey of UDIP habitat conditions. Midwest Generation filled this critical, evidentiary gap by presenting an extensive 2008 QHEI Survey of the UDIP covering not 3, but 50, separate survey sites prepared by well-trained and experienced personnel with in-depth knowledge of the UDIP. Neither the Illinois EPA's nor the Environmental Groups' Comments identify any deficiency in either the quality or the findings of this significant 2008 QHEI Survey.

Similarly, Illinois EPA gave little thought or attention to the widespread presence of siltation in the UDIP, a well-recognized limiting condition for waterways. In response, Midwest Generation caused to be conducted an extensive UDIP siltation survey, including contaminated sediment sampling, and presented a detailed report by qualified experts containing an extensive analysis of the sampling results. Again, neither the Illinois EPA's nor the Environmental

Group's Comments dispute the presence of the widespread and extensive UDIP siltation conditions documented in the 2008 study nor do they take issue with expert opinions that such conditions have significant adverse effects on the aquatic community. Further, neither party takes issue with the irrefutable fact established from the 2008 sediments analyses that the UDIP sediments are highly contaminated. Perhaps by its silence, the Agency is conceding that its prior speculation about sediment quality improving is clearly wrong.

And finally, Midwest Generation presented an extensive expert review of the decades-long, annually conducted Dresden Pool fish surveys, as well as other peer-reviewed studies concerning significant stressors and their adverse effects on fish, to show that the conditions in the UDIP satisfy one or more of the UAA Factors. Again, neither Illinois EPA nor the Environmental Groups challenge the quality of the fish survey data or the credibility of the findings made in these third-party studies.

Perhaps understandably, in response to this virtual tsunami of scientific data and supporting expert opinion, the Agency resorts to out of context attacks, misconstruction and/or distortion of isolated statements within the extensive scientific record presented. It bears noting that the Agency Comments include newly alleged information which it properly should have presented during the hearings so that its credibility and reliability could have been challenged through questioning and the presentation of relevant rebuttal evidence. The Board should disregard such information in making its findings. Certainly, when the Hearing Officer allowed only a two-week period for the preparation of these reply comments, it was never contemplated that new theories or information not previously introduced into the rulemaking record would be contained in parties' final comments. To give such comments any weight, let alone the same weight as record evidence fully examined and tested by hearing questioning or rebuttal witnesses, threatens to make a mockery of this rulemaking and the Board's procedures. Nevertheless, and where time and opportunity allowed, Midwest Generation collected and presents a rebuttal even to these "beyond the record" alleged facts, although admittedly in some instances this required an "in kind" response with rebuttal evidence not already in the record.

Both the Illinois EPA's and the Environmental Groups' arguments are plainly and simply wrong. They do not refute the findings and conclusions presented in MWGen's Final Comments on Subdocket C which established that one or more of the UAA Factors, namely Factors 3, 4 and 5, have been satisfied for the UIDP. Likewise, the Environmental Groups have failed to show that either Brandon Pool or the South Branch of the Chicago River should be ALU A instead of ALU B.

I. THE EVIDENCE IS UNREFUTED THAT DAMS AND HYDROLOGIC MODIFICATIONS PRECLUDE ATTAINMENT OF THE CWA GOALS.

MWGen has shown that the dams and other hydraulic modifications and controls present in both the UDIP and Brandon Pool prevent the establishment of the kind of habitat necessary to support the balanced, indigenous fish population required to attain the CWA's fishable goal. The dams are a major contributing cause of a cascade of negative aquatic effects (*e.g.*, resulting flow conditions, accumulation of silt, including contaminated sediments), which also contribute to satisfying UAA Factors 3 and 5. The Illinois EPA and the Environmental Groups generally assert that the UDIP dams are not detrimental enough to satisfy UAA Factor 4, but fail to rebut the record evidence showing the opposite is true.

A. The Agency's Allegations regarding UDIP "Pre-Dam" Conditions are Incomplete, Unpersuasive and Contradicted by its Prior Finding.

The Illinois EPA contends that the same lake-like conditions existed before and after the present UDIP dams were constructed, relying solely on the contents of a 1908 article (which is neither part of the Subdocket C record nor attached to the Agency's comments). The Agency contends this means it cannot be the dams that are causing the adverse effects seen today. (IEPA Final Comments, p. 35) However, the limited excerpts the Agency references from the 1908 article do not provide enough factual information to identify what UDIP habitat conditions actually existed in 1908, let alone to support the Agency's sweeping conclusion that 1908 conditions are the same as those the dams create today. The quoted excerpts generally refer to the presence of two "lake-like" environments. This alone does not establish that the conditions then are the same as those now. For example, given the apparent absence of channelization and the flow fluctuations caused by today's dams, how could the 1908 conditions mirror today's conditions? Did the widespread siltation that covers the UDIP today exist back then? Similarly, the limited information provided does not rule out the presence of riffles or runs of the river back which fed, or perhaps connected, these two "lake-like" areas. Such higher gradient areas could have provided good, clean substrate along with the necessary riffles and runs to support a better quality fish community.

Moreover, Illinois EPA's belated but apparent change of heart concerning UDIP conditions pre- and post-dam construction is wholly inconsistent with and contradicts its own finding on this issue. From the beginning of this rulemaking, its position has been "that the Lower Des Plaines River continues to be a highly modified water body that does not resemble its pre-urbanized state."[1]

Putting aside the Agency's incomplete and belated contentions about 1908 pre-impoundment conditions in the UDIP, the key and fundamental UAA issue is what level of aquatic life can the UDIP support now? On this issue, an extensive amount of evidence was presented in the attachments to the EA Engineering Report (Exhibit 366) showing that obligate riffle dwellers and other species that need fast water (*e.g.,* rheophilic species) are either absent or

[1] IEPA Statement of Reasons, October 26, 2007, p. 22

greatly reduced in abundance in the UDIP. This evidence showed, for example, that catch rates of redhorse in the UDIP are greatly reduced compared to the nearby Kankakee River. The EA Engineering field data also show that darters are either absent or greatly reduced from the UDIP. The data presented from over 3000 fish collections clearly is sufficient to support the finding that such species are greatly affected by the existing, impounded conditions in the UDIP.

B. The Extensive 2001 Lyons Study is Valid Evidence of the Adverse Aquatic Effects of Dams which was Properly Presented in Expert Testimony by EA Engineering's Greg Seegert.

Illinois EPA unsuccessfully attempts to undermine the scientific findings of the EA Engineering Report and the supporting expert testimony of EA's Greg Seegert that the adverse effects caused by the highly impounded condition of the UDIP are severe. [2] (Illinois EPA Final Comments, p. 36.) The Agency singles out one of several supporting technical references cited in EA's Report, an extensive study conducted by Lyons *et al.* 2001 (the "Lyons Study"), and claims that EA Engineering misrepresented it as "a study of the effects of dam spacing on fish communities." (*Id*.) This is simply not true.

The EA Report cited the Lyons Study in support of its statement that "[s]tudies have shown that the reductions in the diversity of the fish community are greatest where the spacing between dams is least."[3] This is an accurate statement of what the Lyons study data showed and it was not an "untested" hypothesis, as the Agency claims. The study's authors had collected data regarding the spacing of dams and interpreted those data to mean that dam spacing best explained the observed results, which is why they stated the study data "implies" that spacing of

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[2] The EA Report is Exhibit 2 to Exhibit 366, *Aquatic Life Use Attainability Analysis for the South Branch of the Chicago River, the Chicago Sanitary and Ship Canal, and the Upper Dresden Island Pool*, EA Engineering, Sept. 2000

[3] Ex. 2 of Ex. 366, p. 11

dams was a factor.[4] Obviously, Lyons *et al.* (2001) believed that fragmentation by dams was the most likely explanation for the data they collected or they would not have made this statement. Similarly, as EA further stated, "[s]tudies on the Fox River in Illinois sponsored by U.S. EPA clearly demonstrated these impacts as shown by declines in IBI scores upstream of each dam," citing to Santucci and Gephard 2003.[5] Illinois EPA does not attempt to refute the fact that the Fox River study did demonstrate this impact.

The Lyons Study was extensive, it included 155 large river sites, which were placed into seven categories according to the degree or nature of the impacts identified: (1) least impacted; (2) impounded; (3) hydropower peaking; (4) navigation; (5) point source; (6) non-point source; (which included sites with ≥20% urban area); and (7) multiple (river sites with two or more of the impact categories present). For the hydropower peaking category, Lyons *et al*. studied the effects on fish due to "peaking," referring to how the dams are operated. The studies of the effects of hydropower peaking took place in reaches in which <u>no other stressors</u> were identified. The study results showed what is called a "bimodal response" in that some sites below "peakers" had excellent IBI scores, while a similar number had poor IBI scores, suggesting a cause other than the peaking itself. In trying to explain the difference in these IBI scores among sites below "peakers," it was noted that those sites where the dams were closer apart had the poor scores. Based on examination of the data, the authors themselves, not EA or Mr. Seegert, concluded that the most reasonable explanation for the observed bimodal distribution was dam spacing. Hence, Illinois EPA's attempt to distinguish the Lyons Study findings by noting that the dams in this

[4] See Lyons *et al*. (2001), p. 37, fn. 5, copy attached to Post Hearing Comments of the Illinois EPA for Subdocket C, dated March 2, 2012. While not wishing to debate here whether Lyons *et al.*'s use of the verb "implies" is a stronger verb than the Agency's substitution of "suggests," it is important to understand that studies in the field of aquatic science often use such terms because it is difficult, if not impossible, for such studies to definitively prove "cause and effect."

[5] *Id.*

rulemaking are not operated in a peaking mode completely misses the point - - the Lyons Study concluded that peaking did not explain the difference in IBI scores.

The Illinois EPA further contends that unlike the Lyons Study, because "[n]one of the major dams in the CAWS and Lower Des Plaines River are located as close as 2.7 miles to each other" and that "the two dams that bound Upper Dresden Island Pool are about 14 miles apart", the Lyons Study is not "valid evidence" to support EA's conclusions. (IEPA Final Comments, p. 37) From all of the data collected in the Lyons Study, it authors established a mean value of 2.7 miles between dams for reaches with adverse effects and a much higher mean value of 43 miles between dams for reaches with no effects. Clearly, the 14-mile separation between the Dresden Pool dams, as well as the even closer 5-mile separation between the Brandon Pool dams, is much closer to the 2.7 mean value for spacing of dams which cause adverse effects than is the 43 mile mean value for dams that do not.

As noted above, one of the other "impact" categories of river sites evaluated by Lyons *et al*. was impoundments. They described their impounded study sites as being:

> …in riverine reaches at the upstream end of impoundments formed by dams. These sites were more lotic than lentic, but they had reduced current velocity, wider channels, and increased sediment deposition as a consequence of the impoundment.

Lyons *et al.* (2001) at p. 1080.

"Lotic" refers to flowing water, from the Latin "lotus", to wash. "Lentic" refers to relatively still terrestrial waters such as lakes and ponds.[6] The Lyons Study found that even in impounded reaches where the waterway was still more flowing than still, these more lotic sites had IBI scores that were only fair and statistically comparable to their "multiple impact category", which

[6] Allan, J.D. 1995. *Stream Ecology: Structure and Function of Running Waters*. Chapman and Hall, London, p. 388

was their poorest performing category.[7] Thus, the negative effects of impounding waters are clear and irrefutable.[8] As the LDR UAA Report also confirmed, the impoundment of the Lower Des Plaines River creates a deep pool environment that is lacking in course substrate, channel diversity, riffle habitat, and gradient.[9]

The Illinois EPA's difficulty in appreciating either the validity or significance of the Lyons Study, and hence Mr. Seegert's reliance upon it, may stem from its lack of familiarity with hydropower sites in Wisconsin, which are concentrated in the northern part of the state in rivers such as the Menominee, Oconto, Flambeau, and Chippewa. In contrast, EA's Greg Seegert, MWGen's expert, has personally worked on all of these, and many of the other rivers (*e.g.,* the Wolf, Wisconsin, and Mississippi rivers) included in the Lyons Study.[10] Mr. Seegert is an expert on the fish fauna of Wisconsin who has taught several courses for the Wisconsin DNR on fish identification and is the incoming president of the Wisconsin Chapter of the American Fisheries Society.[11] Mr. Seegert's opinions here were supported by his personal knowledge of these rivers, including his knowledge that the habitat of the reaches in their free flowing portions, unlike the impounded areas, of these rivers is excellent.

Among all the extensive scientific evidence Midwest Generation introduced in this rulemaking concerning the multiple, adverse aquatic life effects caused by dams like those in the UDIP, the Agency only challenges a single reference by EA Engineering to a finding in the Lyons Study. This speaks volumes regarding the strength and persuasiveness of the supporting

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[7] Lyons *et al.* (2001), p. 1086, 1089-1090

[8] The Environmental Groups' witness, Dr. Thomas, suggests that dams on large rivers surely cannot be affecting all of the nation's waterways. In addition to the fact that the lower Des Plaines River is not accurately termed a "large river," adverse effects from dams have in fact been found in large rivers. Lyons *et al.* (2001) found that the "Mississippi River, which is substantially larger than any other river in Wisconsin…is also degraded over its entire length within the state." Clearly, rivers, regardless of size, are not immune to adverse effects from dams, what differs is the degree of severity of those effects.

[9] LDR UAA Report, Attachment 1 to IEPA's Statement of Reasons, at p. 4-32

[10] Resume of Greg Seegert, Ex. 1 to Ex. 366

[11] *Id.*

evidence Midwest Generation introduced to show that the UDIP conditions satisfy UAA Factor 4. For example, the Agency has not challenged the even more persuasive findings of the in-depth study of the impounded conditions in the Fox River. (See MWGen Final Comments, pp. 30-31) The dams in the Fox River cause it to be 50% impounded, significantly less than both the 100% impounded Brandon Pool and the 93% impounded Dresden Pool. (*Id.*) Nevertheless, even the significantly less impounded condition of the Fox River was found to cause a plethora of negative aquatic life impacts, including, lower fish species richness, poor macroinvertebrate scores and low QHEI scores indicating poor habitat conditions. (*Id.*)

More and more studies of the impacts of dams are documenting their severe adverse effects on aquatic life. For example, in 2003, an assessment of the impacts of dams was done on the main stem of the DuPage River and the West Branch DuPage River.[12] The study found that as a result of the dams, there is a poor macroinvertebrate population and low fish diversity.[13] The following summary of their study results corroborates the accuracy of Mr. Seegert's testimony on the adverse effects of dams:

> In addition to system-wide effects, dams are known to have localized impacts on fish communities due to degraded habitat and water quality conditions in the upstream impounded area (Santucci and Gephart 2003, Kenehl *et al*. 1999). For the DuPage River, a total of 26 species, representing 65% of all species collected, were found only at the free –flowing stations downstream of the dams, and did not occur in the upstream impounded areas (Table 1.5). With the exception of golden shiner, all species found in the impounded areas were also found in the free-flowing areas. For all stations combined, free-flowing areas held roughly twice as many species as the impounded areas upstream of the dams (Table 1.5)[14]

The DuPage River study also noted the adverse effects of siltation on aquatic life (whether or not there is contaminated sediment also present). The impoundment behind one of the dams, the

[12] See Hammer *et al*., "Assessments of the Impacts of Dams on the DuPage River" (2003), The Conservation Foundation. A copy is attached as Exhibit B.
[13] *Id*. at p. 6
[14] *Id*. at pp. 15-16

McDowell Grove Dam, contained a "vast amount of fine-grained silt and sand which as[sic] blanketed most of the natural habitat on the channel bottom, resulting in poor fish and macroinvertebrate communities.[15] The authors concluded that the "dams on the DuPage River are a significant contributor to the overall degradation of native species."[16]

These and other unrefuted, scientific data and findings, presented through the expert testimony of EA Engineering's Greg Seegert, clearly support a finding that the same, significantly adverse effects due to the dams are found in the UDIP, as well as in the Brandon Road Pool.

C. The Evidence shows that the UDIP Locks and Dams, Just like the Brandon Pool Locks and Dams, Cannot be Altered to Alleviate their Detrimental Effects.

Incredibly, Illinois EPA argues there was insufficient evidence to show that the locks and dams in the UDIP cannot be altered to alleviate their detrimental effects, as required by UAA Factor 4, and without any support whatsoever, implies that they can be so altered somewhere in the unforeseeable future. (IEPA Final Comments, p. 33) Somehow, the Illinois EPA overlooked the fact that its argument is flatly contradicted by its simultaneous position that this same evidence is sufficient to show that the locks and dams in the Brandon Pool (one of which is the same lock and dam that impounds the UDIP at its northern end), as well as in the CSSC, satisfy UAA Factor 4. Illinois EPA has consistently maintained that UAA Factor 4 is satisfied for the Brandon Pool and CSSC because of the presence of the dams and that they cannot be managed differently.[17] No one in this rulemaking has ever contended that the dams in the CSSC and Brandon Pool are not the same types of dams as in the UDIP or that they are operated differently. The evidence regarding the operation of all these dams to serve navigational and flood control

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[15] *Id*. at p. 7
[16] *Id*. at p. 33
[17] See, *e.g.*, IEPA Statement of Reasons, p. 48

purposes shows they are all managed and operated in the same way. Given their common flood control purposes to protect the Chicagoland area, they must be operated in a coordinated and inter-related manner. No distinctions whatsoever have been identified, except for where each dam is located on the waterway. The Illinois EPA's arbitrary and capricious contention regarding a purported evidentiary insufficiency specific only to the UDIP locks and dams is incredulous.

As summarized in MWGen's Final Comments (pp. 28-36), the clearly supported conclusion for all of these dams is that they cannot be removed and their current operations are necessary to protect the existing uses of navigation and flood control - - as such, the Clean Water Act prohibits actions which remove or interfere with these uses. Plainly stated, dams are dams. Even if one hypothesizes that the water level fluctuations in the UDIP could be potentially reduced, albeit at the sacrifice of their flood control function to handle wet weather-generated increased flows from the Chicago area, still all the other and many insidious effects of the dams would remain. In sum, the UDIP evidence clearly satisfies UAA Factor 4.

II. UDIP HUMAN CAUSED CONDITIONS, INCLUDING WIDESPREAD SILTATION AND CONTAMINATED SEDIMENTS, SATISFY UAA FACTOR 3 AND PREVENT THE ATTAINMENT OF CWA GOALS.

Midwest Generation has shown that human caused conditions throughout the system, particularly widespread and extensive siltation, satisfy UAA Factor 3. The evidence includes: an extensive 2008 field survey of the UDIP showing that sedimentation was moderate to severe in over two thirds of the UDIP and was highly contaminated at numerous sampling sites; the expert opinions of Dr. Allan Burton who identified and explained the impacts of multiple human caused conditions or sources of pollution in the UDIP in support of his opinions; and the expert opinions of Greg Seegert addressing the adverse aquatic life effects caused by these conditions. (See, *e.g.*, MWGen Final Comments, pp. 38-39) Dr. Burton, an aquatic toxicologist with particular expertise in the role of sediment and storm water quality as stressors effecting freshwater ecosystems, had extensively studied UDIP conditions in the 1990's and again for this rulemaking.[18] Dr. Burton found that UAA Factor 3 was satisfied based on the evidence of excessive physical and chemical impairments, particularly evidenced by the sediment survey data, in the UDIP.[19] Mr. Seegert also concluded that human caused conditions or sources of pollution prevented the UDIP from attaining the CWA's aquatic life goals based on their adverse effects on aquatic life. Neither the Agency's nor the Environmental Groups' Comments undermine the persuasiveness and weight of this evidence that satisfies UAA Factor 3.

A. The Harm to Aquatic Life Caused by Barge Traffic is only one of Several Contributing Conditions that Together Satisfy UAA Factor 3.

Apparently in an attempt to distract from the fact that the sum of all of the evidence satisfies UAA Factor 3, Illinois EPA's Comments distort MWGen's position by incorrectly making it seem that the predominant supporting evidence for UAA Factor 3 was that barge traffic injures or kills individual fish in the UDIP. (IEPA Comments, pp. 27-29) Illinois EPA may wish this was true, but it is not. Accurately stated, MWGen's position is that the evidence showing that the fish population in the UDIP is harmed by the heavy barge traffic (as well as by the turbid conditions the barge traffic causes) is just one of several contributing factors that, taken together, satisfy UAA Factor 3. The Agency's Comments do not dispute the facts showing that the heavy barge traffic is such a contributing factor, because it does harm aquatic life in the UDIP, nor does it refute the study findings cited by Mr. Seegert (Gutreuter Report (2003)) that confirmed 5% of the gizzard shad population were lost per year due solely to this stressor.

IEPA instead attempts to "divide and conquer" the mountain of evidence of multiple human-caused conditions in the UDIP by contending that just this condition alone does not

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[18] See Burton Pre-Filed Testimony, pp. 1-2,5-6,11-12
[19] Burton Pre-Filed Testimony, Ex. 369, pp. 13-14

satisfy UAA Factor 3. Midwest Generation has never said it does. In fact, if the UDIP did not have such extensive siltation, if its sediments were not so highly contaminated, if it did not suffer from the adverse effects caused by its increasingly urbanized drainage area, if the CSOs did not exist, and, if we assume for arguments sake, that the only contributing human-caused condition in the UDIP was harm caused by the injuries and deaths due to commercial navigation traffic, then yes, it is not likely UAA Factor 3 would be satisfied. But the language of UAA Factor 3 speaks to "human-caused conditions" plural. And the harm caused to UDIP fish from commercial navigation is just one of the many above-mentioned, human caused conditions and sources of pollution that together clearly satisfy UAA Factor 3.[20]

B. The Evidence Shows that Extent of the Siltation and Sediments in the UDIP is Sufficient to Satisfy UAA Factor 3.

Turning to the extensive and thorough data documenting the predominance of sedimentation in UDIP, which was moderate to severe in over two thirds of the UDIP (see, *e.g.*, MWGen Final Comments, pp. 38-39), and the expert testimony that such extensive siltation conditions negatively impair aquatic life in the UDIP, the Illinois EPA argues that Midwest Generation did not show exactly how much sediment was too much to allow a balanced, indigenous aquatic population to live there. (IEPA Comments, pp. 29-30) More specifically, Illinois EPA singles out "page 10" of the EA Engineering Report for an insufficient explanation of how the amount and distribution of sediment in the UDIP is a primary detriment to attaining the Clean Water Act Goals. (IEPA Comments, p. 30) However, the EA Engineering Report did explain that excessive sediments "can impair aquatic life by filling interstitial spaces of spawning gravels, impairing fish food sources, filling rearing pools, and reducing beneficial habitat

[20] All of the evidence relating to the other UDIP conditions that satisfy UAA Factor 3 is summarized in detail in MWGen's Subdocket C Comments at pp.36-58.

structure in stream channels."[21] Mr. Seegert testified not only that "the adverse effects from sediment deposition is a widely accepted fact"[22], but also about the specific adverse effects from the extent of siltation found in the UDIP survey, including that the amount of siltation provided minimal spawning areas for a variety of species[23] and that it covered up rocks that might otherwise provide some suitable habitat for fish known as "simple lithophils"[24]

The Agency essentially is asking for a specific threshold amount of sediment that allows for a river of this size to attain CWA goals, when the UAA regulations do not require or provide any such thresholds, and knowing full well that no such specific standards have been defined or that they could be because each river system is somewhat different. Accepting the IEPA's demand for such pinpoint accuracy in the degree of sediment that tips the scales against attainment would render it impossible based on current scientific knowledge to satisfy UAA Factor 3. The undisputed fact remains that the unrebutted expert testimony and supporting data showed that because two thirds of the UDIP sites suffer from moderate to severe sedimentation, it is not capable of attaining the CWA fishable goal.

C. There is no Scientific Basis for the Agency's Novel Extrapolation of the Single QHEI "Substrate" Metric to Attempt to Show "Attainability" of the CWA's Goals.

The Qualitative Habitat Evaluation Index (QHEI) developed by Ed Rankin in 1989 is a habitat scoring system consisting of six individual metrics each of which are scored and then summed to determine the total QHEI score for an individual survey site.[25] Streams that have QHEI scores greater than 60 are capable of supporting fish communities consistent with CWA

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[21] Ex. 2 of Ex. 366 at p. 9
[22] 4/9/09PM Tr. at 40
[23] *Id*. at 33
[24] *Id.* at 40-41, 59-60, 69-70
[25] 5/16/11 Tr. at 135. The six QHEI metrics are: 1) Substrate, 2) Instream cover, 3) Channel morphology, 4) Bank erosion and riparian zones, 5) Pool/run/riffle quality, and 6) Stream gradient. Further discussion of the QHEI can be found in Ex. 2 of Ex. 366 at 20.

goals.[26] Of the 50 UDIP sites subjected to QHEI scoring in 2008, most had a QHEI score below 60 and many scored below 45, meaning almost all of the UDIP is not a good habitat for a healthy fish population consistent with CWA goals.[27] The mean QHEI score for the entire UDIP was 47, well below a score of 60, and just barely above the score of 45, the level that is deemed clearly incapable of supporting such fish communities.[28] Importantly, the spatial distribution of the QHEI scores showed that the majority of the habitat in the UDIP is poor or fair.[29]

Unable to challenge the reliability of the extensive and highly probative 2008 QHEI scores, and without even referencing them, the Illinois EPA for the first time advances the bizarrely creative, but wholly indefensible, theory that because 40% of the UDIP 2008 QHEI individual metric substrate scores are greater than or equal to 12, out of a total possible substrate metric score of 20, attainment is therefore possible because this single substrate metric score "is analogous to the [QHEI] threshold of 60". (Illinois EPA Comments, pp. 30-31) There is no scientific basis for the Agency's self-serving theory of extrapolation from a single substrate metric score, and none is provided, nor is there any precedent whatsoever for advancing it. .

Moreover, the Agency's creation of a new "figure" (see Attachment B to the Illinois EPA comments), apparently to lend this purely mathematical exercise some scientific gravitas, does not "illustrate that substrate conditions in the [UDIP] do not clearly prevent attainability of the Clean Water Act aquatic-life goal," as it baldly asserts. (*Id.* at p. 30) In truth, one QHEI metric does not provide a complete and accurate picture of habitat conditions. Given the total lack of scientific support and expert acceptance of the IEPA's novel approach of splitting out a single metric in the QHEI and extrapolating it to evaluate attainability potential, it is no wonder that the

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[26] *Id.*
[27] Ex. 2 of Ex. 366 at 21; 1/28/08 Tr. at 250-251
[28] Ex. 366 at 10
[29] Ex. 366 at 10, Attachment 2F of Ex. 2 of Ex. 366

Illinois EPA kept this argument under wraps until its "final" comments – safe from probing questioning at Subdocket C hearings where it would have been unable to defend it.

In short, the fact that 40% of the UDIP 2008 QHEI substrate scores are greater than or equal to 12 means nothing, other than further emphasizing the fact that 60% (or more than half) of the 50 UDIP sites could not attain even this minimal score to which the Agency apparently attaches such great importance. One must know the total QHEI score to make intelligent decisions regarding habitat quality. There is no scientific support for taking a single QHEI metric and extrapolating it into a total QHEI score.

Further, in all 20 of the 2008 QHEI sites that the Illinois EPA relies on for this extrapolation, the score of ≥12 was achieved because one or more (usually one) of the dominant substrate was gravel or cobble/boulder. (See 2008 QHEI Survey Site Scoring Sheets, Attachment 2E to Ex. 366) However, there were only two cases out of those 20 sites where there was fast water associated with the hard substrates (the Brandon tailwater and another site about a mile below the tailwaters). As more fully explained below in response to the Agency's "cobbles and boulders" argument, without the necessary, accompanying fast water, hard substrates alone do not provide suitable habitat for the suite of fish species known as obligate riffle dwellers (*e.g.*, redhorse, darters, etc.). In other words, they need "riffles." And most important, without this combination of fast water and hard substrates, obligate riffle dwellers and certain other fish species will either be absent or so reduced in numbers that the balanced, indigenous population that achieves the CWA's fishable goal will not be attainable.[30] This is why Mr. Rankin, who developed the QHEI, was quickly able to determine the UDIP was impaired and recommended Ohio's "Modified Warmwater Habitat-Impounded" ALU as the appropriate use. (See Attachment R to IEPA's Statement of Reasons). IEPA continually and conveniently ignores the

[30] Seegert Pre-Filed Testimony, Ex. 366 at 6-7

obvious "elephant in the room" – the dams and the impounding effects they cause, such as the lack of fast water.

D. Widespread and Significant Exceedances of Established Contaminated Sediment Guidelines in the UDIP Constitutes Evidence of Likely Adverse Aquatic Life Effects to Satisfy UAA Factor 3.

The Illinois EPA also responded to Midwest Generation's evidence that the contaminated sediments throughout the UDIP are yet another contributing factor to satisfying UAA Factor 3. Midwest Generation demonstrated that large portions of the Brandon Pool and the UDIP are of poor sediment quality characteristic of urban-dominated watersheds and unable to support a healthy aquatic habitat.[31] MWGen also showed that the contaminated sediments are acutely or chronically toxic to most, if not all, aquatic species.[32] The Illinois EPA does not challenge the quality or validity of any of this evidence. Instead, after having passed over the issue of adverse aquatic life effects from contaminated sediments in the UDIP without so much as having taken a single sediment sample, the Illinois EPA responds that MWGen's extensive 2008 sediment study is insufficient to show that contaminated sediments are yet another of the contributing human-caused conditions that collectively satisfy UAA Factor 3. (IEPA Final Comments, pp. 42-46)

As defined in the regulations, a UAA is supposed to be a scientific assessment, but the Agency did not perform any scientific assessment of the UDIP sediment conditions. See 40 CFR §131.3(g). Having expediently, but wrongly, assumed that UDIP contaminated sediment conditions had improved over time and would not be a limiting condition, the Agency's inaction biased the UAA process against a finding that sediment conditions were a contributing limiting condition in the UDIP. When faced with this significant evidentiary gap in the Agency's UAA rulemaking petition, Midwest Generation took the necessary steps to cause to be conducted in

[31] Exhibits 377and 378; 1/13/10 PM Tr. at 20-21
[32] Attachment 1 of Ex. 369 at 7-10; 1/13/10 PM Tr. at 87

2008 a scientific assessment of sediment contamination conditions in the UDIP at its own expense.

Illinois EPA attacks Midwest Generation's extensive sediment sampling data and expert analysis by wrongly claiming that widespread and significant exceedances of the Sediment Quality Guidelines ("SQGs") it documented in the UDP are not sufficient to show that UAA Factor 5 was not met. (IEPA Comments, pp. 42-46) First, contaminated sediments is another human-caused condition that contributes to satisfying UAA Factor 3. It is not only relevant to UAA Factor 5 concerning physical conditions in the waterway. Second, the Agency's only support for this contention is a cited reference to CERCLA guidance that cautions that because the SQGs are a generic screening tool to identify the presence of contaminated sediments, they may not be substituted for the process of deriving site-specific, sediment clean-up standards for contaminated sediment at a given CERCLA Superfund site.[33] Perhaps the Agency misunderstood the significance of the extensive exceedances of SQGs for UAA purposes. UAA Factors 3 and 5 do not require a determination of, or comparison of SQGs to, site clean-up standards. The CERCLA question of "how clean is clean" for sediment remediation purposes is irrelevant in the UAA context. The cited CERCLA guidance document does not support the Agency's claim that extensive and significant exceedances of the SQGs do not indicate an adverse effect on aquatic life.

SQGs are recognized "commonly accepted benchmarks" used by sediment experts to draw conclusions regarding the contaminated nature of the sediments and their likely impacts.[34] Under the SQGs, the "Threshold Effects Concentration" ("TEC") represents concentrations below which adverse biological effects are not expected to occur. The Probable Effects

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[33] This was expressly acknowledged by Dr. Burton in his Pre-Filed Testimony, Ex. 369 at p. 7, fn.1.
[34] MWGen Final Comments p. 43, fn. 162; Ex. 369 at 7, fn.1; Attachment 1 of Ex. 369 at 7&9

Concentration ("PEC") represents concentrations in the middle of the effects range and above which adverse biological effects are expected to occur more often than not.[35] The 2008 EA Engineering UDIP and Brandon Road Pool sediment contamination study demonstrated that concentrations of PAHs and total PCBs exceeded not only the TEC but also the PEC values.[36] This certainly establishes that it is probable that the contaminated sediments in the UDIP are having a toxic effect on the aquatic life.[37] The Agency has provided no legal authority to support its apparent position that something more than a preponderance of the evidence standard, *i.e.*, that something is more likely than not to be true, applies to show that a UAA Factor has been satisfied.

Similarly, the Environmental Groups provide no scientific support for their position that despite the widespread sediment contamination (and other human-caused conditions), because merely 10% of the UDIP (the Brandon Tailwaters) have "highly desirable fish," it somehow follows that the UDIP as a whole is capable of attaining the CWA goals. (Environmental Groups Final Comments, p. 12) The evidence shows that the Brandon Tailwaters is isolated and surrounded by predominately poor to fair habitat that is unable to support intolerant fish. (MWGen Final Comments, p. 67) Years of annual EA fish survey UDIP data show that the Brandon Tailwater is not dominated by "highly desirable fish,"[38] and the fish found there are often affected with DELTS (deformities, erosions, lesions, and tumors). (MWGen Final Comments, p. 69)

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[35] 2008 Sediment Chemistry Study, at p. 9 (Attachment to Ex. 369)
[36] Appendix C of Attachment A of Ex. 369, Sediment Chemistry Study, Upper Illinois Waterway, Upper Dresden and Lower Brandon Pools, EA Engineering, Science, and Technology, 2008; TEC is for threshold effects concentration, which represents concentrations below which adverse biological effects are not expected to occur.
[37] MWGen Final Comments, p. 42, Attachment 1 of Ex. 369 at 7-10; 1/13/10 PM Tr. at 87
[38] Ex. 366, p. 21

The Environmental Groups argue that good fisheries can exist with contaminated sediments, citing to testimony by Limnotech's Scott Bell. (Environmental Groups Final Comments, p. 13) But that is not an accurate characterization of Mr. Bell's testimony. What Mr. Bell did say was that in Limnotech's development of its Habitat Index for the CAWS, when rating the various habitat variables that were most damaging to macroinvertebrates, contaminated sediments were below the top five in Limnotech's rating system.[39] There was no expert testimony that "good fisheries" can be supported by waters like the UDIP that have extensive contaminated sediments.

III. THE UDIP PHYSICAL CONDITIONS SATISFY UAA FACTOR 5.

In assessing the physical habitat conditions of the UDIP, it was Midwest Generation that answered the UAA regulations' call for the presentation of scientific data to satisfy UAA Factor 5. (See 40 CFR §131.3(g)). It caused extensive scientific QHEI data to be collected, which was then presented and interpreted by an expert in aquatic biology, Greg Seegert. The scientific evidence in this UAA shows that the UDIP cannot attain the CWA goals.

The lack of course substrate, riffles and other conditions that are typical of natural waters preclude the UDIP, as well as Brandon Pool and the South Branch of the Chicago River, from attaining the CWA goals. Not only did MWGen present sufficient evidence to show this, the Agency's LDR UAA Report established it too. The LDR UAA Report stated that the impoundment by the Brandon Road and Dresden Island Locks and Dams "creates a deep pool environment that is lacking in coarse substrate, channel diversity, riffle habitat, and gradient." (LDR UAA at p. 4-32) Also, as discussed in more detail in Midwest Generation's Final Comments, the LDR UAA Report found that the poor habitat conditions in the UDIP could not be improved without impairing the protected existing navigation use. The LDR UAA Report

[39] Testimony of Mr. Bell, 3/10/11, pp. 162-163

concluded that as long as commercial navigation takes place, a protected use under the Clean Water Act, "changes to the poor habitat features are irreversible. (*Id*.)

A. Because of the lack of Riffles in the UDIP, which require a combination of hard substrate and fast water, it cannot support a Balanced, Indigenous Aquatic Population to Attain the CWA's Fishable Goal.

The Illinois EPA tries to shoehorn the UDIP into an aquatic use level it cannot attain based on little or no scientific evidence. For the first time in this rulemaking and without any scientific basis, the Agency contends that there is a so-called "cobble and boulder benchmark" which Midwest Generation's 2008 QHEI survey results fail to meet. (IEPA Final Comments, pp. 34-40) But no such bright line scientific benchmark exists. Illinois EPA proceeds to mistakenly claim that fast water areas with cobble/boulder are not critical to the attainment of a fish community consistent with the CWA fishable goal.[40]

In an attempt to advance this erroneous, unsupported theory, the Agency distorts the meaning of Mr. Seegert's expert testimony. Mr. Seegert clearly testified that the suite of fish species known as "obligate riffle dwellers," as well as certain other fish species, need to have habitat consisting of "fast water" and "hard substrates" together, at the <u>same</u> location. In other words, they need "riffles." Riffles, by definition, are areas of fast water with hard substrates (*i.e.*, gravel, cobble, boulder).[41] As Mr. Seegert clearly testified, it is the lack of riffles (particularly the lack of fast water) that will continue to limit the fish community in the UDIP.[42] Illinois EPA apparently does not understand that to have a diversified fish community, a stream must have fast water in conjunction with hard substrates (*i.e.*, riffles and runs); in other words,

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[40] The IEPA also makes the unfounded and unsubstantiated claim that "even unimpacted low-gradient rivers can typically have small amounts of coarse substrates and yet support balanced fish communities." (IEPA Final Comments at p. 40) Even if this was true, it pertains to unimpacted low-gradient rivers, a description which certainly does not apply to the multi-impacted UDIP.

[41] A riffle is defined as a "shoal, reef, or shallow in a stream, producing a stretch of ruffled or choppy water; a stretch of such water; a ripple or the ripples of such water." *Webster's New World College Dictionary*, 2010, Wiley Publishing, Inc., Cleveland, Ohio

[42] Ex. 366, p. 7

neither fast water alone nor hard substrates alone will provide this balance. Without this combination of fast water and hard substrates, these fish species will either be absent or in greatly reduced numbers and a balanced fish community will not be attainable.[43]

B. Neither EA Engineering nor Mr. Seegert Underestimated the Suitable UDIP Habitat Necessary to Support a Balanced Fish Community.

Illinois EPA compounds its errors by either misrepresenting or not comprehending the data that was presented by EA Engineering in its 1995 investigation of the Upper Illinois Waterway (see Attachment LL to the Agency's Statement of Reasons).[44] (IEPA Comments, p. 39) Professing ignorance regarding what minnows, darters, and suckers EA Engineering was referring to as needing habitat that is scarce in the UDIP, the Agency states:

> For example, of the 16 fish species mentioned in the Report (*e.g.*, p. 18) as intolerant or moderately intolerant and as occurring in Lower Des Plaines River, Attachment LL (specifically, Table 2 and Appendix A) to Illinois EPA's original "Statement of Reasons" indicates that none of these species require spawning substrates as large as cobble or boulder. Moreover, based on information in Attachment LL, no more than three of these 16 species are known to require "fast water". Consequently, in the Report for Midwest Generation, the overemphasis on "boulder/cobble" substrates and "fast water" in Upper Dresden Island Pool underestimates the actual amount of spawning and feeding habitat that is available and suitable to fish species that could constitute a balanced fish community there."

IEPA Final Comments, p. 39.

There are so many errors in the Agency's interpretation of EA Engineering's UIW Report that it is hard to know where to begin to correct the record. First, the following species (and more) were already made known to the Agency in the EA Engineering Report attached to Mr. Seegert's Pre-Filed Testimony (see Ex. 2, p. 27 attached to Ex. 366), but because it professes

[43] Ex. 366, p. 10, Ex. 2 of Ex. 366, pp. 5, 19, 33
[44] Attachment LL to the IEPA's Statement of Reasons is "The Upper Illinois Waterway Study, Interim Report, 1994 Ichthyoplankton Investigation, RM 276.2-321.7" EA Engineering, Science, and Technology, April 1995 (hereinafter "Attachment LL")

ignorance regarding what minnows, darters, and suckers EA was referring to, a partial illustrative list follows:

- Rosyface shiner
- Suckermouth minnow
- All regionally expected darters except Johnny darter
- River redhorse
- Greater redhorse
- Black redhorse
- Shorthead redhorse
- Golden redhorse
- Silver redhorse
- White sucker

Second, there was no "overemphasis on 'boulder/cobble' substrates and fast water." It was never stated by EA Engineering or Mr. Seegert, that all the referenced fishes required substrates as large as cobble or boulder or that they all required fast water. As explained above, Seegert's testimony and the EA Engineering Report state that a subset of fishes, specifically obligate riffle dwellers, are the ones affected. While some of the 16 species Illinois EPA refers to are obligate riffle fishes, others admittedly are not. But further, there are also other species not on the cited list of 16 that are obligate riffle dwellers, *e.g.*, suckermouth minnow.

Third, Illinois EPA's assertion that based on Table 2 and Appendix A to Attachment LL none of these species "require substrates as large as cobble or boulder" and that only three species require fast water is simply wrong. In fact, Table 2 of Attachment LL lists 10 species as being rock and gravel spawners. The table does not specify the size of the "rock", but because it describes these species as "gravel and rock" spawners, one can reasonably infer that "rock" is intended to include cobble and/or boulder substrate. Further, Appendix A to Attachment LL lists "rubble" (a term used interchangeably with "cobble") or boulder as a spawning substrate for five of these species. Thus, at least half of the 10 species use hard substrates larger than gravel.

Illinois EPA's inappropriate focus on cobble/boulder substrates alone, while ignoring gravel substrate, clearly underestimates the degree to which this group of species utilizes and needs <u>hard</u> substrates, regardless of the size of the substrate material.

Fourth, Illinois EPA's unsupported statement that no more than three of these species require "fast water" is even more erroneous. (IEPA Final Comments, p. 39) Appendix A to Attachment LL provides habitat information on only 11 of the 16 species listed in Table 2 of Attachment LL. As indicated above, 6 of the 11 species in Appendix A of Attachment LL are listed as spawning on or inhabiting riffles, which, by definition, are <u>fast water areas</u>. These six species are silver, shorthead, golden, and river redhorse, as well as logperch, and slenderhead darter. In some instances, the descriptions in Appendix A even expressly state that the species inhabits "riffles" and specifically mentions "fast" or "swift" water. For example, the description for shorthead redhorse notes that they spawn in riffles and in swift water with gravel, stone, or rubble substrates, and the nursery area for this species is expressly described as "fast water." [45] Similarly, the spawning habitat of slenderhead darter is described in Appendix A as "swift water…in riffles…over gravel and rubble."[46] It is simply incredible, or perhaps disingenuous, that Illinois EPA read these descriptions and yet still mistakenly concluded that "no more than three species require fast water."

In the authoritative treatise on Illinois fishes, "Fishes of Illinois" (1979), by Dr. P.W. Smith, it is noted that in addition to the six species listed in Appendix A of Attachment LL that utilize fast water and riffles, hornyhead chub and rosyface shiner also make extensive use of riffles.[47] To eliminate any doubt regarding the inaccuracy of the information presented by the Agency concerning the habitat needs of the subject fishes, Midwest Generation sets forth below

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[45] Appendix A to Attachment LL, p. A-15
[46] Appendix A to Attachment LL, p. A-48
[47] Smith, P.W. *The Fishes of Illinois*, Univ. of Illinois Press, Urbana, IL (1979)

an extensive excerpt from "The Fishes of Illinois" treatise which clearly and expressly supports EA Engineering's findings and Mr. Seegert's expert opinions based thereon concerning the following fishes' needs for the combination of hard substrate and fast water:

Species	**Habitat**
Hornyhead chub	High gradient streams (*i.e.*, fast water) over gravel or rubble bottoms
Rosyface shiner	Fast, large creeks; schools in riffles, and *"it is disappearing from streams that have been modified by impoundments and excessive siltation"*
Silver redhorse	Spawning occurs in deep, clear riffles
River redhorse	Occurs in swift, gravelly riffles and is intolerant of silty bottoms
Black redhorse	Inhabits high gradient (*i.e.*, fast) streams and occurs in riffles over gravel and rubble
Shorthead redhorse	Optimal habitat is fast water over a gravel bottom
Smallmouth bass	Occurs in gravelly or rocky rivers with moderate to fast currents
Logperch	Spawning occurs over strong riffles
Slenderhead darter	Preferred habitats are shallow raceways and riffles and it spawns "over fast, gravelly raceways"

See, Smith, Philip W., The Fishes of Illinois. Univ. of Illinois Press (1979), pp. 72-74, 115-116, 158–164, 229–230, 261–262, 264–266, copies of these excerpted pages are attached hereto as Exhibit C.

Additionally, further support for these findings is provided by a study of fish habitat preferences by the Minnesota Department of Natural Resources (Aadland *et al.* (1991), see copy of relevant excerpts attached as Exhibit D). It confirms that a number of these same species need a combination of <u>both</u> hard substrate and fast water habitat to support them – a combination which the highly impounded UDIP simply cannot provide. For example, the study's "raceway guild" category (*i.e.*, fast water) includes both adult and juvenile shorthead redhorse as well as adult and juvenile smallmouth bass. This is also the preferred spawning habitat for logperch. Shorthead redhorse adults and spawners also prefer fast riffles as do adult logperch and adult and spawning slenderhead darter. Species found in the UDIP that are listed as preferring "slow" riffles include emerald shiner, hornyhead chub, spotfin shiner, golden redhorse, white sucker, and blackside darter. Aadland *et al*. (1991) also indicate that boulder or rubble is a preferred habitat type for many of these species.

Turning to the two darters on the list of 16 species, Dr. Thomas, who appeared as a witness for the Environmental Groups during these hearings, has previously agreed that the habitat of logperch is "in runs with moderate to fast current and medium to large gravel and rubble." (Thomas 1970, p. 5) In the same publication, Dr. Thomas states that slenderhead darter was most often found in moderate to fast currents and "most often collected from a rubble bottom." (*Id*. at p. 7) Dr. Thomas also noted that three of the four darters studied "reach their peak abundance in the area…where the gradient is one of the highest in the river," *i.e.*, where the water is fastest. (*Id*.)

Clearly, Illinois EPA's assertion that a combination of fast water and hard substrates are not all that important to a balanced fish community is flatly contradicted by the scientific community and certainly not supported by the 1995 EA Report (Attachment LL). In summary, a balanced river fish community depends on a nexus of fast water and clean, hard substrates (*i.e.*, gravel, cobble, boulder), not one in the absence of the other

Having failed to discredit or undermine Mr. Seegert's testimony during the hearings, the Illinois EPA belatedly, but wrongly, contends in its comments that Mr. Seegert contradicted his testimony regarding available suitable habitat in the UDIP. (See IEPA Final Comments pp. 39-

41) In support of the purported inconsistency, Illinois EPA cites to Mr. Seegert's testimony that there is only a "small fraction" of good habitat (approximately 7%) in the UDIP and then to his later testimony (Ex. 428) that there is "an abundance" of suitable habitat for Asian carp in the entire Dresden Pool. (IEPA Final Comments, pp. 40-41) These statements are not contradictory. Again, Illinois EPA has mischaracterized Mr. Seegert's testimony, as well as incorrectly interpreting Table 2.3-2 of the EA 1996 Report he relied on.[48]

First, Illinois EPA's alleged 12.5% value for the total Upper Dresden Island Pool area that Mr. Seegert was allegedly referring to as providing "abundant" Asian carp habitat simply cannot be duplicated based on Mr. Seegert's testimony and the 1996 EA Report. The Agency does not disclose how this value was calculated other than that it covers backwater and side channel habitat. (IEPA Final Comments, p. 41) According to Table 2.3-2 in the referenced 1996 EA Report, the correct value for only backwater and side-channel areas in the Dresden Pool is 11.9% for Upper Dresden Pool and 14.4% for Lower Dresden Pool as those areas are defined in the EA report).[49] To clarify these geographic references, and as previously explained by in the record (see, *e.g.,* Attachment 1, p. 5, fn. 2 to Ex. 366), prior to the IEPA's creation of the "UDIP" UAA segment for this rulemaking, EA Engineering's Dresden Pool survey reports always used the term "Upper Dresden Pool" to denote that portion of Dresden Pool upstream of the Kankakee River, which includes <u>both</u> the UDIP area and the immediately downstream 5-mile Stretch below the I-55 Bridge (the 5-mile Stretch is not part of this UAA rulemaking). "Lower Dresden Pool" refers to the portion of Dresden Pool below the confluence with the Kankakee River, none of which is included in this UAA rulemaking.

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[48] See Exhibit 370, EA Engineering, *Final Report. Ecological Study of the Upper Illinois Waterway*

[49] The "Upper Dresden Pool" was defined in the 1996 EA report as the portion of the Dresden Pool upstream of the Bayhill Marina, not the portion upstream of I-55 as is the Agency's definition of the UDIP that is being used in this rulemaking.

But more importantly, and contrary to Illinois EPA's interpretation of Mr. Seegert's testimony, these riverine backwaters and side channels do not include all of the areas Mr. Seegert was referring to when he testified that the Dresden Pool has an abundance of Asian carp habitat. Mr. Seegert testified that Asian carp "prefer" slow moving waters, such as the riverine backwaters and side channels. He did not testify that these are the only areas in the Dresden Pool that can support Asian Carp.[50]. In fact, as Mr. Seegert testified, Asian carp also do well in other habitat types that are present in the Dresden Pool (the entire Dresden Pool being the relevant area given the absence of any "electric barrier" to prevent Asian carp from passing through the I-55 Bridge regulatory boundary for the UDIP area). These other habitat types include lentic areas, namely tributary mouths and tributary deltas, both of which Illinois EPA mistakenly excluded from their analysis of Mr. Seegert's testimony.[51]

Because of the damming effect from the Dresden Island Dam at the southern end of the Dresden Pool, all tributary mouths in Dresden Pool, such as the mouths of Grant and Jackson Creeks, are what are known as "drowned river mouths," where little or no current is present. In other words, they are "lentic" or "lake-like" habitats. Probably not coincidentally, the mouth of Jackson Creek is where EA Engineering field crews collected five Asian carp in 2010.[52] The large DuPage Delta area is yet another example of lentic habitat in the Upper Dresden Pool that Illinois EPA ignored. If all the suitable Asian carp habitats are included, then the percentage of lentic habitat identified in the EA Report Table 2.3-2 is 28.9% in the Upper Dresden Pool and 25.6% in the LDP, or about an average of 27% for the entire Dresden Pool. Thus, when the full context of Mr. Seegert's testimony is reviewed, the extent of the habitat suitable for Asian carp is clearly far more abundant (*i.e.*, more than a quarter of the Dresden Pool) than the available good

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[50] Ex. 428, p. 8
[51] Seegert Asian Carp Hearing Testimony, 11/8/10, p. 186-188
[52] See Exhibit 2 of Exhibit 428

habitat in the UDIP for supporting a balanced fish population, which by comparison comprises only 7% of the habitat in the Dresden Pool.[53]

C. The Evidence shows that the Urbanized Conditions of the UDIP contribute to Satisfying Both UAA Factors 3 and 5.

In the Illinois EPA comments, the Agency does not challenge the nature and extent of the evidence Midwest Generation introduced which supports the finding that urbanized conditions affecting the UDIP also contribute to satisfying the requirements of UAA Factors 3 and 5. It also does not attempt to refute the scientific studies showing that such urbanized conditions cause significant, adverse aquatic life impacts. The Illinois EPA just generally asserts that urbanization does not or may not affect large rivers. (IEPA Final Comments, pp. 31-2 & 41-2)

The Agency's unsupported, general assertion fails to refute the validity and reliability of the scientific evidence showing that the degree of urbanization in the UDIP is a significant stressor that together with the other relevant evidence shows that UAA Factors 3 and 5 are satisfied. Moreover, the assertion itself is incorrect.

Because the Des Plaines River is larger than some of the rivers that were studied in the reports Midwest Generation's experts cited does not mean that somehow the problem of urbanization goes away. In fact, all the problems caused by urbanization – CSOs, point sources (treated and otherwise), urban runoff, lack of riparian zones, legacy pollutants, and increased sedimentation – still remain. The thresholds for adverse effects might change based on stream size, perhaps higher, perhaps lower, but the problems remain. One of the studies Midwest Generation's expert cited (Wang *et al*. 1997) did study streams the size of the Des Plaines and

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[53] Mr. Seegert further explained in his testimony that to "have the proper range of habitat…what makes a fish community diverse, what allows it to meet the full range of expectations are the things that are…habitat specialists [which] require…high gradient, fast water, hard substrates." Seegert Testimony, 11/8/10, pp. 186-188. Mr. Seegert further explained that the habitat may be good for habitat generalists, but in order to have the broad spectrum of fish, as proposed for the UDIP by the Illinois EPA's ALU, there must be a broad spectrum of habitats available. Seegert Testimony, 11/8/10, pp. 186-189.

reported that "watersheds with more than 20% urban lands invariably had IBI scores <30 (poor-very poor)," even though some of these watersheds had good habitat scores (which the UDIP does not).

Similarly, the above-referenced Lyons Study studied large rivers in Wisconsin. In the Lyons Study, the "Non-Point Source" category included sites that had >20% in urban land uses.[54] The Lyons Study found that the mean IBI scores in this category were identical to the mean for what they expected would be their worst category (the "Multiple Impacts" category). Actually, the "Non-Point Source" category found that those reaches with ≥20% urbanization scored the lowest among the five impact categories the Lyons Study considered. In clear rebuttal of the Agency's unsupported hypothesis, the 20% urbanization threshold for the Non-Point Source category of large Wisconsin rivers is considerably <u>lower</u> than the thresholds identified for the various studies of smaller streams cited in Midwest Generation's evidence of the adverse effects of urbanization. (See, *e.g.*, MWGen Final Comments, pp. 77-80)

The percent of urban land in the UDIP is much higher than either of the urbanization thresholds reported by both Wang *et al*. (1997) and Lyons *et al.* (2001).Clearly, not only do the scientific studies show that urbanization significantly and adversely affects large as well as small rivers, these studies also clearly support the finding that the extent of urbanization in the UIDP is sufficient to cause UAA Factors 3 and 5 to be satisfied.

Further, it is rather disingenuous of the Agency to challenge the UDIP urbanization which contributes to satisfying UAA Factors 3 and 5 while conveniently forgetting one of the fundamental factual findings which the Agency has consistently advanced since the beginning of this rulemaking – that the UDIP is "unique" and hence, its proposed ALU is unique and would not apply anywhere else in the state. (IEPA Statement of Reasons, pp. 46-48) Ignoring the

[54] Lyons *et al*. (2001), p. 1081 (copy attached to IEPA Final Comments)

unique nature of the UDIP, the Agency unpersuasively attempts to lump it in with all other large urban rivers nationwide when claiming the evidence of urbanization in the UDIP is insufficient to show that the UDIP cannot attain them. (IEPA Final Comments, pp. 31-32)

Sweeping generalizations about large urban rivers is a wholly inadequate basis of comparison for the unique UDIP. How many of the large rivers believed to be in attainment have the UDIP's level of urbanization, its many CSOs, receive treated wastewater from a metropolitan area of 5-10 million people, are impounded, have commercial navigation, and are being managed to control Asian Carp? Illinois EPA has presented no evidence to show that UAAs performed on waters that reflect the combined urbanized, channelized and highly impounded nature of the UDIP have been found to be capable of attaining the CWA's goals.

Also, it is questionable given the early stages of the development of tiered aquatic life use classifications by states, and their use of UAAs to determine the proper classification of waters,[55] whether such sweeping generalizations are truly accurate. Most states, like Illinois, still rely on "default" use classifications for waters that assume they can attain the CWA's fishable use without performing UAAs to see if that assumption is truly correct. However, in Ohio, a leader among states in assessing the condition of waters and creating tiered ALU designations to address those conditions, studies have been done which show the adverse aquatic life impacts of urbanization. An Ohio EPA 1996 study of 110 sampling sites found that of the sites classified as being impacted by urban sources, only two sites (4.5%) attained the applicable biological criteria which Ohio uses to assess the status of water bodies. (See attached Exhibit E, Yoder and Rankin, "Assessing the Condition and Status of Aquatic Life Designated Uses in Urban and Suburban Watersheds," (1996) at p. 201 *et seq.*) As further evidence that urbanization may

[55] For example, this UAA is the first and only time the Illinois EPA has conducted a UAA. Twait Testimony, 1/28/08 Tr., p. 117

prevent attainment of CWA goals, in one of the U.S. EPA approved UAAs summarized on its website, "urbanization" was found to be the cause of a water body's inability to attain the CWA's goals under both UAA Factors 3 and 5. The UAA for Valley Creek in Alabama concluded that UAA Factors 3 and 5 precluded attainment based on a finding that "urbanization of the watershed has fostered habitat destruction." (See copy of "Valley Creek, Alabama UAA," dated March 2006, attached hereto as Exhibit F)[56]

D. The Extensive 2008 UDIP QHEI Survey Results Support a Finding that UAA Factor 5 has been satisfied.

The QHEI is an accepted and useful tool to evaluate the physical habitat of a stream and to determine whether or not UAA Factor 5 applies. Because it so extensively covered the entire UDIP through the scoring of fifty sites, the 2008 QHEI survey is not a simple "snap shot" look at the UDIP, or one biased by unrepresentative site selection, but rather gives a thorough and complete picture of its habitat conditions. (See MWGen Final Comments, p. 65) The Illinois EPA does not challenge the findings of the 2008 QHEI survey. It also does not defend its prior reliance on only three QHEI scores, taken from areas unrepresentative of the majority of UDIP habitat conditions, to support its conclusion that the UDIP could "minimally" attain the CWA's fishable goal.

However, the Environmental Groups still persist with the argument that the very few QHEI scores that are above 60 means that the UDIP can attain the Clean Water Act Goals. (Environmental Groups' Final Comments, p. 12) They also attempt to expand the clearly limited degree of suitable habitat in the UDIP by claiming that "aquatic vegetation beds in the UDP make the habitat better than that available in many of the other rivers in Illinois," citing to the

[56] The Valley Creek, Alabama UAA summary document is also available at: http://water.epa.gov/scitech/swguidance/standards/uses/uaa/upload/2006_12_05_standards_uses_uaa_cs_valley_creek.pdf (last checked, 3/9/12)

testimony of Dr. Thomas. (*Id.*) However, Dr. Thomas only "assumed" such aquatic vegetation existed because he never actually examined the substrate conditions in the UDIP.[57] Further, he made "general statements" regarding aquatic vegetation but could not provide any quantification of the size of these areas nor whether the unspecific areas he was referring to pertained to the Upper Dresden Island Pool.[58] Lastly, Dr. Thomas did not provide any evidence regarding the condition of other rivers in Illinois to support his assertion that the habitat in the UDP was better than in those rivers. In sum, Dr. Thomas did not provide any quantifiable or scientific evidence that supports the Environmental Groups' claim regarding the existence and adequacy of aquatic vegetation beds in the UDIP to support a balanced fish community.

As explained in MWGen's Subdocket C Final Comments, and in detail in the EA Report on the 2008 QHEI survey work, the few locations of good habitat (not "excellent" habitat as the Environmental Groups contend) are not representative of the nearly all of the UDIP area. Most sites surveyed in the UDIP had a QHEI score below 60, and many scored below 45, equating to a mean of 47. (Ex. 366 at 10) Thus, taken as a whole, the UDIP has poor to fair habitat, and even fair habitat does not equate to attainment of the Clean Water Act goals. (MWGen Final Comments, p. 65-66; see also 11/9/09 PM Tr. at 147)

The Environmental Groups also contend, citing to EA Engineering's Report (Exhibit 368), that the Modified Index of Well Being ("IWBmod") scoring results for the UDIP are as good or better than the scores for the portion of Dresden Pool below the I-55 Bridge that is currently designated General Use. (Environmental Groups Final Comments, p. 12) However, the cited EA Engineering Report does not support this contention.

[57] 8/14/09 AM Tr., p. 23
[58] *Id*. at pp. 17-18 30

The subject IWBmod scores for Upper Dresden Pool and Lower Dresden Pool are presented in Attachment 1 to Exhibit 368 at pages 5 and 8. Once again, differing terminology used for areas of the Dresden Pool prior to the IEPA's creation of the "UDIP" UAA term is also causing confusion. Footnote 2 on page 5 of Attachment 1 which explains that the term "Upper Dresden Pool" ("UDP") refers to areas both above and below the I-55 Bridge, and not, as the Environmental Groups understood, only to areas above the I-55 Bridge. The terms UDIP and UDP are not interchangeable and do not refer to the same areas of the Dresden Pool.

Further, and more importantly, both of these areas of the Dresden Pool covered by the IWBmod scores had nearly identical scores and those scores put these areas into the poor to fair quality category for fish communities.[59] Hence, an accurate characterization would be that fish communities throughout the Dresden Pool (*i.e.*, both above and below the I-55 Bridge) are poor to fair, including the General Use area below the I-55 Bridge. Accordingly, the IWBmod scoring data were one of the bases supporting Mr. Seegert's expert opinion testimony (Exhibit 366, p.19) that the fish community in the Upper Dresden Pool as well as in Dresden Pool downstream of the Kankakee River were both generally "poor." If anything, what the IWBmod data does provide is more support for Midwest Generation's position that it is not the thermal conditions in the UDIP that are preventing it from attaining the CWA's fishable goal. Even in areas below the I-55 Bridge which are protected by the more stringent General Use thermal water quality standards, the fish community is still only fair to poor.

The Environmental Groups also contend that QHEI scores do not adequately account for the ability of fish to move between the UDIP and other waters. (Environmental Groups Final Comments, p. 7) There is absolutely no support for the proposition that the Clean Water Act or

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[59] See *Detailed Summary of EA Engineering, Science, and Technology's Stream Surveys for the Upper Illinois Waterway (UIW), 1993-2006),* Attachment 1 to Exhibit 366, at pp. 5 and 8

the UAA regulations require that when an entire river segment like the UDIP cannot support a balanced, indigenous fish population, it should nevertheless be classified as capable of attaining the CWA's fishable goal because fish species from other areas may at times swim through it to a waterbody that does provide suitable habitat.

The Environmental Groups claim that because fish can swim "necessary habitat need not be present in every portion of a water body under consideration." (Environmental Groups Final Comments, p. 5) But this begs the point that with no better than 10% good habitat, the UDIP 2008 QHEI scores show there is not anywhere near enough "necessary habitat" to support a higher quality, balanced fish population. To distract attention from this critical and undisputed scientific finding, the Environmental Groups resort to misrepresenting Mr. Seegert's testimony in order to make it fit their "strawman" argument that good habitat need not be present in every potion of a water body. (Environmental Groups Final Comments, p. 6) Mr. Seegert neither "opined nor suggested that walleye, red horse or other fish species cannot live in a water body unless there are places for them to build nests in most or all of the locations in the water body." (*Id.*, citing to Testimony of Greg Seegert, 11/9/09, Tr. 28) In truth, what Mr. Seegert was asked and how he replied was as follows:

> Mr. Ettinger: Would you expect walleye in the system?
>
> Mr. Seegert: No.
>
> Mr. Ettinger: Why not?
>
> Mr. Seegert: Because walleye, they could live in the system, but their habitat requirements are such that I don't think that there's enough hard substrate rock and cobble that's going to support them either as adults, but particularly for spawning purposes, okay? The best thing I can - - or most appropriate thing to say is there's not adequate spawning habitat for walleye in the system.

(Testimony of Greg Seegert, 11/9/09, Tr. 28)

Mr. Seegert's testimony that there is not adequate habitat to support walleye is a far cry from any opinion or suggestion that such habitat needs to be present "in most or all of the locations in the waterbody."

Further, the Environmental Groups own witnesses admitted that they have no evidence to support their theory that other waters may provide necessary "nursery" areas for fish that will then be able to live in and thrive in the UDIP. (Environmental Groups Final Comments, p. 13-14). Their witness, Ms. Laura Barghusen, who advanced this theory in her testimony, is neither a fish biologist nor a habitat specialist. She plainly and simply does not have the qualifications or expertise to opine on fish behavior. She herself admitted she had not "studied the structural habitat of the Upper Dresden Island Pool" and when asked to provide supporting data for her contention that one of the tributary creeks served as a nursery, admitted further that she had no evidence to show this was occurring.[60]

Moreover, Ms. Barghusen's view of the "high quality" of the tributaries to the Dresden Pool is not consistent with the Illinois EPA's stream assessment results for these waters. For example, "Hickory Creek is rated as a 'C' stream under the Agency's Biological Stream Characterization (BSC) system," meaning that it is only a "moderate aquatic resource."[61] And as to the Environmental Group's unsupported allegation that the UDIP has adversely impacted it, the reported sources of impairment in Hickory Creek are all the result of sources of pollution in the creek itself or modifications of the waterway (*e.g.*, CSOs, municipal point source discharges, urban runoff/storm sewers, channelization, impacts from hydrostructure flow

[60] Barghusen Testimony, 10/5/09 Tr. at 118, 124-125, 127
[61] See *IEPA Log No.: C-0147-06, Section 401 Water Quality Certification to Discharge Public Notice/Fact Sheet*, November 15, 2006, at p. 2, attached as Exhibit G, and excerpt from the *IEPA Quality Assurance and Field Methods Manual, Section E: Special Stream Surveys*, Revised 1996 at p. D-2.1, attached hereto as Exhibit H, explaining the BSC ratings categories

regulation/modification and site clearance) that have nothing to do with the water quality of the UDIP.[62] Jackson Creek, another one of the supposedly "high quality" tributaries mentioned by Ms. Barghusen received a similar "C" integrity rating under the IDNR's rating system.[63]

The Environmental Groups contend that "a broad view of the tributaries shows that very rich species assemblages could move into the UDIP if water quality improved", claiming that sampling on the DuPage River supports this conclusion. (Environmental Groups Final Comments, p. 14) But the report on which the Environmental Groups rely for this statement (Ex. 2 to their Comments) in fact lends further support to the finding that without more good habitat, the UDIP cannot support a higher quality of fish. The cited sampling area, located downstream of the Channahon Dam on the DuPage River, is described in the 2003 Hammer *et al* Study (attached hereto as Ex. J, p. 22) as an area where there is "free-flowing water." The report describes habitat conditions there that appear to be good. Thus, it is not surprising that it produced a good IBI score. However, right above that dam, where the habitat was poorer, fish communities were correspondingly poorer. As the District's Dr. Melching testified, citing to Rankin (1989), "high velocity results in higher IBI scores and low velocity results in lower IBI scores, *i.e.*, a less diverse fish community."[64] Regardless of the fish community in the DuPage River or the other tributaries to UDIP or the CAWS, the UDIP will not attain CWA goals because its habitat is insufficient to support and maintain such communities.

The Environmental Groups also rely on testimony by Dr. Thomas that "most large river fish are able to move." True, but he presented no data or other evidence that these types of fish populate the vicinity of the UDIP. The EA annual fish surveys show there are few, large river

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[62] *Id*.
[63] See excerpt from IEPA Log No. C-0413-08 Section 401 Water Quality Certification to Discharge Public Notice/Fact Sheet, June 12, 2009 at p. 3, attached hereto as Exhibit I
[64] 11/17/08 Tr., p. 150

fishes (*e.g.*, sturgeons, paddlefish) because the Lower Des Plaines is not accurately characterized as a "large river." The EA annual fish survey data shows that most of the species in UDIP show little or no migratory movement. The small Brandon tailwaters, the only area with fairly good habitat, can only support so many fishes and, except for some movement of suckers into the Brandon tailwaters in May, the EA field data fails to support Dr. Thomas' contention that there is significant movement into the only area of fairly good habitat in the UDIP. No other field data has been provided that shows otherwise.

The fact is that the EA annual fish surveys performed for 22 years in the entire Dresden Pool area show that sixteen moderately and highly tolerant fish species accounted for 52.8% of the catch. (See MWGen Final Comments, p. 69) The same species were among the ten most abundant fish species collected during the 1993-1995 and 1997-2005 time periods, a twelve-year time span when if anything water quality showed some slight improvement.[65] And these same ten species "composed remarkably similar percentages of the catches during these two periods (85.1% vs. 88.3%).[66] Further, "the preponderance of moderately tolerant and highly tolerant fishes reflects the degraded habitat of Dresden Pool."[67] For all of the years combined (1993-2006), "only 1.7% of the fish collected in the Dresden Pool were intolerant or moderately intolerant.[68] The scientific data supports the conclusion that both the area below the I-55 Bridge and above it should be the same use designation and that use designation should be reflective of its inability to support a balanced, indigenous fish population.

The Environmental Groups' contention that the UDIP fish survey results indicate the potential to meet General Use goals is absolutely wrong and contrary to the abundance of fish

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[65] See *Detailed Summary of EA Engineering, Science, and Technology's Stream Surveys for the Upper Illinois Waterway (UIW), 1993-2006),* Attachment 1 to Exhibit 366, p. 10
[66] *Id*.
[67] *Id.* at p. 11
[68] *Id*.

survey data in this record. Similarly, their contention that the area with the "lowest quality" of fish is "directly below" the Midwest Generation Joliet Stations' discharges is a patently false representation of what the 1993-2006 fish surveys data show. (Environmental Groups Final Comments, p. 13)[69] There have been times when the EA Engineering fish surveys record fewer numbers of fish at this location than others (which is not the equivalent of the "lowest quality" fish), but this is not consistently the case. Further, as Citgo and Corn Products expert witness James Huff testified, no drop in fish diversity was observed in the ten years of data collected at the District's fish sampling locations immediately downstream of the Midwest Generation stations in the CAWS.[70] More specifically, at the Cicero Avenue location, immediately below two of the Midwest Generation stations, the District found the greatest fish diversity.[71]

A fatal flaw in the Environmental Groups' theory is that there simply is not enough good habitat in the UDIP to "support" these traveling fish so that they "could live in the UDIP" as the Environmental Groups contend. Despite the assertions of Dr. Thomas[72], good fish communities (which are distinct from good "fisheries") compatible with CWA goals do not occur in areas of poor sediment. He has not shown otherwise. Further, the EA Engineering fish surveys field data do not show that the fish community in the Brandon tailwaters is "healthy." DELT anomalies are common (particularly for bottom feeder fish who would be more exposed to the adverse effects of contaminated sediments) and biological index scores are only fair.[73]

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[69] In their comments, the Environmental Groups' citation to the record at "9/9/09PM Tr. 40, 44" for this alleged testimony appears to be incorrect, as no such hearing testimony appears on that page. Even checking similar transcript citations (*e.g.*, 11/9/09PM and 11/10/09 Tr. 40, 44) did not appear to reveal any such testimony by Mr. Seegert. Hence, it could not be determined what alleged testimony was believed to support this statement.
[70] 5/6/09 Tr., pp. 22-23
[71] *Id*.
[72] See Environmental Groups Final Comments at p. 13
[73] See *Detailed Summary of EA Engineering, Science, and Technology's Stream Surveys for the Upper Illinois Waterway (UIW), 1993-2006),* Attachment 1 to Exhibit 366, pp. 6-7

It should be noted that the opinions of Dr. Thomas regarding the value of QHEIs, the type of habitat that is necessary to support a balanced fish population and the nature of the habitat that exists in the UDIP are impaired by his almost total lack of experience and expertise in these areas generally. Dr. Thomas has never conducted a QHEI survey in the UDIP or anywhere else.[74] He has never conducted any type of aquatic life or habitat survey in the UDIP.[75] During the twelve-year period that he was the Director of the Illinois Waste Management Research Center, it mostly contracted out projects that focused on aquatic habitat quality and/or aquatic biology.[76] In preparation of, and as a basis for, his testimony, he did a drive-by visual observation of only four or five areas in the Lower Des Plaines River, at least one of which he was not sure was in the UDIP.[77] He never got into the waters of the UDIP or waded along its shoreline to assess, sample or otherwise evaluate any subsurface habitat conditions; he did not examine any substrates and never went into the Brandon tailwaters area.[78] His water depth observations were based on his view from atop the I-55 Bridge.[79] And perhaps most importantly, prior to this brief trip to the UDIP the year before he testified, he had never been there before.[80] Dr. Thomas is simply not a qualified expert on the value of QHEIs or the habitat conditions in the UDIP. Therefore, the purported "expert" opinions he offered on these issues should be disregarded.[81]

Finally, Mr. Rankin, the developer of the QHEI, is most certainly aware of the fact that fish can swim. In his paper describing the QHEI (Rankin 1989), Mr. Rankin emphasizes that it

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[74] 8/14/09 Tr.AM, p. 8
[75] *Id*. at p. 10
[76] *Id*. at p. 39-40
[77] *Id*. at pp.11-15
[78] *Id*. at pp. 17-18, 23
[79] *Id*. at 18
[80] *Id*. at 22-23
[81] The same is true of Dr. Thomas' sweeping opinion that the UDIP locations that had QHEI scores in the 45 to 60 range enabled them to meet the CWA goals. When cross-examined on this opinion, Dr. Thomas admitted that he had not even looked at the particular characteristics of all these areas in order to arrive at this opinion. *Id*. at 70-72

is the overall habitat of a reach that should be considered, and that isolated areas of bad or good habitat are not the determiners of the resultant fish community, rather it is the totality of the habitat. In this case, it is clear that the totality of the habitat in UDIP is poor to fair and cannot support the CWA's goals.

IV. BRANDON ROAD POOL SHOULD BE DESIGNATED AS ALU B AND NOT ALU A.

A. The MBI's RM 290.1 QHEI Score of 68.5 was not in the Brandon Road Pool and does not Support an ALU A Designation.

The Environmental Groups argue that the Brandon Road Pool should be classified as ALU A and not ALU B. They primarily rely on a single MBI QHEI score of 68.5 that is mistakenly believed to be located in the Brandon Road Pool, even though all of the physical evidence about the conditions in that pool cast serious doubt on that conclusion. The poor quality assurance procedures employed in MBI's QHEI work yet again create confusion and misunderstanding.[82] On MBI's list of the QHEI sites it surveyed and accompanying scores (Exhibit 5), it failed to clearly identify the location of its QHEI survey sites by referencing specific UAA segments. Instead, MBI simply referred to the sites' location under the heading the "Des Plaines River." Consequently, the Environmental Groups base virtually their entire Brandon Pool Use A argument on the wrong conclusion that the 68.5 QHEI score MBI recorded at river mile 290.1 was located in the Brandon Pool, when it was not. (Environmental Groups Final Comments, p. 24) As explained further below, the sampling location identified as river mile "290.1" in the Des Plaines River is actually in the upper Des Plaines River, not the Brandon Road Pool.

[82] Midwest Generation explained in detail in its Subdocket C Final Comments why MBI's QHEI scores are not accurate or reliable evidence of habitat conditions in the UDIP. (See MWGen Final Comments, pp. 70-74)

Admittedly, there was significant confusion during the hearing testimony as to the location of the MBI QHEI sites. First, MBI employee Mr. Yoder had to defer to the Illinois EPA witnesses to try to identify his own company's QHEI site locations' list. (See Yoder Testimony, 2/1/08 Tr., p. 70) Mr. Smoger of the Illinois EPA testified that river mile 290.1, 297.0 and 298.3 were outside the Lower Des Plaines UAA geographic area. (2/1/08 Tr., p. 72) But then Mr. Smoger expressed uncertainty as to whether RM 290.1 was or was not in the upper part of Brandon Pool. (*Id*., p. 73). The Agency witnesses did not have any river charts to refer to that showed where the sampling locations were (*Id*., p. 80) nor did anyone know if MBI had physically marked them in the field. (*Id*., p. 81).[83] However, the longitude and latitude coordinates for the location of the RM 290.1 site are provided in the MBI QHEI site scoring sheet (Ex. 7) (*i.e*., +41.55936, -88.08092). These coordinates confirm that the sampling location is an area of the upper Des Plaines River, completely separate from, but which runs parallel to, the Brandon Road Pool. A picture of the upper Des Plaines River location with these coordinates shown is attached as Exhibit J.[84] Midwest Generation submits that the weight of the evidence shows that the QHEI score of 68.5 at RM 290.1 was not located in Brandon Road Pool, or at the very least, the evidence does not prove that it was.

Also, QHEI scores of above 60 are entirely inconsistent with the consistently poor physical conditions in the Brandon Road Pool. The LDR UAA Report describes the Brandon

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[83] Illinois EPA's witnesses also had to guess that some MBI QHEI scoring locations, which appeared to overlap based on river mile designations, were on the opposite sides of the river, but they were not certain. See 2/1/08 Tr., p. 83-84 Similarly, for two other MBI QHEI sites locations, the MBI QHEI scoring sheets (Ex. 7) showed that the longitude and latitude for the locations at two differently recorded river miles, RM 279.5 and RM 276.5, were identical. (2/1/08 Tr., pp. 85-86) Mr. Smoger tried to explain that the "actual river mile of a slough is pretty much the same lineal distance along the river. Buts it's off the river in an actual slough, perhaps"; acknowledging that the river mile does not always accurately describe the location. 2/1/08 Tr., p. 87 Mr. Yoder, MBI's QHEI project supervisor, ended the discussion by frankly stating "Yeah, I agree, it's a mystery to me." 2/1/08 Tr., p. 87

[84] This map can be duplicated by going to http://itouchmap.com/latlong.html, and inserting the longitude and latitude coordinates in Exhibit 7 for RM290.1 (+41.55936, -88.08092) in the section entitled "Show Point from Latitude and Longitude."

Pool as a man-made section of the river channel, which "has been deepened and widened to accommodate barge traffic on the river."[85] The walls are lined with concrete retaining structures, and "barge traffic consumes a large portion of the river channel."[86] Also, the substrate in the Brandon Pool is limited to soft fine-grained organic sediments, with little organic detritus and woody debris. Finally, spawning substrate is limited to "small cracks and expansion joints in the concrete walls," and "[s]hallow substrates and overhanging vegetation do not exist."[87] Further, the previous QHEI values for the Brandon Pool in the LDR UAA were an average of 45.76.[88] The LDR UAA concludes that "[i]n the Brandon Pool because of the concrete and sheet pile retaining walls, the opportunities for in-stream habitat improvement are minimal or non existent(*sic*).[89] The Brandon Road Pool conditions are very similar to those in the CSSC. The evidence does not support a finding that the Brandon Road Pool should be classified any differently from the CSSC. ALU B is the appropriate use designation for Brandon Road Pool.

B. IDNR Public Comment #505 does not Support a Higher Use Designation for the Brandon Road Pool.

Besides the above-described QHEI score, the Environmental Groups rely on IDNR Public Comment #505 to support their claim that the Brandon Road Pool should be designated as ALU A and not ALU B. The Illinois EPA disagrees with the Environmental Groups' characterization of the IDNR Public Comment. Illinois EPA witness Roy Smoger testified that the IDNR Report actually shows that the Brandon Pool has an exceptionally unbalanced fish community, which is insufficient to attain the aquatic life goal under the CWA.[90] The "mere

[85] LDR UAA Report, Attachment A to IEPA Statement of Reasons, pp. 4-9-4-10
[86] *Id*. at pp. 4-10
[87] *Id*. at pp. 4-12
[88] *Id*. at Table 4.3
[89] *Id*. at pp. 4-34
[90] Smoger Testimony, 3/10/08 AM Tr. at 63

presence of fish provides little information about the condition of a stream," but the information as to the types and numbers of species gives an excellent picture of the water course and its well being." LDR UAA Report at 6-1. Even though IDNR found a few intolerant species in its catch, the predominate number of fish collected, 63.5% in fact, were tolerant species. "They weren't moderately tolerant. They weren't intolerant. They were tolerant."[91] Nearly 50% of the total catch was the common carp.[92] "Any time you find a fish sample where nearly half of the number of individuals are…comprised of common carp…this tells you this is not a good place."[93] Plus, nearly 50% of the catch was made up of exotic species.[94] The prevalence of exotic species coupled with the dominance of tolerant species tells us that the area is highly disturbed. [95] As Mr. Seegert testified, if the biomass were calculated instead of the individuals caught, "it would be like 90 or 95% percent because…your typical common carp is five pounds."[96] The reality is that there is an exceptionally poor fish community in the Brandon Pool reflecting the poor habitat. Ex. 2 of Ex. 366 at p 17.

The Environmental Groups also incorrectly claim that the IDNR's Public Comment constitutes evidence that DELTs are low in the CAWS. (Environmental Groups Final Comments, p. 25) The IDNR only stated that "most of the fish observed during both Rotenone operations had few DELTS and the general body condition was very good to excellent." (IDNR Public Comment #505, p. 3) The key point here is the IDNR's reference to "few DELTS" per

[91] Seegert Testimony, 11/10/10 Tr. at 234
[92] Seegert Testimony, 11/10/10 Tr. at 236
[93] Seegert Testimony, 11/10/10 Tr. at 236
[94] Seegert Testimony, 11/10/10 Tr. at 236
[95] Seegert Testimony, 11/10/10 Tr. at 237
[96] Seegert Testimony, 11/10/10 Tr. at 238-239. The Environmental Groups also claim that the IDNR sampling method was superior. However, comparing electroshocking collections to rotenone samples is like comparing apples to oranges. Seegert Testimony, 11/10/10 Tr. p. 231. A rotenone sampling method is atypical and not at all standardized. Seegert Testimony, 11/10/10 Tr. at 232. Finding 34 species in a large river with such a huge sampling effort is not very high. Seegert Testimony, 11/10/10 Tr. at 234. "[The Illinois DNR's] contention that there's a high percentage of moderately tolerant species is just wrong." Seegert Testimony, 11/10/10 Tr. at 234

fish and not the absence of DELTS. For fish DELT assessment and reporting purposes, it is not the number of DELTs per fish that is considered; but rather the percent of fish that have <u>any</u> DELTs, regardless of whether an individual fish has one DELT or 50 DELTs. Because the IDNR said that "most of the fish" had few DELTs, a far larger percentage likely had one or more DELTs. And, even if only 5% of the fish had DELTs, this is an excessive number per Ohio EPA IBI protocols and would indicate significant problems with the fishery.[97] Obviously, given the huge number of fish killed in the rotenone application, the IDNR did not have the capability of performing and recording the results of a formal DELT assessment on all of the fish collected.

As the Illinois EPA stated in their Final Comments for Subdocket C, "[t]he CAWS and Brandon Pool Aquatic Life Use B waters are composed of vertical-walled, deep draft shipping channels without fixed aquatic and overhanging riparian vegetation and other zones of refugia for aquatic life,…[and] are routinely subject to navigation and other anthropogenic conditions that are more sever[e] than those in the CAWS Aquatic Life Use A Waters." (IEPA Final Comments, p. 14) Based on the evidence showing that the actual QHEI sample location is the upper Des Plaines River, the Brandon Pool has consistently poor habitat, and the predominance of tolerant species demonstrating an unbalanced fish community, the Board should reject the Environmental Groups' request to designate the Brandon Pool as ALU A instead of ALU B.

V. THE UDIP AND SOUTH BRANCH CHICAGO RIVER IMPACTS ARE NOT "REASONABLY REVERSIBLE" THROUGH HABITAT IMPROVEMENTS.

The Environmental Groups also dispute the QHEI's scores' ability to account for the potential for habitat improvement. The UAA regulations require consideration of reasonably reversible impacts that can be reversed in the foreseeable future. See 40 CFR 131.10(g) and 40

[97] See *Detailed Summary of EA Engineering, Science, and Technology's Stream Surveys for the Upper Illinois Waterway (UIW), 1993-2006),* Attachment 1 to Exhibit 366, p. 7

CFR 131.10(j)(1). The impacts at issue here are not "reasonably reversible" in the foreseeable future.

The Environmental Groups' argument relies on two witness comments, one by Mr. Thomas and the other by Mr. Seegert, regarding "possibilities" for UDIP improvements, not "reasonably reversible" habitat constraints that can be addressed in the foreseeable future. (Environmental Groups Final Comments, pp. 8-9) Dr. Thomas' opinions with respect to improvements to physical habitat in a river and the resulting effect on the aquatic community are not based on any actual experience. In response to the question of what experience he had with such projects, Dr. Thomas testified he had worked on only two such projects and only in the design stage. For either project, he did not know what the effect was on aquatic life.[98] When questioned about his testimony regarding adding some sand and gravel to create shoreline habitat in the UDIP, Dr. Thomas was not sure whether these areas existed, whether or not this type of work would result in any improved fish habitat, admitted he had not done any analysis, and ultimately conceded that he did not have any data to determine whether there are areas in the UDIP that would benefit from mitigation projects or to what extent..[99]

With regard to Mr. Seegert's cited testimony, he was actually commenting that it was "possible" to restore the UDIP at a cost of "about tens or hundreds of millions of dollars."[100] He later referred back to this testimony, indicating he meant that "if we had unlimited amounts of money, perhaps you could do it" and proceeded to explain that it would mean eliminating the commercial navigation traffic on the UDIP:

> But then I got thinking about that and realized that how could you put in a riffle in a system that's established for commercial navigation? There'd be no way to get the

[98] 8/14/09AM Tr. at pp. 42-46
[99] *Id*. at pp. 48-51, 93-94, 97
[100] Seegert Testimony, 11/9/09 Tr. pp. 21-22

> barges through it. So, again, you would have to take out commercial navigation in order to have riffles. So you'd have to take out the damns [sic] and eliminate navigation in order to put in a riffle assuming a riffle could be put in.[101]

When read in its proper context, and given no one contends any entity (government or private) plans, particularly in the foreseeable future, to spend unlimited amounts of money to restore the UDIP and that such restoration would require eliminating the protected, existing use of commercial navigation, Mr. Seegert's testimony supports the conclusion that is the conditions are not "reasonably reversible."

Mr. Seegert acknowledged that small improvements can be made to the UIDP, such as along its shorelines by the addition of cover or increasing the amount of aquatic vegetation, to add some more litoral habitat. But as he also pointed out, these improvements will not materially change the fish community in the UDIP. More of this type of habitat just helps support more of the same type of fish that are already present, (*e.g.*, largemouth bass and other centrarchids, bluntnose minnow), not those that are needed to produce a balanced fish community (*e.g.*, obligate riffle dwellers [*e.g.*, darters] and rheophilic species (*e.g.*, most redhorse, darters, some minnows), which are the types of fish needed to produce a balanced fish community. None of the reasonable and feasible habitat improvements will address the fatal habitat deficiencies in the UDIP - - its lack of riffles. Absent these types of habitat improvements, which the existence of the dams and the existing commercial navigation use prevent, the additional fish species which rely on their presence cannot be supported in the UDIP. Thus, the lack of diversification and balance in the fish population is not "reasonably reversible" and will continue.

The Environmental Groups assertion that there are endless possibilities for habitat improvement also includes the mischaracterization that the exhaustive MWRD Habitat

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[101] Seegert Testimony, 11/10/09AM Tr., pp. 6-7

Evaluation and Improvement Reports were limited in breadth. But their own witness, David Thomas, opined that the District's work was "a very extensive examination."[102] In sum, to state it is "possible" to improve a habitat to the point where the water body can support a balanced, indigenous fish population does not equate to the applicable standard that it is "reasonably reversible" as required by the UAA regulations.

The Environmental Groups also contend that the South Branch of the Chicago River could be improved and thus should be designated as ALU A. But this contention is flawed for several reasons. As the Illinois EPA has reiterated in its comments, it supports its original proposal that the South Branch of the Chicago River should be designated as ALU B stating that "in the absence of new scientific in information that would change the conclusions in Illinois EPA's original proposal, the Agency is not willing to concur with the agreement between MWRDGC and the Environmental Groups…." (IEPA Final Comments, p. 22) There is no new scientific information to conclude the South Branch is capable of attaining a designation higher than ALU B, and thus, the Board should reject the Environmental Groups' proposal. (See also, MWGen Final Comments, pp. 59-61)

The Environmental Groups once again rely on the District's Habitat Improvement Report but, as Midwest Generation already addressed in its Final Comments (at p. 61), Mr. Bell explained that the assumptions on which the habitat improvement potential for the South Branch was based were "unrealistic", because they were "largely predicated on the assumption that half of the vertical side walls can be removed and improved, which may not be feasible." (*Id.*) Mr. Bell was not aware of any similar projects of this scope and size ever having been done.[103] Further, as the Habitat Improvement Report explains, its chart listing potential habitat

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[102] Prefiled Testimony of David Thomas, Ex. 473 at p. 1
[103] Prefiled Testimony of S. Bell, Ex. 447 at p. 13; Testimony of S. Bell 5/16/11 Tr. at 199-200

improvements may be helpful in prioritizing the CAWS reaches for such improvements, but "it does not provide information about the potential benefits of the habitat improvements to the biological community."[104] The report stated that this could not be reliably measured, and concluded that even after the potential improvements "the resulting index scores indicate that habitat would remain relatively poor." (PC #284, p. 59) Even the Environmental Groups gave a low priority (*i.e.*, "5?") to the proposed improvements for the South Branch as compared to other CAWS segments. (Environmental Groups Final Comments, Ex. 1 at p. 6) The low priority of the South Branch for habitat improvements may also reflect the fact that any such improvements depend upon the agreement of landowners, which is a complete unknown, and any design would "have to be resistant to barge wake energy and fluctuating water levels," without any reference to whether such a design is feasible.

Finally, the mere existence of a proposed agreement between the MWRD and the Environmental Groups regarding habitat improvement projects is not sufficient to satisfy the UAA regulation's standard of "reasonable reversibility" for the South Branch of the Chicago River. The MWRD's Final Comments clearly state no habitat improvement projects have been agreed to and the District "continues to state the issues and concerns that it has raised as to the Illinois EPA proposed aquatic life designated uses in its testimony on this matter." (MWRD Final Comments, p. 2) Not only has no evidence been presented to show that these improvements will be performed, but more importantly, that they would result in making the higher ALU A attainable. There is absolutely no showing that if these projects are implemented, it will significantly change the South Branch's capability to support a better quality fish population.

[104] PC #284 at p. 51 (Habitat Improvement Report, Part 1)

In sum, anything is possible, but the reality is the aquatic life use potential for the UDIP, the Brandon Pool, the CSSC and the South Branch of the Chicago River is basically what exists today. There are no reasonably reversible conditions that would achieve significant enough improvement to support a balanced fish community. All of the evidence relating to the other UDIP and CAWS conditions that satisfy UAA Factor 5, including heavy siltation, and nutrient loading is summarized in detail in MWGen's Subdocket C Comments at pp. 58-80. The weight of all of this evidence is sufficient to satisfy UAA Factor 5.

VI. CONCLUSION

Midwest Generation has presented this detailed review and analysis of the arguments advanced by the Illinois EPA and the Environmental Groups to demonstrate that their comments fail to rebut the expert opinions and scientific evidence it and others presented in this rulemaking. That evidence, taken together, shows that the UDIP cannot attain the Clean Water Act ("CWA") goals because UAA Factors 3 (unremediated human caused conditions or sources of pollution), 4 (dams and other hydrologic modifications which cannot be feasibly modified) and/or 5 (physical habitat conditions) have been satisfied. To accept the Illinois EPA's proposed ALU for the UDIP is to set a use that is not attainable. As the U.S. EPA has stated in its guidance document entitled "UAAs and Other Tools for Managing Designated Uses" (March 2006), Preface, p. 2: "We do not believe that setting unattainable uses advances actions to improve water quality."

Throughout the over four years of testimony and filings, MWGen has constantly, carefully, and completely, through expert testimony, reports and exhibits, shown that the UDIP, Brandon Pool, CSSC and the South Branch of the Chicago River are irreversibly impaired waterways that cannot attain the CWA Goals. Based upon this mountain of evidence, the Board should designate the South Branch of the Chicago River and the Brandon Pool as ALU B, and adopt the revised proposed UDIP Use Designation, attached as Exhibit A to these comments, which more completely and accurately describes the attainable aquatic life use for the UDIP and its protected, existing navigation and flood control uses.

Respectfully submitted,

MIDWEST GENERATION, L.L.C.

By: /s/ Susan M. Franzetti
Susan M. Franzetti

Date: March 19, 2012

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EXHIBIT A

REVISED EXHIBIT A

PROPOSED AQUATIC LIFE USE DESIGNATION FOR THE UPPER DRESDEN ISLAND POOL

302.237 Upper Dresden Island Pool Aquatic Life Use Waters

Lower Des Plaines River from the Brandon Road Lock and Dam to the Interstate 55 Bridge is designated for the Upper Dresden Island Pool Aquatic Life Use. These effluent-dominated, urban-impacted waters are capable of maintaining warm water aquatic-life populations consisting primarily of lentic species of tolerant and intermediately tolerant types that are adaptive to the impounded, channelized and artificially-controlled flow and widespread siltation conditions created by the operation of the locks and dams that are necessary to maintain the existing navigational use and upstream flood control functions of the waterway system. These waters must meet the water quality standards of 35 Ill. Adm. Code 302, Subpart D.

EXHIBIT B

The Conservation Foundation
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ASSESSMENTS OF THE IMPACTS OF DAMS ON THE DUPAGE RIVER

Jennifer Hammer and Robert Linke P.E.
Principle Investigators

October 2003

ACKNOWLEDGMENTS

We would like to acknowledge the Illinois Department of Natural Resources (IDNR) Conservation 2000 program for project funding and the U.S. Environmental Protection Agency (USEPA) Region 5 Water Division for providing extensive in-kind participation in the project. The Conservation Foundation provided staff and the DuPage River Coalition Ecosystem Partnership provided support for the project. Steve Pescitelli from the IDNR assisted in fish collection, data analysis and report editing. Don LaBrose from the Forest Preserve District of DuPage County assisted in fish collection and provided historical data. Nancy Williamson coordinated activities with the C2000 program of the IDNR. Ed Hammer coordinated all activities with USEPA, water quality habitat sampling and developed the Quality Assurance Project Plan. Danielle Tillman assisted with the QAPP development water quality sampling and coordinated macroinvertebrate collections. Other USEPA Region 5 staff assisting with the study included: John Dorkin and George Azevedo (sediment sampling), Dave Pfeiffer and Nancy Thomas (water quality sampling) Terrance Patterson (GPS), Dertera Collins (data management) and the Central Regional Laboratory (water quality and sediment analysis). The Illinois Environmental Protection Agency analyzed chlorophyll data.

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INTRODUCTION

The DuPage River is a large tributary to the Des Plaines River, which originates in northwestern Cook County and joins the Des Plaines near the border between Kendall and Will Counties southwest of the greater Chicago metropolitan area. This 376 square mile watershed is heavily urbanized, with 48.5% of the total surface area being developed (IDNR CTAP, 1999). The DuPage is divided into three main catchments or subwatersheds; the West Branch DuPage River (124 sq. mi.) and the East Branch DuPage River (80 sq. mi.) drain much of central and western DuPage County and flow south into the main stem DuPage River (168 sq. mi.), which extends along the western edge of Will County to the confluence with the Des Plaines River. Most of the development and urbanization in the watershed is within the East and West Branches in DuPage County, whereas the main stem watershed of the DuPage River in Will County is largely agricultural.

Figure 1.1 DuPage River near Shorewood, IL.

Although water quality has improved dramatically in the watershed over the last twenty years, much of the river remains classified as an "Impaired Water" by the Illinois EPA due to excess nutrients, salinity & chlorides, and suspended solids. These problems are indicative of a watershed under stress from human impacts on the landscape. The purpose of this study is to assess one such impact, namely the impact of man-made dams on fish passage, recreational uses and water quality.

Figure 1.2 West Branch DuPage River near Warrenville, IL.

Physical assessments of the dams were made to provide information on structure, safety and recreational use of the river and the impoundments around each dam. Biological assessment data is used to provide an understandable water quality endpoint of relevance to society: the biological integrity of waterbodies. Fish and macroinvertebrates are good water quality indicators because they spend all or most of their lives in the water and are good integrators of environmental conditions.

STUDY AREA

This assessment is limited to the dams located on the main stem DuPage River and West Branch DuPage river. The dams on these reaches are shown in Figure 1. The first dam on the DuPage River is the Channahon Dam, located less than 0.5 miles from the DuPage's confluence with the Des Plaines River in the I&M Canal State Park in Channahon. This 9 foot high dam has effectively disconnected the DuPage River from the Des Plaines River, from a biological standpoint. The impoundment behind this dam extends upstream 4.1 miles and covers and area of 75 acres. The environment within the impoundment is characterized as a deep and slow-moving channel with little or no flow diversity, silty deposits over a rocky substrate. These conditions have resulted in a poor macroinvertebrate population and relatively low fish diversity.

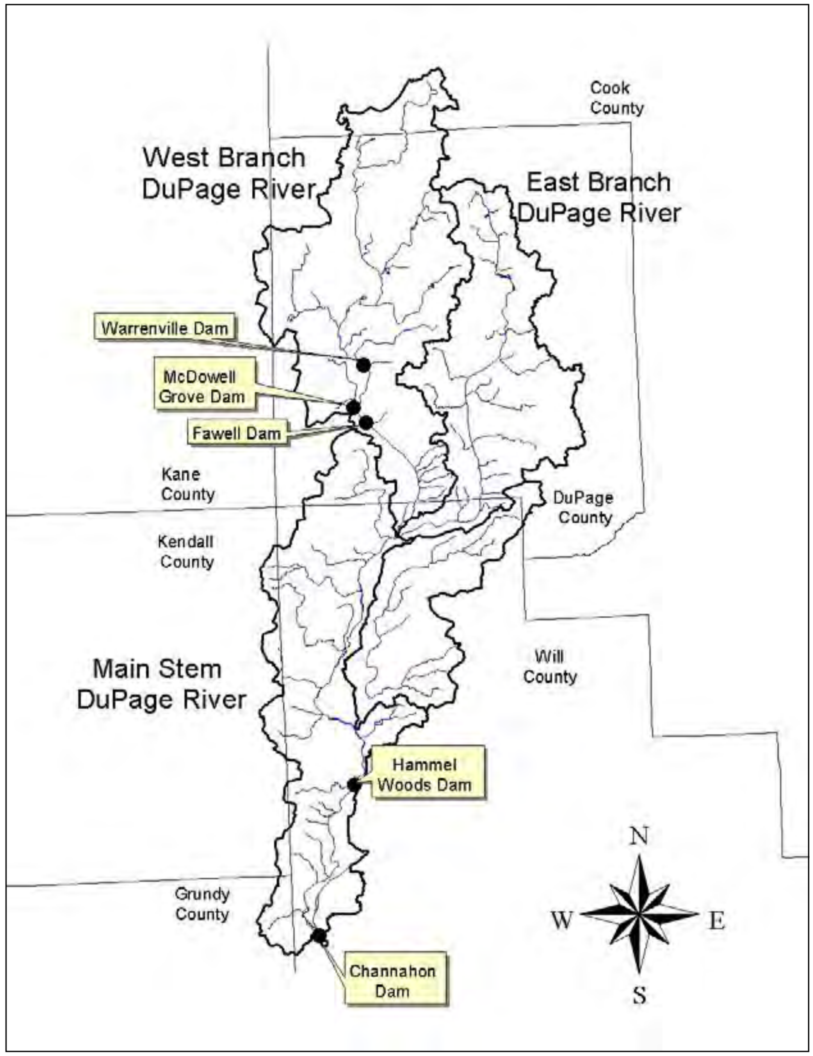


Figure 1.3 DuPage River Watershed Map with dams on the West Branch and main stem noted.

Approximately ten miles upstream of the Channahon Dam is the river's second dam, located in the Hammel Woods Forest Preserve just north of Route 52 in Shorewood (River Mile 10.59). This dam, known as the Hammel Woods Dam, is very small; only 2.3 feet in height. The impoundment created by this dam is therefore very small, having a length of only 1600 feet (0.3 mi.) and a surface area of 5.2 acres. The small nature of this dam and it's impoundment, along with the relatively steep gradient of the river is this area has resulted in a condition in which the river ecosystem is relatively unaffected by the dam, although this dam is considered to have the most threat to public safety due to its dangerous hydraulics.

Moving upriver into the West Branch subcatchment, a third dam is located at river mile 36 on the West Branch DuPage River. Known as the Fawell Dam, it can be found north of Ogden Avenue in Naperville. This dam could not be included in the study because it was undergoing major reconstruction, which precluded the investigators from collecting the data needed to analyze the impacts of the dam on both water quality and the biological resources in this segment of the river.

The next upstream dam on the West Branch is the McDowell Grove Dam, located at river mile 36.55 within the McDowell Grove Forest Preserve. This 4 foot high dam has an impoundment length of 2900 feet and a surface area of approximately 8 acres. Much of the impoundment is filled with fine-grained silts resulting in a mean depth of about 1.5 feet. The impoundment behind the McDowell Grove Dam contains a vast amount of fine-grained silt and sand which as blanketed most of the natural habitat on the channel bottom, resulting in poor fish and macroinvertebrate communities.

The upstream most dam on the West Branch DuPage River is located at river mile 38.8 in the Warrenville Grove Forest Preserve with the City of Warrenville. The impoundment has a length of 1.2 miles and a surface area of 16.9 acres. The characteristics of the impoundment are very similar to those observed a McDowell Grove Dam, as its slack water has caused large amounts of sediment to settle out and smother the natural aquatic habitat (coarse sand, gravel and cobbles).

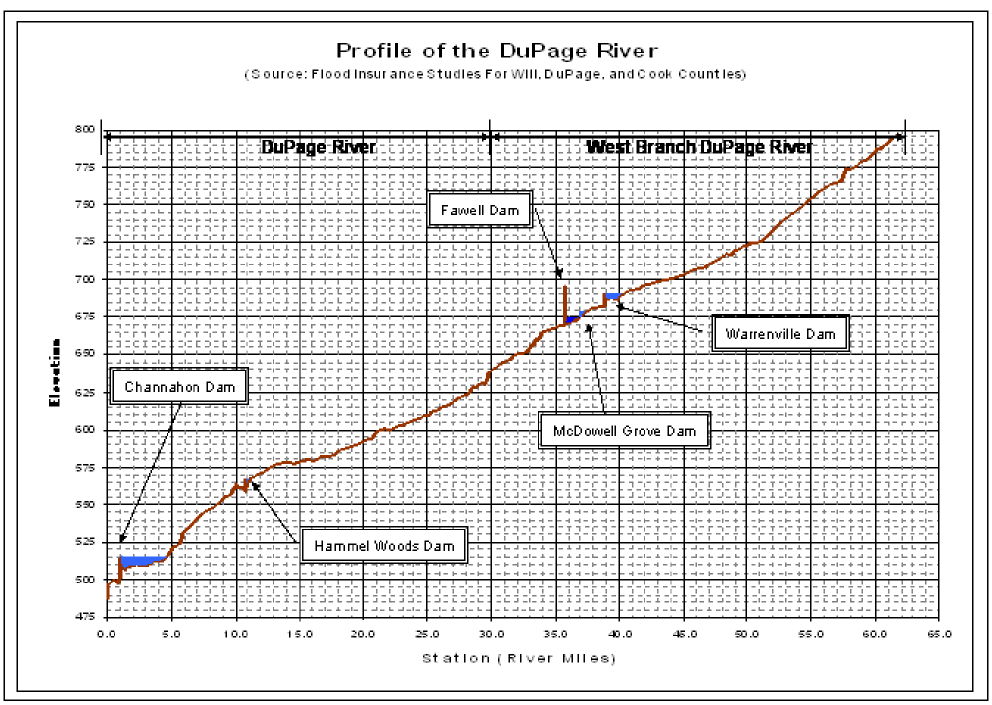


Figure 1.4 Profile of the DuPage River and West Branch and locations of dams

METHODS

SAMPLE DESIGN

Three stations were established at each of the four dams included in this study. The first station, a segment of the river upstream of the impoundment, was intended to represent the free-flowing areas of the river. The second station, 50 – 500 feet upstream of the dam depending on safety precautions, represented the impoundments, and the third station, immediately downstream of the direct influence of the dam, represented free flowing segments below the dams. Station locations are listed in Table 1.1.

Table 1.1 Sampling locations

Stream	Sample Location	Latitude	Longitude
West Branch DuPage	Downstream of Mack Rd, Warrenville, IL	41.841614702	-88.198674109
West Branch DuPage	Warrenville Dam Pool, Warrenville, IL	41.822003431	-88.172691208
West Branch DuPage	Downstream Warrenville Dam, Warrenville, IL	41.821250483	-88.172310686
West Branch DuPage	Downstream Diehl Rd, Naperville, IL	41.804503191	-88.177334898
West Branch DuPage	McDowell Dam Pool, McDowell Woods, Naperville, IL	41.794836165	-88.187256224
West Branch DuPage	Downstream McDowell Dam, McDowell Woods, Naperville, IL	41.794271674	-88.187083569
DuPage River	Upstream of 119th St, NW of Plainfield, IL	41.667037179	-88.182991860
DuPage River	Hammel Dam Pool, Hammel Woods, Shorewood, IL	41.522500323	-88.192986806
DuPage River	Downstream Hammel Dam, Hammel Woods, Shorewood, IL	41.521871183	-88.194284600
DuPage River	Downstream Shepley Rd, N. of Channahon, IL	41.467749111	-88.209758132
DuPage River	Channahon Dam Pool, Channahon, IL	41.422349465	-88.229098538
DuPage River	Downstream Channahon Dam, Channahon, IL	41.421085553	-88.227716359

FISH

Fish community sampling was performed to assess the localized effects of dams on stream quality, and system-wide effects of dams on species distribution. A total of 11 stations were sampled during summer 2000 (Table 1.2) on the West Branch and main stem of the DuPage River. Two additional stations were sampled in September 2001 to supplement species distribution data. Stations were located in free-flowing areas downstream, and impounded areas upstream of each dam at Channahon, Shorewood, McDowell Grove, and Warrenville (Figure X.1), Due to access problems, samples were taken only in the downstream area of the Fawell Dam. Fish collections were also made at four stations in free-flowing areas away from the dams in order to provide additional information on species distribution (Figure 1.5). Sample design, and station labeling followed protocols established by Santucci and Gephart (2003) for a similar study evaluating the effects of dams on Fox River fish communities:

- MID FF = mid segment stations in free-flowing reaches away from dams.
- DS FF = downstream free-flowing reaches immediately below dams.

- US IMP = upstream-impounded areas immediately above dams.

Stations were 300-2000 feet in length, depending on width of the stream and accessible area available.

Table 1.2 Fish community station locations, habitat type, river mile above mouth and collection dates (DS FF = downstream free-flowing; US IMP = upstream impounded; MD FF = mid segment free-flowing).

River	Station Location	Habitat Type	River mile above mouth	Sampling Date
DuPage	Channahon below dam	DS FF	0.9	9/8/00
	Channahon above dam	US IMP	1.1	9/8/00
	Shepley Road	MD FF	5.6	9/27/01
	Hammel Woods above dam	DS FF	10.5	9/7/00
	Hammel Woods below dam	US IMP	10.7	9/7/00
	119th Street	MD FF	24.0	9/27/01
West Branch	Fawell below dam	DS FF	36.0	7/26/00
	McDowell Grove below dam	DS FF	36.4	7/26/00
	McDowell Grove above dam	US IMP	36.5	8/3/00
	Diehl Road	MD FF	37.6	7/26/00
	Warrenville below dam	DS FF	38.7	8/3/00
	Warrenville below dam	US IMP	38.8	8/3/00
	Mack Road	MD FF	41.2	7/25/00

Boat electro-fishing was utilized for fish collection at locations with water depth greater than 1.6 meters, using a boat equipped with a 3500 watt - 3 phase generator (AC). Where habitat and water depths permitted, supplemental collections were made at boat sites with a backpack electro-fishing unit. Areas too shallow for boat access were sampled using a small floating “barge” equipped with remote probes. For all techniques, larger fish specimens were weighed, measured and returned to the stream. Smaller individuals were preserved and identified in the laboratory. In addition to determining species distribution and abundance at each station, stream conditions were evaluated using the Index of Biotic Integrity (IBI, Smogor 2000). The IBI is a widely used stream quality measurement based on the fish community, taking into account the number and types of species present, their tolerance to degradation, food, habitat and spawning preferences. These attributes are evaluated using 10 different parameters, or metrics, each with a possible score of 0-6. Scoring is based on comparison to established reference conditions for unmodified streams of similar size and region of the State. Total IBI scores range from 0-60, with higher scores indicating better quality.

The IBI is the basis for determining the letter-based Biological Stream Characterization (BSC, Bertrand et al. 1996), which includes the following IBI ranges and descriptors:

- 51-60 = A (Unique Aquatic Resource);
- 41-50 = B (Highly Valued Aquatic Resource);
- 31-40 = C (Moderate Aquatic Resource);
- 21-30 = D (Limited Aquatic Resource);
- 0-20 = E (Restricted Aquatic Resource).

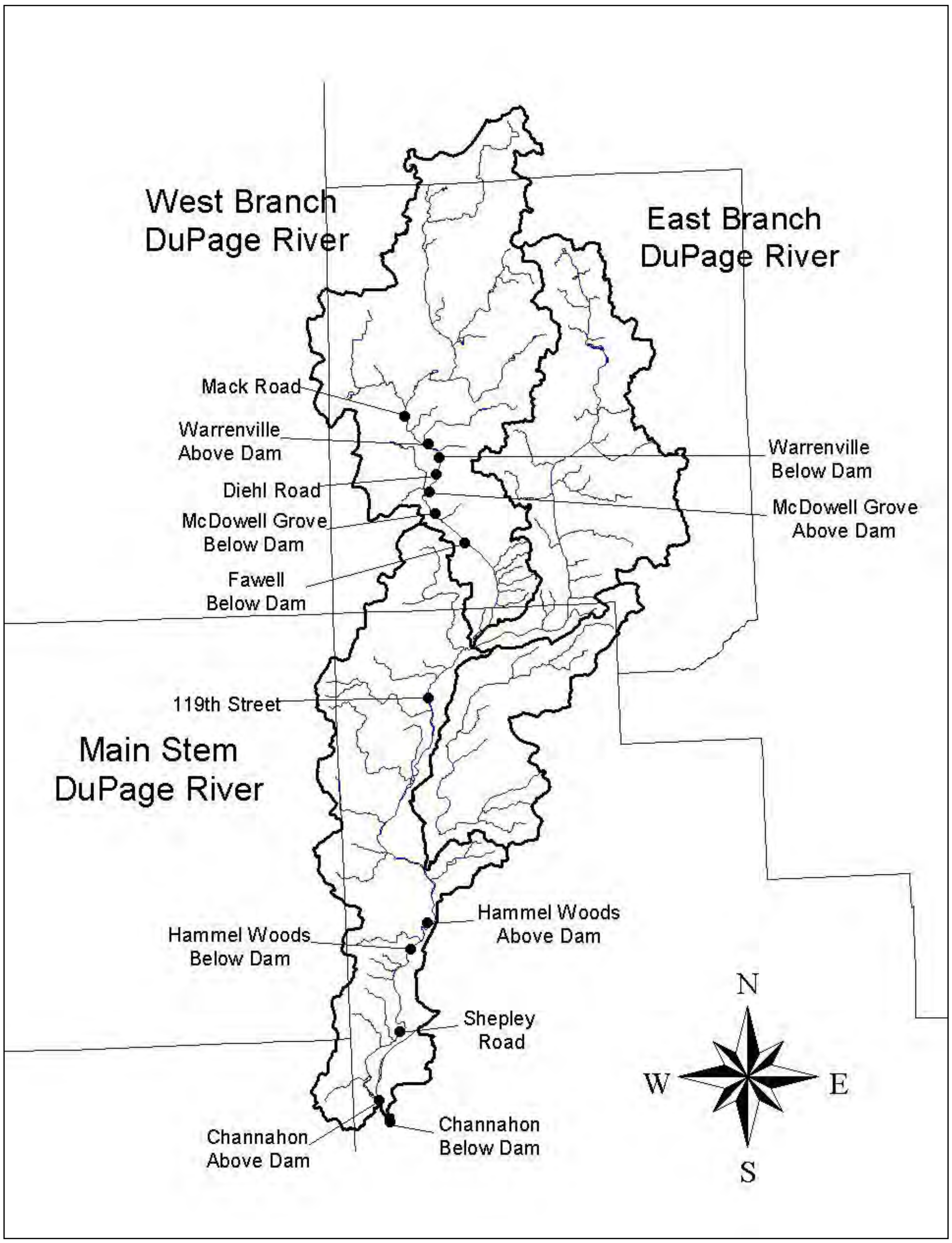


Figure 1.5 Sampling Locations for the study

Previous sampling in the DuPage Watershed includes a recent survey conducted at 6 stations by the Illinois Department of Natural Resources (DNR) in 1997 (unpublished data). These data were combined with results from the current study for analysis of species distribution.

MACROINVERTEBRATES

Macroinvertebrates were collected using both hand picking and D-frame kick nets. Forceps were used to pick invertebrates from various substrate including rocks, logs and submerged vegetation, while the kick nets were used in areas with faster moving water where the substrate could be kicked up and the invertebrates carried into the nets. One hour of sampling was completed for each site. Sampling time was divided proportionally according to available habitat types. A canoe was used where the water was too deep or too silted to wade.

Samples were preserved in 90% ethanol in the field. In the lab the samples were cleared of debris and sent to Mike Winnell of Freshwater Benthic Services in Michigan for identification to the lowest level of taxonomic resolution.

A multi-metric macroinvertebrate condition index (MCI), developed by Victor J. Santucci Jr. from Max McGraw Wildlife Foundation (Santucci & Gephard 2003), was used to analyze the data collected and is described below.

> The MCI is based on the U.S.EPA Rapid Bioassessment Protocols (Barbour et al. 1999). The index has seven metrics: the number of total taxa, EPT taxa (Ephemeroptera, Plecoptera, and Trichoptera), and intolerant taxa; the percentages of EPT individuals, Chironomidae individuals (midge larvae) and clinger organisms; and the Macroinvertebrate Biotic Index (MBI). Intolerant taxa were those with tolerance ratings 4 (range 0-11) based on the latest Illinois macroinvertebrate tolerance list (IEPA 1995). Clinger organisms were filter-feeding insects that permanently attach to substrates (Merritt & Cummins 1996). This group of organisms is typically intolerant of poor water quality conditions (Barbour et al. 1999) The MBI is the Illinois version of the Hilsenhoff Biotic Index (Hilsenhoff 1987). It provides an overall community tolerance rating based on the mean of tolerance values weighted by organism abundance.
>
> Values for individual metrics were calculated and then adjusted to the same scale and direction of expected response to increase perturbation (with 95th percentiles of the data) and summed across the metrics to obtain a total condition index score for each station (Barbour et al. 1999). The range of values for the MCI was 0 to 700, with higher scores indicating higher quality macroinvertebrate community. The MCI was not appropriate for making comparisons to other studies or gauging ecological health relative to other rivers because only DuPage River kick-netting and hand picking data were used in its development. However the index provides a measure for documenting relative differences in macroinvertebrate communities among DuPage River sample stations.

AQUATIC HABITAT ASSESSMENT

Physical in-stream habitat was assessed at all sampling locations using both the Illinois Environmental Protection Agency (IEPA) Stream Habitat Assessment Protocol (SHAP) and Ohio Environmental Protection Agency's Qualitative Habitat Evaluation Index (QHEI). The assessments were completed by wading or canoeing the length of the fish sampling stations.

The SHAP combines 15 metrics that assess the quality and quantity of available aquatic habitat. The field metrics include Bottom Substrate, Deposition, Substrate Stability, In-stream Cover, Pool Substrate Characterization, Pool Quality, Pool Variability, Canopy Cover, Bank Vegetation Stability, Top of Bank Land Use, Flow Related Refugia, Channel Alteration, and Channel Sinuosity. Width/Depth Ratio and Hydrologic Diversity are calculated in the office. The metrics are summed for each station resulting in a score ranging from 15-208. The scores are then rated as Excellent (>= 142), Good (<142 & >=100), Fair (<100 & >= 59) and Poor (<59).

The QHEI uses six metrics to evaluate the quantity and quality of available aquatic habitat. The metrics include Substrate Type, In-stream Cover, Channel Morphology, Riparian Zone and Bank Erosion, Pool/Glide and Riffle/Run Quality and Gradient. The metrics are summed for each station resulting in a score of 0-100. Scores over 60 typically represent streams with good habitat that should support a diverse fish community. Index scores between 46 and 60 generally indicate degraded habitats that may or may not meet warm water criteria for supporting aquatic life. Scores below 46 typically represent severely degraded habitats that do not support quality fisheries. (Ohio EPA)

WATER CHEMISTRY

To determine the effects of algal respiration and photosynthesis on parameters chosen for this study samples were collected before sunrise and in the late afternoon at each sampling location, in anticipation of the extremes in the diurnal fluctuation of dissolved oxygen (DO). Water quality monitoring probes were set in each pool to record dissolved oxygen, temperature, pH and conductivity every fifteen minutes for a twenty-four hour period.

Because DO was the primary water quality variable of interest in this study, it was sampled most intensively. Using a Yellow Springs Instruments portable meter (YSI 95), DO and temperature were measured at three points in three transects across the pool of the dam. Measurements were taken at three depths (surface, mid-depth, and about 0.3 m from the bottom) at each point. If water was less than 1 m deep, only two measurements were taken. Measurements were also taken at three points across a single transect at the upstream and downstream sites. All measurements were collected before dawn and in the late afternoon. A Hydrolab Data Logger was placed in each pool approximately 0.3 meters above the substrate for a 24-hour period.

Readings for Dissolved Oxygen, temperature, pH and conductivity were recorded every five minutes for the duration.

Table 1.3. Water quality parameters collected at 12 sampling stations.

Recoded in the field	
Dissolved Oxygen (mg/L & % saturated)	pH
Temperature (celcius)	Conductivity (uS/cm)
Turbidity (NTU)	
Analyzed in the laboratory	
Total Organic Carbon (mg/L)	Total Phosporus (mg P/L)
Suspended Solids (mg/L)	Chlorophyll-a corrected (ug/L)
Ammonia Nitrogen (mg N/L)	Chlorophyll-b (ug/L)
Total Kjeldahl Nitrogen (mg N/L)	Chlorophyll-c (ug/L)
Nitrate/Nitrite mg N/L	Pheophytin-a (ug/L)
Total Dissolved Phosphorus (mg P/L)	

Nutrient, suspended solids, turbidity and chlorophyll samples were collected by taking grab samples at the center of flow and 0.3 meters below the surface of the water at each sampling location. Individual sample bottles were filled and preserved in the field and placed in coolers with ice. Nutrient and suspended solids samples were delivered to the USEPA lab within 48 hours after collection. Turbidity samples were analyzed in the field with a Turbidity meter. Chlorophyll samples were filtered after each round of collection and frozen until all sampling was concluded; they were then delivered to Illinois EPA for analysis. All parameters measured are listed in Table 1.3.

ACCUMULATED SEDIMENT

In order to assess current ecological conditions in the impounded areas and predict future conditions under a variety of dam modification or removal alternatives three objectives needed to be met. The first was to determine the quality of bulk sediment deposits that might be disturbed by dam modifications; the second was to determine the quantity of bulk sediment deposits that might be disturbed by dam modifications; and the third was to determine the quality of surficial sediment deposits (biota exposure layer) as they currently exist in the study area upstream and downstream of each dam.

To characterize the quality of the sediment a minimum of three hand-driven, 2-inch diameter, lexan tube core samples were taken within 50-100 feet above and below each dam. Each core sample was self-composited (vertically homogenized eliminating all horizon integrity) into a stainless steel bowl, mixed with a stainless steel spatula in the field, and placed in jars on ice until delivered to the USEPA Lab in Chicago. Samples were analyzed for metals, ABN’s, pesticides and PCB's, ammonia nitrogen, Kjedahl nitrogen, total organic carbon, and grain size. All sampling locations were recorded with hand-held GPS units.

To provide a rough estimate of the volume of sediment behind each dam sediment was probed with a ½" steel pipe at 20-40 locations within 1000-2000 feet above and below each dam. Three transects at approximately 50-100 feet, 500-1000 feet and 1000-2000 feet distances upstream and downstream of the dam were sampled by zigzagging across the transect. Water depth to the top of the sediment and sediment depth to the bottom of pipe penetration were measured to the nearest 0.25 feet and recorded on an electronic data-logger with locational GPS data.

To assess the quality of the surficial sediment ponar grab samples were collected along the right-middle-left of three transects above and below the dams at distances of 50-100 feet, 500-1000 feet and 1000-2000 feet for a total of nine grabs above and nine below. The three grabs collected in each transect were composited in the field and placed in jars on ice until delivered to the USEPA lab in Chicago. The result was three upstream samples and three downstream samples for each dam. All sampling locations were recorded with hand-held GPS units.

QUALITY ASSURANCE AND QUALITY CONTROL

A Quality Assurance Project Plan was completed and approved by the USEPA before sampling commenced. All sampling equipment was cleaned using non-phosphate soap between stations to eliminate cross contaminations of samples. Duplicate and blank samples were collected to monitor precision of sampling techniques and laboratory operations. The duplicate was collected at the same time and location as every tenth sample. Blank samples were filled in the field using de-ionized water provided by the USEPA laboratory at the same time the duplicates were collected. Duplicate samples evaluate the variation in concentrations of constituents in the samples due to sampling and processing methods. Contamination of sampling equipment and processing water are assessed by the blank samples. The USEPA laboratory provided all sample bottles. YSI meters and Hydrolab data-loggers were calibrated daily or before each new deployment using standards provided by the USEPA laboratory.

STUDY RESULTS

FISH

For all stations combined, a total of 2,351fish, representing 41 species were collected, including two non-native species, carp and goldfish (Table 1.5). One hybrid taxa (bluegill X green sunfish) was also found. Although the mosquito fish is native to Illinois, the natural range is limited to southern half of the State. No endangered or threatened species were collected in this study.

Cyprinids (minnows and carp) were the most abundant and diverse family present, with 13 species accounting for 47% (1,109) of the total collection (Table 1.5). Centrarchids (sunfishes) were also abundant comprising 40% (945) of the total. The five most common species in order of abundance were: sand shiner, green sunfish, bluegill, spotfin shiner, and bluntnose minnow (Table 1.5). These species made up 68% of the fish sampled. Species abundance and composition for this study were similar to those found in the survey conducted in 1997 (Illinois Department of Natural Resources, unpublished data).

In order to evaluate the system-wide effects of dams on fish distribution, we determined species occurrences within each river segment created by the existing dams. For this analysis, data from the 1997 survey (IDNR unpublished data) were also included. Out of the 41 species collected from the main stem and the West Branch of the DuPage River, 18 species (42%) were found throughout the river system, and did not appear to be affected by the dams. In contrast, 23 of the 41 total species (58%) did appear to be affected by the dams, primarily by blocking upstream movement. Table 1.4 shows the distribution of the 23 affected species in each river segment between dams. The area downstream of the Channahon Dam, which is directly connected to the Illinois River, had the most diverse species assemblage, with all 23 affected species present. The number of species diminished upstream of Channahon, and Shorewood Dams (Table 1.4). Upstream of Fawell Dam, none of the 23 species were found in the 1997 or 2000 collections.

Historically, the DuPage River system experienced severe water quality degradation (IEPA 1983). The absence of intolerant species in the upper watershed may be due to the past water quality conditions, and the inability of species to re-colonize this area through recruitment from downstream areas of higher fish diversity. Results of our current study and more recent IEPA data (IEPA 2002), indicate that water quality in the DuPage River system has improved in recent years, however, the dams block movement of fish into the previously degraded areas, presenting an impediment to restoration efforts in the watershed.

In addition to system-wide effects, dams are known to have localized impacts on fish communities due to degraded habitat and water quality conditions in the upstream impounded area (Santucci and Gephart 2003, Kenehl et al. 1999). For the DuPage River, a total of 26 species, representing 65% of all species collected, were found only at the free-flowing stations downstream of the dams, and did not occur in the upstream impounded areas (Table 1.5).

With the exception of golden shiner, all species found in the impounded areas were also found in the free-flowing areas. For all stations combined, free-flowing areas held roughly twice as many species as the impounded areas upstream of the dams (Table 1.5).

Table 1.4. Fish species occurrence by river segment for those species whose distribution was affected by dams, for the DuPage River Dam Study (data from current study combined with IDNR 1997 Basin Survey data)

	River Segment					
	Downstream ---> Upstream					
COMMON NAME	**Downstream Channahon**	**Channahon Shorewood**	**Shorewood Fawell**	**Fawell McDowell**	**McDowell Warrenville**	**Upstream Warrenville**
Northern pike	■	■				
Hornyhead chub	■	■				
Central stoneroller	■	■	■			
Suckermouth minnow	■	■				
Emerald shiner	■	■				
Striped shiner	■					
Bigmouth shiner	■					
Quillback	■	■	■			
Northern hog sucker	■	■	■			
Shorthead redhorse	■	■	■			
Golden redhorse	■	■				
Silver redhorse	■					
Channel catfish	■	■	■			
Flathead catfish	■	■				
Stonecat	■	■				
Tadpole madtom	■	■	■			
Blackstripe topminnow	■	■	■			
Rock bass	■	■	■			
Longear sunfish	■	■				
Slenderhead darter	■					
Johnny darter	■	■	■			
Banded darter	■	■	■			
Freshwater drum	■	■				

Table 1.5 Summary of fish collection results at each station. (DS FF =downstream free flowing; US IMP = upstream impoundment; MD FF = mid segment free flowing.)

		Channahon Dam		Shepley Road	Hammel Woods Dam		119th Street	Fawell Dam	McDowell Grove Dam		Diel Rd.	Warrenville Dam		Mack Rd.
COMMON NAME	**Total No.**	**DS FF**	**US IMP**	**MD FF**	**DS FF**	**US IMP**	**MD FF**	**DS FF**	**DS FF**	**US IMP**	**MD FF**	**DS FF**	**US IMP**	**MD FF**
Gizzard shad	29	7	16	0	0	0	0	0	0	0	0	2	4	0
Goldfish	2	0	0	0	0	0	1	0	0	0	0	1	0	0
Carp	158	3	4	8	13	28	36	7	5	16	2	2	23	11
Golden shiner	1	0	0	0	0	0	0	0	0	0	0	0	1	0
Creek chub	11	1	0	0	0	0	0	0	0	0	8	1	0	1
Hornyhead chub	2	0	0	2	0	0	0	0	0	0	0	0	0	0
Central stoneroller	10	2	0	7	0	0	1	0	0	0	0	0	0	0
Suckermouth minnow	9	4	0	5	0	0	0	0	0	0	0	0	0	0
Striped shiner	3	3	0	0	0	0	0	0	0	0	0	0	0	0
Spotfin shiner	301	15	0	0	0	0	8	14	111	6	80	37	1	29
Fathead minnow	2	0	0	0	0	0	0	0	0	0	0	2	0	0
Bluntnose minnow	208	9	0	3	0	4	33	5	75	4	5	19	1	50
Bigmouth shiner	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Sand shiner	401	0	0	0	0	0	0	0	56	0	227	4	0	114
Quillback	5	0	0	0	0	0	5	0	0	0	0	0	0	0
White sucker	85	0	0	5	0	2	42	8	1	2	15	1	4	5
Northern hog sucker	17	3	0	2	4	5	2	1	0	0	0	0	0	0
Shorthead redhorse	28	8	0	12	1	0	3	4	0	0	0	0	0	0
Golden redhorse	15	11	0	4	0	0	0	0	0	0	0	0	0	0
Silver redhorse	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Channel catfish	13	3	0	3	2	2	0	3	0	0	0	0	0	0
Yellow bullhead	14	0	0	6	0	0	5	1	0	0	0	0	0	2
Flathead catfish	1	0	0	0	1	0	0	0	0	0	0	0	0	0
Stonecat	1	0	0	1	0	0	0	0	0	0	0	0	0	0
Tadpole madtom	21	0	0	3	0	0	18	0	0	0	0	0	0	0
Blackstripe topminnow	44	3	7	19	0	3	12	0	0	0	0	0	0	0
Mosquitofish	14	6	0	0	0	0	3	0	0	0	0	4	1	0
Yellow bass	5	0	0	0	0	0	0	0	5	0	0	0	0	0
Black crappie	12	2	0	0	3	1	1	1	0	1	0	2	1	0
Rock bass	35	0	0	28	5	0	2	0	0	0	0	0	0	0
Largemouth bass	53	2	7	6	0	0	4	4	5	7	2	6	8	2
Smallmouth bass	44	1	0	12	3	0	5	2	5	0	3	5	0	8
Green sunfish	382	2	0	57	15	5	13	29	147	11	72	11	5	15
Sunfish hybrid	27	1	0	0	2	0	0	12	6	1	5	0	0	0
Bluegill	304	4	11	18	14	15	13	62	12	57	68	24	2	4
Longear sunfish	15	0	1	14	0	0	0	0	0	0	0	0	0	0
Orangespotted sunfish	68	0	0	2	0	9	0	10	17	8	5	3	9	5
Slenderhead darter	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Johnny darter	2	0	0	0	0	0	2	0	0	0	0	0	0	0
Banded darter	4	0	0	4	0	0	0	0	0	0	0	0	0	0
Freshwater drum	2	1	0	0	1	0	0	0	0	0	0	0	0	0
	2351	**94**	**46**	**221**	**64**	**74**	**209**	**163**	**445**	**113**	**492**	**124**	**60**	**246**
	41	**23**	**6**	**22**	**11**	**10**	**20**	**14**	**11**	**9**	**11**	**16**	**12**	**12**

Table 1.6 Index of Biotic Integrity (IBI) and species numbers at each sampling location. (DS FF =downstream free flowing; US IMP = upstream impoundment; MD FF = mid segment free flowing.)

River	Station Location	Habitat Type	IBI	No. Species
DuPage	Channahon below dam	DS FF	48	23
	Channahon above dam	US IMP	14	6
	Shepley Road	MD FF	42	22
	Shorewood below dam	DS FF	28	11
	Shorewood above dam	US IMP	21	10
	Ferguson Road	MD FF	33	20
West Branch	Fawell below dam	DS FF	27	14
	McDowell Grove below dam	DS FF	18	11
	McDowell Grove above dam	US IMP	17	9
	Diel Road	MD FF	19	11
	Warrenville below dam	DS FF	22	16
	Warrenville above dam	US IMP	18	12
	Mack Road	MD FF	19	12

Free-flowing communities included game species such as smallmouth bass and rock bass, as well as many intolerant varieties such as darters and suckers. The area upstream of the Shorewood Dam was the only area containing intolerant stream species (smallmouth bass and northern hogsucker). Based on observations conducted during sampling, and results of the habitat study (QHEI, Table 1.10), the area upstream of the Shorewood Dam exhibits free-flowing characteristics due to the low height of the dam (3.2 feet) and the accumulation of coarser bedload sediments such as sand and gravel.

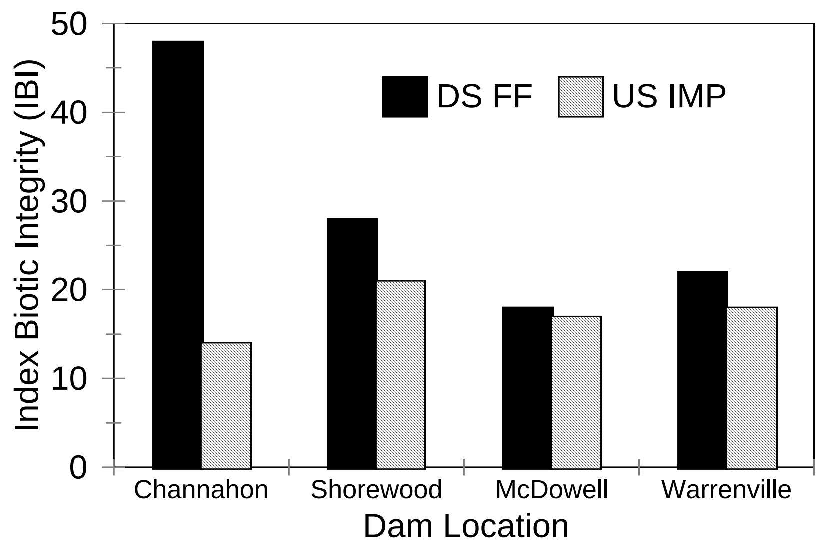
Local effects were evaluated by comparing IBI for the downstream free-flowing (DS FF) and upstream impounded (US IMP) areas at four dams (Tables 1.4 and 1.6). As expected, the DS FF area at Channahon Dam had a higher IBI (48) than the US IMP area (IBI = 16). Due to the low height of the dam (as noted above), the difference in IBI between US IMP and DS FF at Shorewood was minimal. Although the upstream dams at McDowell Grove (height 5.1 feet) and Warrenville (8.0 feet) are high enough to create distinct impounded areas, there was little difference in IBI between DS FF and US IMP at these dams. The effectiveness of the IBI in evaluating stream quality was greatly reduced at these upstream dam locations due to the overall low species numbers, and generally degraded nature of the fish communities, which

Table 1.7 Distribution of fish species by habitat type (DS FF = downstream free-flowing; US IMP = upstream impounded; MD FF = mid segment free-flowing).

FAMILY	COMMON NAME	SCIENTIFIC NAME	MD FF	DS FF	US IMP
Clupeidae	Gizzard shad	*Dorosoma cepedianum*	+	+	-
Cyprinidae	Goldfish	*Carassius auratus*	+	-	-
	Carp	*Cyprinus carpio*	+	+	+
	Golden shiner	*Notemigonus crysoleucas*	-	-	+
	Creek chub	*Semotilus atromaculatus*	+	+	-
	Hornyhead chub	*Nocomis biguttatus*	+	-	-
	Central stoneroller	*Campostoma anomalum*	+	+	-
	Suckermouth minnow	*Phenacobius mirabilis*	+	+	-
	Striped shiner	*Luxilus chrysocephalus*	-	+	-
	Spotfin shiner	*Cyprinella spiloptera*	+	+	-
	Fathead minnow	*Pimephales promelas*	-	+	-
	Bluntnose minnow	*Pimephales notatus*	+	+	+
	Bigmouth shiner	*Notropis dorsalis*	-	+	-
	Sand shiner	*Notropis ludibundus*	+	+	-
Catostomidae	Quillback	*Carpiodes cyprinus*	-	+	-
	White sucker	*Catostomus commersoni*	+	+	+
	Northern hog sucker	*Hypentelium nigricans*	+	+	+
	Shorthead redhorse	*Moxostoma macrolepidotum*	+	+	-
	Golden redhorse	*Moxostoma erythrurum*	+	+	-
	Silver redhorse	*Moxostoma anisurum*	-	+	-
Ictaluridae	Channel catfish	*Ictalurus punctatus*	+	+	+
	Yellow bullhead	*Ameiurus natalis*	+	+	-
	Flathead catfish	*Pylodictis olivaris*	-	+	-
	Stonecat	*Noturus flavus*	+	-	-
	Tadpole madtom	*Noturus gyrinus*	+	-	-
Cyprinodontidae	Blackstripe topminnow	*Fundulus notatus*	+	+	+
Poeciliidae	Mosquitofish	*Gambusia affinis*	+	+	+
Percichthyidae	Yellow bass	*Morone mississippiensis*	-	+	-
Centrachidae	Black crappie	*Pomoxis nigromaculatus*	+	+	+
	Rock bass	*Ambloplites rupestris*	+	+	-
	Largemouth bass	*Micropterus salmoides*	+	+	+
	Smallmouth bass	*Micropterus dolomieu*	+	+	-
	Green sunfish	*Lepomis cyanellus*	+	+	+
	Sunfish hybrid	*Lepomis hybrid*	+	+	+
	Bluegill	*Lepomis macrochirus*	+	+	+
	Longear sunfish	*Lepomis megalotis*	-	+	+
	Orangespotted sunfish	*Lepomis humilis*	+	+	+
Percidae	Slenderhead darter	*Percina phoxocephala*	-	+	-
	Johnny darter	*Etheostoma nigrum*	+	-	-
	Banded darter	*Etheostoma zonale*	+	-	-
	Freshwater drum	*Aplodinotus grunniens*	+	-	-
		total no. species	**31**	**33**	**15**

effectively masked the difference between the DS FF and US IMP. For example, we examined IBI scores for all free-flowing areas only, from Channahon Dam to Mack Road, and found decreasing stream quality moving from the downstream to upstream areas (Table 1.4). The number of species also decreased in the upstream areas (Table 1.7)

Figure 1.6. Index of Biotic Integrity for downstream free flowing (DS FF) and upstream impounded (US IMP) habitats each dam location for the DuPage River Dam Study.



Despite the similarity in IBIs for the upstream and downstream areas at McDowell Grove and Warrenville Dams, the effects of the dams were still apparent as indicated by the total abundance of fish collected. The total number of fish collected at DS FF was 2X greater than US IMP at the McDowell Grove Dam, while DS FF was 4X greater than US IMP at Warrenville (Table 1.5). The mean abundance for all dams was lower for the US IMP areas, compared to the DS FF (Figure 1.5). MID FF areas appeared to be more productive than the DS FF area as indicated by the mean abundance.

Overall, the mean number of species and mean IBI for all dam locations (n=4) were higher for DS FF areas than for US IMP (Figure X.5). Poor habitat, as determined by measured indices (Table XX), and water quality (Table XX) appeared to be the primary factors affecting fish communities in the upstream impounded areas of the dams (with the exception of the low dam at Shorewood).

The local and system-wide effects on fish communities observed in this for the DuPage River, are similar to those found in the Fox River Dam study (Santucci and Gephard 2003). Other studies conducted in Illinois (Pescitelli and Rung 1997) and Wisconsin (Kenehl et al 1997) have also documented the negative effects of low-head dams on stream quality.

Figure 1.7. Index of Biotic Integrity (IBI) for free-flowing stations only at each sampling location (CH = Channahon Dam, SP = Shepley Road, SH = Shorewood Dam, FR = Ferguson Road, FA = Fawell Dam, MID = McDowell Grove Dam, DR = Diel Road, WV = Warrenville Dam, MR = Mack Road).

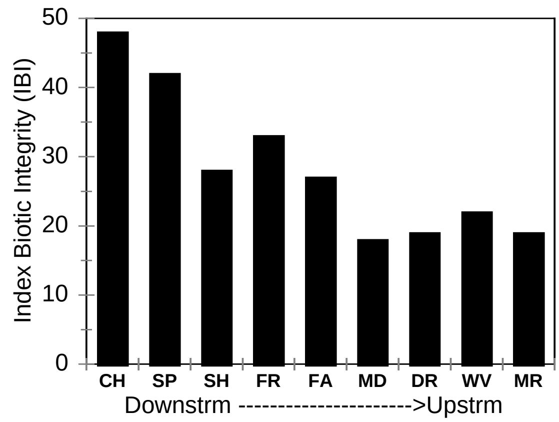
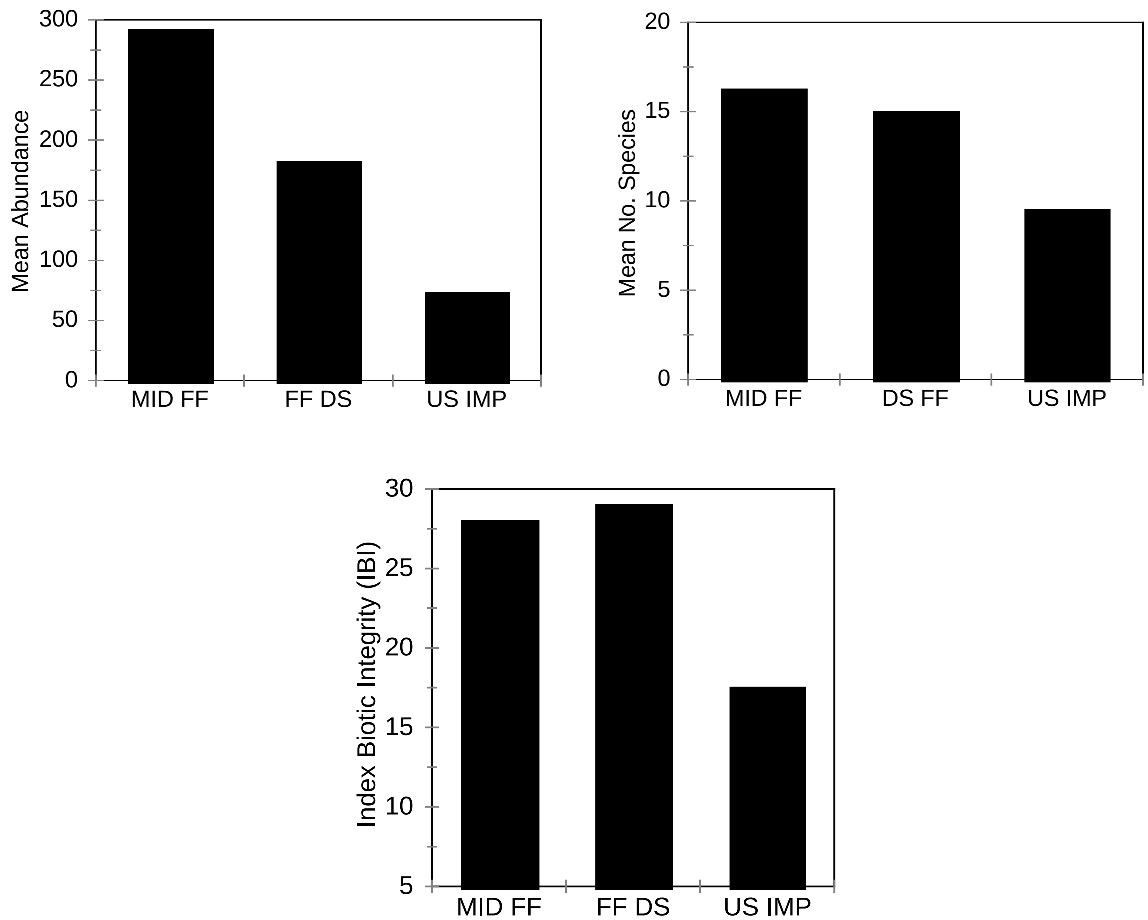


Figure 1.8. Mean abundance, No. of species and IBI for each habitat type for all locations (DS FF = downstream free-flowing; US IMP = upstream impounded; MID FF = mid segment free-flowing).



MACROINVERTEBRATES

Macroinvertebrates and fish communities are indicators of changes in water quality and aquatic habitat in the watershed. Macroinvertebrates make good indicators of water quality and habitat because they:

- live in the water for all or most of their lives
- stay in areas suitable for their survival
- are easy to collect and identify
- differ in their tolerance to amounts and types of pollution
- have limited mobility
- are integrators of environmental condition

(USEPA Office of Science and Technology Biocriteria website)

Dams do not directly impact macroinvertebrates because if conditions worsen adults can move to more suitable habitat, upstream or downstream, to lay eggs. If conditions improve the inverts can quickly repopulate an area. The absence of intolerant macroinvertebrates from the impounded areas behind the dams suggests either poor water quality, poor habitat or a combination of the two.

Sampling resulted in the collection of 2,051 individuals representing 104 taxa of macroinvertebrates. The macroinvertebrate community scores (Table 1.8, Figure 1.9) were the lowest in the Warrenville, McDowell Grove and Channahon pools respectively. This correlates with the poor quality habitat found in each of these pools. Much higher scores were found in the free flowing areas, which also had better habitat diversity. The Hammel Woods pool scores very well due to unusually diverse in-stream habitat for impounded areas.

Table 1.9 shows taxa broken down by habitat type. There are 66 taxa found in the downstream free flowing (DS FF) areas, 42 taxa in the impoundments, excluding the Hammel Dam impoundment, and 73 taxa in the mid segment free flowing (MID FF) areas. The macroinvertebrate data correlates well with the habitat assessments as shown in figure 1.10 where QHEI scores are compared with the MCI scores. Where there is poor habitat there are low macroinvertebrate scores. The macroinvertebrate data exhibits the impacts that the dams at Channahon, McDowell and Warrenville have on the quality of the habitat in the impoundments they create.

Figure 1.9. Macroinvertebrate Community Index (MCI) by habitat type, downstream free flowing (DS FF), impoundments (IMP), and mid segment free flowing (MID FF).

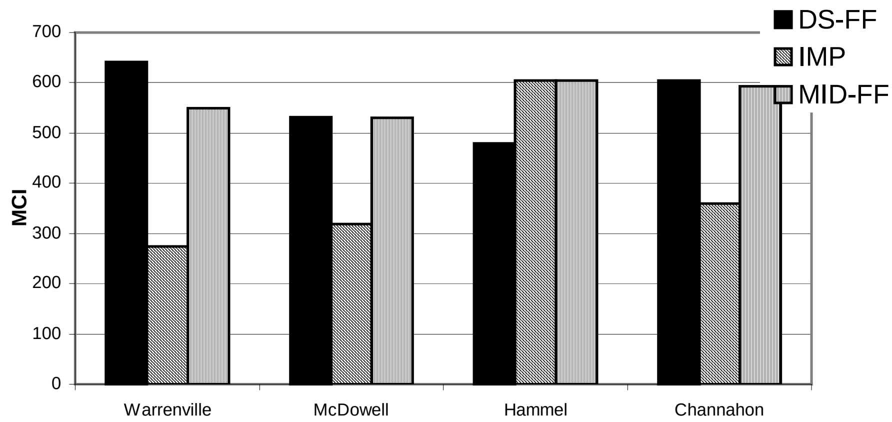


Figure 1.10. Qualitative Habitat Evaluation Index (QHEI) compared with the Macroinvertebrate Community Index (MCI).

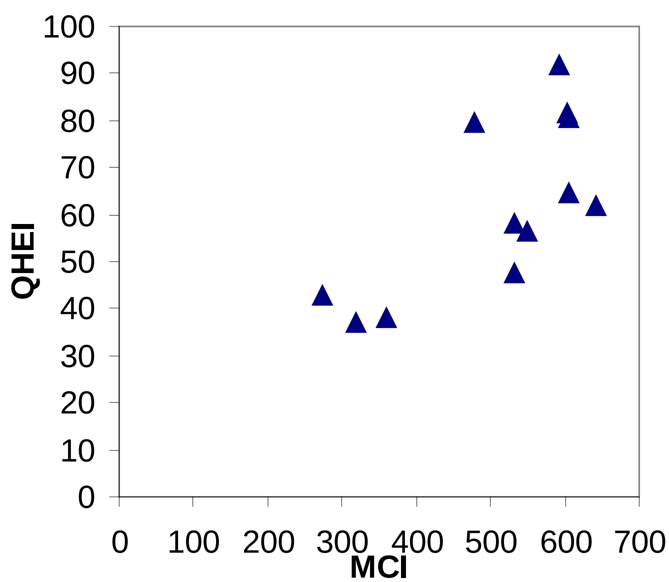


Table 1.8. Macroinvertebrate Community Index

Station	Total Benthos	EPT Taxa	Intolerant Taxa	% EPT Individuals	% Chiron-omidae	% Clinger	MBI	MCI
Warrenville/Mack Rd.	225	11	5	35.60	17.80	59.10	5.7	550
Warrenville Pool	9	1	0	11.10	11.10	33.30	5.7	274
Warrenville Downstream	220	11	5	63.20	5.00	81.40	5.8	641
Diehl Rd.	206	7	5	37.90	12.60	70.40	5.9	531
McDowell Grove Pool	62	3	2	11.30	17.70	17.70	5.5	319
McDowell Downstream	91	10	3	41.80	15.40	78.00	5.6	532
119th St.	191	6	9	65.40	3.10	78.50	5.6	605
Hammel Woods Pool	175	10	12	35.40	18.90	48.00	5.3	604
Hammel Woods Downstream	240	6	6	32.90	2.10	40.40	5.0	479
Shepley Rd.	350	11	7	41.40	5.40	48.90	5.1	593
Channahon Pool	63	2	5	11.10	19.00	25.40	5.5	360
Channahon Downstream	219	11	7	47.90	9.10	64.80	5.6	605

Table 1.9. Macroinvertebrates collected at downstream free flowing (DS FF), mid segment free flowing (MID FF) and at the Channahon, McDowell and Warrenville impoundments.

Taxa	DS-FF	Channahon, McDowell & Warrenville Pools	MID-FF
Turbellaria (flat worms)			
Dugesia tigrina	+	+	+
Oligochaeta (aquatic worms)	+	+	+
Hirudinea (leeches)			
Erpobdella punctata	-	-	+
Mooreobdella microstoma	+	-	+
unid. erpobdellid	+	-	+
Helobdella stagnalis	+	-	+
Helobdella triserialis	+	+	+
unid. glossiphoniid	+	-	-
Isopoda (aquatic sow bugs)	+	+	+
Amphipoda (scuds)			
Gammarus fasciatus	+	-	-
Gammarus pseudolimnaeus	+	-	-
Hyalella azteca	+	+	+
Ephemeroptera (mayflies)			
Baetis intercalaris	+	-	+
Callibaetis sp.	+	+	+
Caenis latipennis	+	-	+
Caenis spp. (EI)	+	-	-
Leucrocuta sp.	-	-	+
Stenacron interpunctatum	+	+	+
Stenonema terminatum	+	-	+
Tricorythodes sp.	+	+	+
Odonata			
Anax junius	+	-	+
Anax longipes	+	-	+
Hetaerina americana	+	-	+
Argia moesta	+	-	+
Argia sp. (inc., EI)	+	+	+
Enallagma divagans	-	-	+
Enallagma exsulans	+	-	+
Enallagma signatum	+	+	+
Enallagma sp. ?	+	+	+
Enallagma spp. (inc., EI)	+	+	+
Ischnura verticalis/posita (EI)	-	-	+
Ischnura sp. (inc., EI)	+	+	+
Perithemis tenera	-	+	-
Plathemis lydia	-	+	-
Megaloptera (dobson flies)			
Sialis sp.	-	-	-
Trichoptera (caddis flies)			
Protoptila sp.	+	-	-
Helicopsyche borealis	-	-	+
Cheumatopsyche sp.	+	+	+
Hydropsyche aerata	+	-	+
Hydropsyche bronta	+	-	+
Hydropsyche depravata complex	+	-	+
Hydropsyche morosa	+	-	+
Hydropsyche phalerata	+	+	+
Hydropsyche simulans	+	-	+
Hydropsyche valanis	+	-	+
Hydropsyche spp. (EI)	+	-	+
hydropsychid (EI)	+	-	+
Hydroptila sp.	-	-	+
Ceraclea sp.	-	-	-
Oecetis inconspicua complex	-	-	+
Coleoptera (beetles)			
Dubiraphia spp.	+	+	+
Macronychus glabratus	-	+	-
Stenelmis crenata	+	-	+
Stenelmis grossa	+	-	+
Stenelmis sexlineata	-	+	-
Stenelmis spp. (L)	+	-	+
Gyrinus sp.	-	-	+
Diptera (true flies)			
Ceratopogonidae			
Bezzia/Palpomyia sp.	-	+	-
Chironomidae			
Ablabesmyia mallochi	+	-	+
Ablabesmyia monilis	-	-	+
Chironomus sp.	-	+	-
Clinotanypus sp.	-	+	-
Corynoneura sp.	-	-	+
Cricotopus (C.) bicinctus	-	-	+
Cricotopus (I.) sylvestris	-	+	-
Cricotopus/Orthocladius	+	-	+
Cryptochironomus sp.	+	+	+
Dicrotendipes neomodestus	-	+	+
Dicrotendipes sp.	+	-	+
Harnischia sp.	-	+	-
Parachironomus tenuicaudatus complex	-	+	-
Polypedilum flavum	+	+	+
Polypedilum illinoense-gr.	+	+	+
Polypedilum scalaenum-gr.	+	+	+
Polypedilum sp.	-	+	-
Procladius sp.	+	+	+
Rheocricotopus robacki	+	-	-
Rheotanytarsus sp.	+	-	+
Tanypus neopunctipennis	-	+	-
Tanypus stellatus	-	+	-
Tanytarsus sp. 08-gr.	-	-	-
Tanytarsus sp. 13C	-	-	+
Thienemanniella lobapodema	-	-	-
Thienemanniella similis	-	-	+
Thienemanniella xena	+	-	+
Thienemanniella sp.	+	-	+
Tribelos fuscicorne	-	+	-
Xenochironomus xenolabis	-	-	-
Culicidae			
Anopheles sp.	-	+	-
Empididae			
Hemerodromia sp.	-	-	+
Simuliidae			
Similium vittatum complex	-	-	+
Gastropoda (snails and limpets)			
Ferrissia rivularis	+	+	+
Ferrissia walkeri	+	-	-
Ferrissia sp.	+	-	-
Physella sp.	+	+	+
Gyraulus circumstriatus	+	+	-
Amnicola limosa	+	-	+
Amnicola sp.	-	-	+
Elimia sp.	+	+	+
Pelecypoda (clams and mussels)			
Corbicula flumineum	+	-	+
Musculium transversum	-	-	+
Musculium sp.	+	-	+
Pisidium casertanum	+	-	-
Pisidium compressum	+	+	-

AQUATIC HABITAT

In-stream habitat is a key characteristic of a healthy stream ecosystem. Streams must exhibit well-developed and diverse habitats in order to support healthy macroinvertebrate and fish communities. "Habitat" takes into consideration attributes like substrate type, in-stream cover, flow diversity, channel formation (riffles, pools and runs), sinuosity, canopy cover, and riparian land uses. Many of our stream miles have been altered, directly or indirectly, by man through channelization, bridge crossings, dams, storm sewer and wastewater effluent discharges. These changes have greatly impacted the quality of in-stream habitat.

Overall stream habitat improves going down stream, this is most likely influenced by the greater amount of development and therefore the greater amount of impervious surfaces that drain directly into the upstream portions of the system. This increased drainage causes flows to be flashy and destructive. Many of the stream segments have eroded banks and are stripped of in-stream structure; this causes a lack of diversity of microhabitats and local flow conditions. SHAP and QHEI scores and rankings can be found in Table 1.10.

The Diehl Road station had the best SHAP and QHEI scores for the West Branch DuPage River with a good and intermediate ranking respectively. This segment had a few pools and one good riffle, but lacked diversity in substrate type and flow. This is a relatively characteristic site for the free flowing sections of the West Branch DuPage River. Both of the impounded pools ranked as "poor" using either metric. The pools were very silted in and relatively shallow with little to no diversity in substrate type, cover or flow.

Table 1.10. Habitat Assessment Scores

Site	SHAP Score	SHAP Rating	QHEI Score	QHEI Rating
Mack Road	86	Fair	56.5	Intermediate
Warrenville Dam Pool	81	Fair	43	Poor
Warrenville Downstream	80	Fair	62	Good
Diehl Road	109.5	Good	58	Intermediate
McDowell Dam Pool	76	Fair	37	Poor
McDowell Downstream	95.5	Fair	47.5	Intermediate
119th Street	99	Fair	64.5	Good
Hammel Dam Pool	134	Good	81.5	Good
Hammel Downstream	132	Good	79.5	Good
Shepley Road	148	Excellent	92	Good
Channahon Dam Pool			38	Poor
Channahon Downstream	135	Good	80.5	Good

The Shepley Road station ranked the best on the Main Stem DuPage River as well as over all with an "excellent" and a "high good" on the SHAP and QHEI respectively. This station is the best example of what a warm water stream should look like, it has excellent pool riffle development as well as diverse flow types.

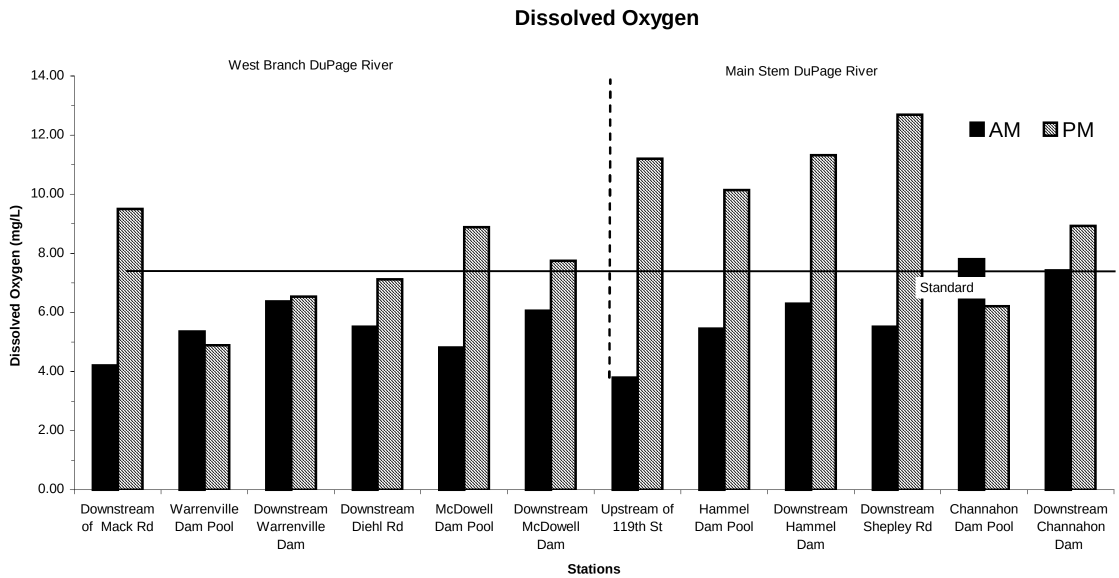
The two impounded pools on the main stem vary greatly. The Hammel Dam pool scored well on both metrics, had very little Siltation and had a diverse selection of microhabitats. This may be due to the relatively low height of the dam and the relatively young age for the structure. The Channahon Pool is much more comparable to the pools in the West Branch DuPage River, low metric scores, high levels of silt, lack of microhabitats and flow diversity. The extreme height of this dam and relatively shallow gradient of this segment of the river creates a long impoundment of more than four miles.

The habitat scores show evidence of the impacts the dams at Channahon, McDowell and Warrenville have on in-stream habitat. The impounded areas behind these dams slow down and homogenize flow and settle out fine sediments, which cover valuable substrate. These areas no longer support healthy fish or macroinvertebrate communities.

WATER CHEMISTRY

The DuPage River is highly enriched with nutrients throughout the system. For the most part nutrient levels do not appear to be affected by the dams. Dissolved oxygen (DO) is another indicator of stream health. The DO levels in the river fall below the minimum 5 mg/L standard (IEPA) at the Warrenville Dam Pool to as low as 3.98 mg/L, and at 119th Street to as low as 2.98 mg/L. The 119th Street sampling station was in a free flowing section of the main stem DuPage River and low DO levels at this station were not anticipated. Along with the low DO levels, another indicator of stress to the system are the diurnal fluctuations of DO. Diurnal fluctuations occur naturally in water bodies due to photosynthesis during the day and plant respiration at night. However, large variability between the daily high and low DO values is a potential indicator of nutrient enrichment.

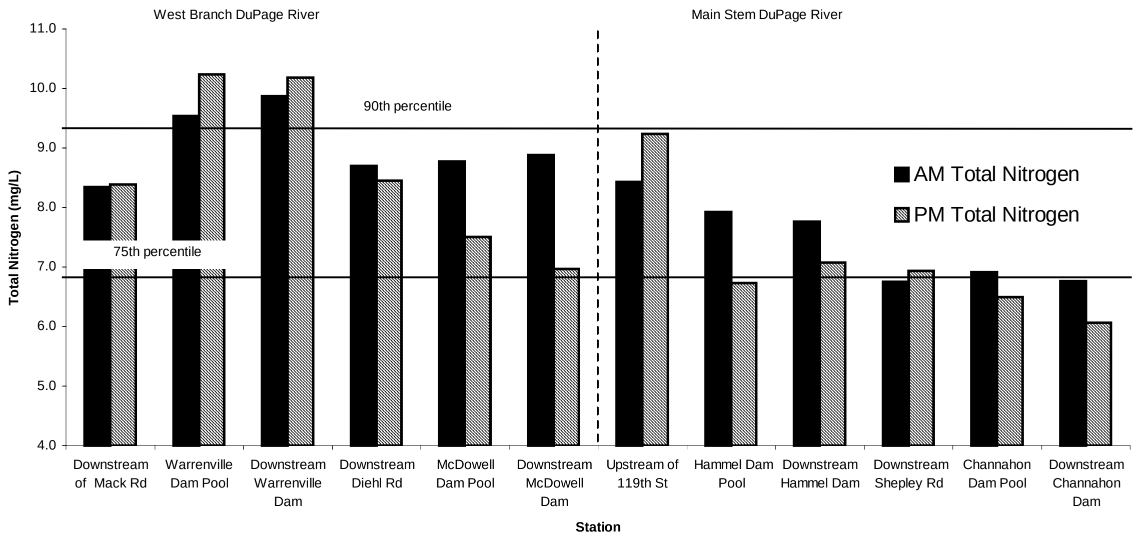
Figure 1.11. Total Dissolved Oxygen Values

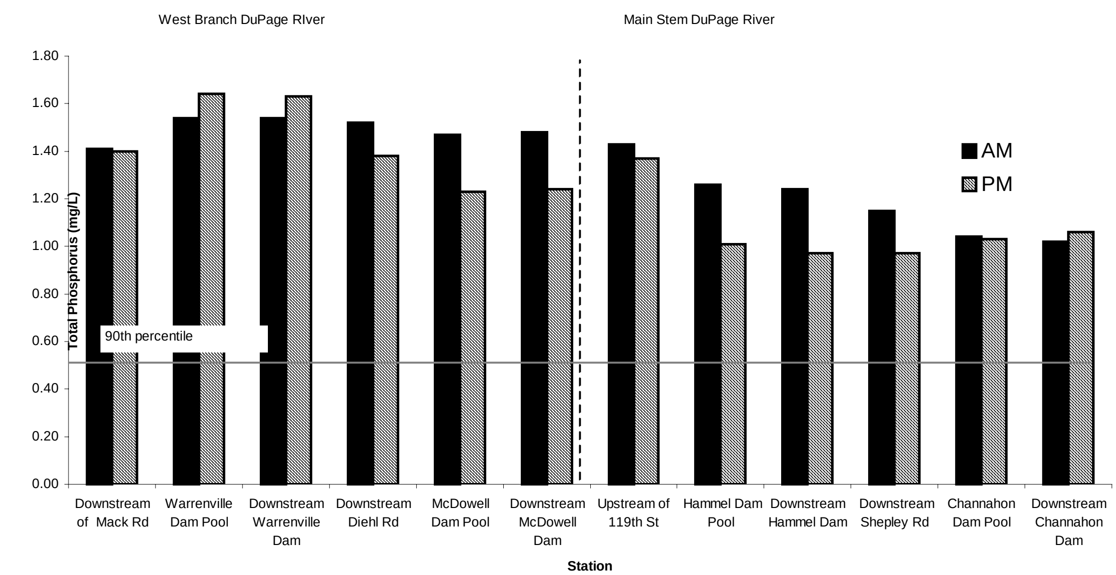


When compared to recommended guidelines for Nitrogen Zone 2 and Phosphorus Zone 4 for Midwestern Streams (Robertson et al. 2001), recorded values were highly elevated along the entire system. Total nitrogen values were for the most part between the 75th percentile (6.80 mg/L) and the 90th percentile (9.35 mg/L) with a high of 10.24 mg/L at the Warrenville Dam Pool and a low of 6.06 mg/L at the Channahon Dam Pool, well above the expected level of 1.24 mg/L for a minimally impacted site within the zone. Total phosphorus levels were all above the 90th (0.54 mg/L) percentile with a high of 1.64 mg/L at Warrenville Dam Pool and a low of 0.97 mg/L downstream of the Hammel Dam and at Shepley Road, well elevated above the expected value of 0.11 mg/L (Figure 1.12). High nutrient levels can be attributed to the fact that a significant portion of the flow comes from 19 wastewater treatment plants (WWTP) in the watershed as well as the mostly urbanized land cover in the upper portions of the watershed. These WWTP do not have permit limits for nutrients and are not required to provide nutrient removal.

Chlorophyll-a was sampled as an indicator of algal growth and nutrient enrichment in the water column. All samples were well below the recommended value of 7.3 mg/L based on the 25th percentile of all seasons data from aggregate ecoregion VI streams (USEPA 2000). Chlorophyll-a may be depressed due to the lack of a “seed source” for phytoplankton, the velocity of the flow, as well as the large beds of macrophytes and peryphyton throughout most of the system that uptake some of the nutrients. Retention time behind the dams is also much shorter than behind dams on the Fox River, which limits the potential for phytoplankton to build-up under normal flow conditions. A large amount of the nutrients that enter this system appear pass through the system and enter the Illinois River without having been converted to biomass.

Figure 1.12 Total Nitrogen And Total Phosphorus Values





The DuPage River watershed is plagued with usual impacts of urban streams, high nutrient levels from wastewater effluent and urban runoff, sedimentation from construction sites and streambank erosion as well as the remnants of past channelization. From the information collected in this study the dams themselves do not greatly impact the water chemistry of the river system.

ACCUMULATED SEDIMENT

Sediment depths were recorded at 135 locations behind the four dams studied. Sediment volumes ranged from 1,668 cubic yards behind the Hammel Woods dam to 30,686 cubic yards behind the Warrenville dam (Table 1.11). The estimated volumes may not include the entire volume of accumulated sediment because sampling only extended approximately 1000 feet above each dam. Sediment distribution maps are included with the summaries for each dam (see Part B of this report).

Table 1.11. Volume of bulk sediments accumulated behind the four dams studied Sediment depths were determined by probing at 31-42 locations within approximately 1,000 feet of the dam. Sediment volume estimates were made with GIS interpolation software (ESRI, Arcview 3.x).

Dam	**Number of probes**	**Sample area (sq ft)**	**Mean depth (ft.)**	**Sediment volume (cu. Yd.)**
Warrenville	31	216,236	3.9	30,686
McDowell	31	165,054	2.9	21,288
Hammel Woods	31	102,472	0.47	1,668
Channahon	42	295,491	0.379	24,920

Grain size analysis was conducted on 13 core and 13 ponar samples from impounded areas upstream of the four dams and 6 core and 16 ponar samples from free flowing areas below the four dams. Medium to fine sand (<0.5mm) made up approximately 65% of core and 58% of ponar samples by weight in the impounded areas and 60% of core and 31% of ponar samples by weight in the free flowing areas below the dams. Impoundment sediments also consisted of coarse to medium sand (16%), gravels (8% in core and 26% in ponar) and silts and clays (7%). Particle size distribution of gravel differed between core and ponar samples in both the impounded areas, 7.5% in core and 26% in ponar, and in free flowing areas, 14.2% in core and 40.3% in ponar. Medium to fine sands also differed between core and ponar samples in the free flowing areas, 60% in core and 31% in ponar. The impounded areas had more clays and silts than free flowing areas (7% vs. 1.5% respectively) and less gravels (7.5% in core and 26% in ponar vs. 14.2% in core and 40.3% in ponar). Silts and clays take longer to drop out of the water column, so more of these fine-grained materials accumulate in the slower moving water within the impounded areas.

Sediment quality analysis consisted of 2,784 individual analyses of 59 contaminants in 19 core and 29 ponar (87 ponar grabs) samples from four impoundments above the dams and four free flowing areas below the dams. 1,360 or 49 percent of the analyses were below the detection limits of the analysis methods. Most of the non-detects occurred in the alkylphenols (endocrine disruptors) and pesticides. Metals analysis had the greatest number of detect and PCB were not detected in any of the samples. Levels for Sediment Kjeldahl Nitrogen were considered low at <870 mg/kg and moderate at <4,790 mg/kg. None of the samples had levels above the moderate range. Levels of sediment phosphorus were considered low at <299 mg/kg and moderate at <2,160 mg/kg, 83% of the impoundment samples and 9% of the free flowing samples were elevated above the moderate range for phosphorus. Tables summarizing the sediment data can be found in Appendix B.

Specific information on structure, safety, and recreational uses are listed by dam in Sections 2 through 5 of the report.

Table 1.12 Mean grain size analysis (percent by weight) and specific gravity (g/cm3) for impounded and free flowing areas above and below the four dams.

	Core grain size (mean percent by weight)					Core
Habitat and Station	**Coarse gravel (4)**	**Coarse to fine gravel (10)**	**Coarse to medium sand (35)**	**Medium to fine sand (200)**	**Silt and Clay (tray)**	**specific gravity (mean g/cm3)**
Impounded						
Warrenville	0.00	5.54	26.75	52.49	15.31	2.49
McDowell	0.00	1.75	12.28	76.27	9.71	2.25
Hammel Woods	0.00	16.39	25.28	55.93	2.40	2.28
Channahon	1.73	5.81	18.72	64.83	8.91	2.23
All Impounded Areas	**0.74**	**6.90**	**18.86**	**65.31**	**8.20**	**2.27**
Free Flowing						
Warrenville	2.31	4.09	23.58	68.35	1.67	2.21
McDowell	8.88	7.24	19.30	62.63	1.94	2.26
Hammel Woods	8.45	7.12	25.28	56.26	2.31	2.31
Channahon	N/A	N/A	N/A	N/A	N/A	N/A
All Free Flowing Areas	**7.57**	**6.65**	**23.00**	**60.40**	**2.08**	**2.28**

	Ponar grain size (mean percent by weight)					Ponar
Habitat and Station	**Coarse gravel (4)**	**Coarse to fine gravel (10)**	**Coarse to medium sand (35)**	**Medium to fine sand (200)**	**Silt and Clay (tray)**	**specific gravity (mean g/cm3)**
Impounded						
Warrenville	4.94	11.26	29.14	49.90	4.75	2.61
McDowell	26.22	6.06	11.27	53.26	3.52	2.33
Hammel Woods	30.73	7.24	11.87	57.09	3.84	2.41
Channahon	0.00	8.19	17.12	65.67	9.02	2.14
All Impounded Areas	**18.82**	**7.46**	**14.43**	**57.93**	**5.29**	**2.32**
Free Flowing						
Warrenville	14.32	8.44	36.97	38.59	0.72	2.30
McDowell	39.74	16.17	20.91	22.33	0.86	2.41
Hammel Woods	20.88	17.31	30.25	30.84	0.72	2.58
Channahon	25.62	9.76	27.28	35.40	1.95	2.45
All Free Flowing Areas	**26.88**	**13.41**	**27.23**	**31.17**	**1.26**	**2.47**

SUMMARY CONCLUSIONS

Over the last fifteen years The Conservation Foundation and others have worked hard to improve and protect the quality of the DuPage River watershed. Many improvements have been seen both in water quality and the increased level of awareness people have for the river and river issues. Many more people view the river as an important part of the ecosystem and an amenity in their community.

Although great strives have been made, there is still much to do to meet the water quality goals of the Clean Water Act of fishable and swimable. Some of the greatest constituents of concern are nutrients, sediment and habitat alteration. Dams can increase the impacts of all three, with the greatest consequences to aquatic habitat.

This study has collected data that indicates that dams on the DuPage River are a significant contributor to the overall degradation of native aquatic species and their habitat. Water quality sampling performed as part of the study indicates that these low-head dams probably do not significantly exacerbate the existing, system-wide water quality problems of the DuPage River. As discussed in Sections 2 through 5 of this report, three of the five dams within the study area do not provide any useful function other than they maintain a flat water pool and create the sound of rushing water, both of which are usually considered attractive to many people visiting the public areas around these dams. Moreover, all of the dams (the ones at Channahon and Hammel Woods in particular) create an elevated safety hazard to the people using the river, be it for fishing, swimming, or boating.

Dam owners and local decision makers should actively consider options to address these safety and ecological concerns so that the safety of the general public and patrons to these facilities is improved and the health of the watershed's natural resources are preserved.

The next four sections of the report are organized into separate assessment reports for each of the four dams included in this study. Information on potential alternatives, their benefits, drawbacks and associated costs has been included to provide decision makers and stakeholders with as much site-specific information as possible to make the most informed decision as to how to manage the dams to ensure a safe and healthy future for residents, visitors and the river.

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Appendix A. Water quality analysis.

Parameter	**Mack Rd**		**Warrenville Dam Pool**		**Warrenville Downstream**	
Collection Time	05:24	16:26	04:47	15:35	04:50	15:32
Temperature (C)	25.52	27.75	27.80	28.92	27.87	27.42
Dissolved Oxygen mg/L	4.21	9.5	5.36	4.89	6.37	6.53
Dissolved Oxygen % Sat.	52.4	123.7	70.0	64.2	82.4	85
Conductivity (uS/cm)	1187	1239	1133	1149	1125	1266
pH	7.60	8.1	7.97	7.7	8.00	7.76
Total Organic Carbon mg/L	6.00	8	7.00	7	7.00	7
Suspended Solids mg/L	24	9	28	15	48	31
Turbidity (NTU)	20	10	39	22	43	24
Ammonia Nitrogen	0.05 U	0.05	0.13 M	0.05	0.11 M	0.06
Total Kjeldahl Nitrogen (mg/L)	0.92	1.22	1.09	1.24	1.28	1.43
Nitrate-Nitrite (mg/L)	7.42	7.17	8.45	9	8.59	8.75
Total Nitrogen (mg/L)	8.34	8.39	9.54	10.24	9.87	10.18
Total Dissolved Phosphorus (mg/L)	1.35	1.34	1.39	1.54	1.42	1.51
Total Phosphorus (mg/L)	1.41	1.4	1.54	1.64	1.54	1.63
Collection Time	05:24	16:26	04:47	15:35	04:50	15:32
Chlorophyll-a corrected (ug/L)	4.34	5.44	4.53	6.14	5.01	5.65
Chlorophyll-b (ug/L)	1	1	1	1	1	1
Chlorophyll-c (ug/L)	1	1	1	1	1	1
Pheophytin-a (ug/L)	3.39	1.51	3.84	1.47	5.78	1.78
Chlorophyll Volume Filtered (mL)	640	720	360	570	400	470

Parameter	Diehl Road		McDowell Dam Pool		McDowell Downstream	
Time	05:58	16:09	05:33	15:52	05:32	15:33
Temperature (C)	26.08	28.14	26.35	30.01	26.36	29.31
Dissolved Oxygen mg/L	5.52	7.12	4.81	8.88	6.06	7.75
Dissolved Oxygen % Sat.	69.2	93.0	61.1	120.4	76.7	104.4
Conductivity (uS/cm)	1100	1119	1207	1210	1129	1130
pH	7.60	7.66	7.65	8.08	7.67	8.00
Total Organic Carbon mg/L	7.00	7.00	7.00	7.00	8.00	7.00
Suspended Solids mg/L	67	27	42	19	51	17
Turbidity (NTU)	41	19	33	14	36	20
Ammonia Nitrogen	0.09	0.08	0.08	0.05	0.07	0.06
Total Kjeldahl Nitrogen (mg/L)	1.46	0.99	1.23	1.03	1.07	1.02
Nitrate-Nitrite (mg/L)	7.24	7.46	7.54	6.48	7.81	5.95
Total Nitrogen (mg/L)	8.70	8.45	8.77	7.51	8.88	6.97
Total Dissolved Phosphorus (mg/L)	1.34	1.28	1.32	1.17	1.35	1.15
Total Phosphorus (mg/L)	1.52	1.38	1.47	1.23	1.48	1.24
Chlorophyll-a corrected (ug/L)	5.36	2.89	3.09	2.58	3.55	3.35
Chlorophyll-b (ug/L)	1	1	1	1	1	1
Chlorophyll-c (ug/L)	1	1	1	1	1	1
Pheophytin-a (ug/L)	7.27	1.96	5.27	1	7.34	1.12
Chlorophyll Volume Filtered (mL)	600	700	520	835	460	750

Parameter	119th Street		Hammel Dam Pool		Hammel Downstream	
Time	06:25	16:29	05:26	15:28	05:27	15:18
Temperature (C)	23.71	28.28	25.60	30.10	25.61	30.00
Dissolved Oxygen mg/L	3.80	11.20	5.45	10.14	6.30	11.32
Dissolved Oxygen % Sat.	45.9	145.1	68.5	137.9	81.1	154.4
Conductivity (uS/cm)	1116	1094	1035	1019	1029	1009
pH	7.42	8.28	7.84	8.48	7.82	8.50
Total Organic Carbon mg/L	6.00	7.00	7.00	7.00	7.00	7.00
Suspended Solids mg/L	20	12	48	15	37	16
Turbidity (NTU)	14	10	29	12	25	13
Ammonia Nitrogen	0.08	0.05	0.05	0.05	0.05	0.05
Total Kjeldahl Nitrogen (mg/L)	0.97	1.80	1.16	1.04	1.08	1.32
Nitrate-Nitrite (mg/L)	7.46	7.44	6.76	5.69	6.68	5.75
Total Nitrogen (mg/L)	8.43	9.24	7.92	6.73	7.76	7.07
Total Dissolved Phosphorus (mg/L)	1.36	1.30	1.13	0.93	1.10	0.92
Total Phosphorus (mg/L)	1.43	1.37	1.26	1.01	1.24	0.97
Chlorophyll-a corrected (ug/L)	2.16	1.48	2.09	1.84	2.09	2.38
Chlorophyll-b (ug/L)	1	1	1	1	1	1
Chlorophyll-c (ug/L)	1	1	1	1	1	1
Pheophytin-a (ug/L)	2.06	1.03	1.45	1	2.64	2.9
Chlorophyll Volume Filtered (mL)	980	950	800	900	600	800

Parameter	Shepley Road		Channahon Dam Pool		Channahon Downstream	
Time	05:51	17:02	05:17	15:43	05:17	15:23
Temperature (C)	26.10	30.74	28.50	29.89	28.37	28.27
Dissolved Oxygen mg/L	5.52	12.69	7.80	6.21	7.42	8.93
Dissolved Oxygen % Sat.	69.2	168.9	102.4	83.7	97.6	109.7
Conductivity (uS/cm)	UA	1084	1007	1054	UA	UA
pH	7.88	8.82	8.54	8.10	8.51	8.11
Total Organic Carbon mg/L	6.00	7.00	7.00	8.00	7.00	7.00
Suspended Solids mg/L	17	7	18	13	18	12
Turbidity (NTU)	9	5	16	9	14	10
Ammonia Nitrogen	0.05	0.05	0.05	0.05	0.05	0.05
Total Kjeldahl Nitrogen (mg/L)	1.12	1.10	1.27	1.11	1.22	0.70
Nitrate-Nitrite (mg/L)	5.63	5.84	5.64	5.39	5.54	5.36
Total Nitrogen (mg/L)	6.75	6.94	6.91	6.50	6.76	6.06
Total Dissolved Phosphorus (mg/L)	1.03	0.92	0.91	0.96	0.94	0.98
Total Phosphorus (mg/L)	1.15	0.97	1.04	1.03	1.02	1.06
Chlorophyll-a corrected (ug/L)	2.58	1.97	1.86	3.25	1.92	3.11
Chlorophyll-b (ug/L)	1	1	1	1	1	1
Chlorophyll-c (ug/L)	1	1	1	1	1	1
Pheophytin-a (ug/L)	1.41	1	1.07	1	1.43	1
Chlorophyll Volume Filtered (mL)	980	900	800	900	900	700

Appendix B. Sediment quality characteristics of core and ponar samples.

Warrenvile Dam

		Above Dam						Below Dam					
Parameter	**Unit**	**Core 1**	**Core 2**	**Core 3**	**Ponar 1**	**Ponar 2**	**Ponar 3**	**Core 1**	**Core 2**	**Core 3**	**Ponar 1**	**Ponar 2**	**Ponar 3**
Ammonia Nitorgen	mg N/Kg	491	216	282	124	290	199	184	49	42	8	13	14
Total Kjeldahl Nitrogen	mg N/Kg	3680	3130	3490	1470	2990	2840	1330	614	463	165	255	326
Total Phosphours	mg N/Kg	5210	3450	4500	3190	3630	4570	2460	2150	2020	1670	1530	1730
Total Solids	% Solids	43.2	41.9	39.4	56.8	37.8	41.7	50.4	67.5	71.7	79.1	75.8	69.3
Total Volatile Solids	% Solids	10.5	10.5	9.74	5.92	10.1	10.9	12.7	5.85	2.45	2.81	2.68	4.2
Total Organic Carbon	% C	4.5	3.9	3.5	2.5	5.2	4.5	4.9	1.7	1.3	1.1	0.6	1.1
Pesticides													
Aldrin	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
alpha-BHC	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
beta-BHC	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
delta-BHC	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
alpha-Chlordane	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
gamma-Chlordane	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
p,p'-DDD	ug/G	0.05	0.036	0.077	0.013	0.036	0.029	0.042	0.024	0.006	0.01	0.008	0.005
p,p'-DDE	ug/G	0.03	0.017	0.02	ND	0.013	0.011	0.014	0.01	ND	0.004	0.003	ND
p,p'-DDT	ug/G	ND	0.215	0.105	0.148	ND	0.145	0.031	0.019	ND	ND	0.039	ND
Dieldrin	ug/G	ND	ND	ND	ND	ND	ND	ND	0.019	ND	ND	0.017	ND
Endrin	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endrin Aldehyde	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endrin ketone	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endosulfan I	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endosulfan II	ug/G	ND	0.295	0.39	ND	ND	0.76	0.529	0.279	0.051	ND	ND	ND
Endosulfan Sulfate	ug/G	ND	0.413	0.71	ND	ND	0.752	ND	ND	ND	ND	ND	ND
Heptachlor	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hept Epoxide	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Lindane	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methoxychlor	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCB	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Warrenvile Dam (continued)

Parameter	Unit	Above Dam						Below Dam					
		Core 1	Core 2	Core 3	Ponar 1	Ponar 2	Ponar 3	Core 1	Core 2	Core 3	Ponar 1	Ponar 2	Ponar 3
Metals													
Aluminum	mg/Kg	11000	11000	14000	7200	11000	10000	3900	3100	2700	1700	2900	2800
Barium	mg/Kg	170	160	160	120	140	140	95	100	63	46	55	60
Beryllium	mg/Kg	0.69	0.64	0.76	0.49	0.59	0.61	0.34	0.29	0.21	0.22	0.23	0.28
Boron	mg/Kg	7.7	9.2	8.5	10	9.4	9.8	8.8	ND	ND	ND	ND	ND
Cadmium	mg/Kg	0.7	0.79	ND	ND	ND	ND	0.26	ND	ND	ND	ND	ND
Calcium	mg/Kg	43000	42000	41000	68000E	40000	41000	64000	73000	55000	88000	73000	75000
Chromium	mg/Kg	30	23	22	13	20	20	9.6	8	5.8	2.6	5.7	5.7
Cobalt	mg/Kg	9.9	8.4	9.3	7.2	7.4	8.1	6.6	6.5	6.5	5.3	6.9	5
Copper	mg/Kg	88	71	86	29	49	47	25	18	9.5	1.5	3.3	6.3
Cyanide	mg/Kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Iron	mg/Kg	30000	27000	30000	20000	25000	26000	15000	12000	9800	9000	9600	9700
Lithium	mg/Kg	15	16	18	13	16	15	8.4	7.1	5.8	8.3	6.4B	7.6B
Lead	mg/Kg	47	40	36	23	32	29	23	19	13	13	11	10
Magnesium	mg/Kg	21000	18000	18000	35000	20000	19000	31000	32000	28000	50000	39000	38000
Manganese	mg/Kg	680	510	550	580	490	580	450	560	380	320	330	370
Mercury	mg/Kg	0.4	0.2	0.5	0.2	0.3	0.2	0.1	0.1	0.1	0.05	0.05	0.04
Molybdenum	mg/Kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nickel	mg/Kg	22	19	25	12	17	17	12	8	ND	ND	9.1	ND
Potassium	mg/Kg	1400	1500	1800	1200	1600	1400	690	510	470	510	560	600
Sodium	mg/Kg	360	350	430	350	300	350	280	260	170	220	180	210
Silver	mg/Kg	2.5	1.6	2.6	1	1.4	1.4	ND	ND	ND	ND	ND	ND
Tin	mg/Kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Titanium	mg/Kg	52	53	67	71	65	58	58	45	57	40	130	63
Vanadium	mg/Kg	17	17	20	10	17	15	7.7	4.7	4.8	2.8	8.4	4.8
Zinc	mg/Kg	240	200	170	120	170	170	96	71	43	22	30	41
Oil & Grease	mg/Kg	1547	1442	1324	856	1744	1491	847	700	ND	ND	672	817
Alkylphenols													
Bisphenol A	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total NP	ug/G	1066	1739	432	ND	ND	886	1398	1080	410	ND	ND	ND
Total NP1EO	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total NP2EO	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Octylphenol	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

McDowell Grove Dam

Parameter	Unit	Above Dam Core 1	Above Dam Core 2	Above Dam Core 3	Above Dam Ponar 1	Above Dam Ponar 2	Above Dam Ponar 3	Below Dam Core 1	Below Dam Ponar 1	Below Dam Ponar 2	Below Dam Ponar 3
Ammonia Nitorgen	mg N/Kg	434	364	468	86	97	295	105	12	13	15
Total Kjeldahl Nitrogen	mg N/Kg	2530	2380	2060	1460	1230	2830	1640	462	807	191
Total Phosphours	mg N/Kg	3430	4960	4380	4020	998	3500	3650	1530	2030	375
Total Solids	% Solids	50.4	43.9	49.7	54.2	63.2	40.2	51.7	78.2	68	84.6
Total Volatile Solids	% Solids	8.81	10.2	9.02	7.7	5.26	9.78	10.7	4.07	4.75	1.81
Total Organic Carbon	% C	3.5	0.7	4.5	4.4	3.5	3.8	5.3	0.9	1.9	0.9
Pesticides											
Aldrin	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
alpha-BHC	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
beta-BHC	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
delta-BHC	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
alpha-Chlordane	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
gamma-Chlordane	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
p,p'-DDD	ug/G	0.034	0.099	0.073	0.02	0.007	0.069	0.031	0.007	0.026	ND
p,p'-DDE	ug/G	0.019	0.04	0.04	0.008	ND	0.019	0.013	ND	0.008	ND
p,p'-DDT	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dieldrin	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endrin	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endrin Aldehyde	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endrin ketone	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endosulfan I	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endosulfan II	ug/G	ND	0.007	ND	ND	ND	ND	ND	ND	ND	ND
Endosulfan Sulfate	ug/G	ND	ND	0.053	0.011	ND	ND	ND	ND	ND	ND
Heptachlor	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hept Epoxide	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Lindane	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methoxychlor	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCB	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

McDowell Grove Dam (continued)

Parameter	Unit	Above Dam						Below Dam			
		Core 1	Core 2	Core 3	Ponar 1	Ponar 2	Ponar 3	Core 1	Ponar 1	Ponar 2	Ponar 3
Metals											
Aluminum	mg/Kg	11000	4200	8400	5600	5800	11000	5300	4400	3300	1500
Barium	mg/Kg	130	63	140	110	63	130	130	62	99	43
Beryllium	mg/Kg	0.63	0.33	0.65	0.42	0.46	0.65	0.51	0.4	0.36	0.3
Boron	mg/Kg	9	ND	16	7.1	8.8	ND	8.7	ND	ND	ND
Cadmium	mg/Kg	0.74	ND	ND	ND	ND	ND	ND	ND	ND	ND
Calcium	mg/Kg	42000	77000	69000	70000	130000	50000	68000	81000	79000	120000
Chromium	mg/Kg	21	6.8	22	12	7.5	17	11	5.8	7.6	2.6
Cobalt	mg/Kg	8.6	5.2	8	6.6	5.4	9	6.3	4.4	4.4	ND
Copper	mg/Kg	56	7	79	26	10	64	32	6.6	18	ND
Cyanide	mg/Kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Iron	mg/Kg	25000	13000	25000	21000	12000	26000	20000	13000	12000	7800
Lead	mg/Kg	36	18	42	25	17	28	21	10	12	11
Lithium	mg/Kg	15	9.5	19	9	16	18	11	13	9	
Magnesium	mg/Kg	20000	35000	35000	34000	74000	24000	31000	40000	37000	65000
Manganese	mg/Kg	610	430	700	750	470	620	570	420	500	390
Molybdenum	mg/Kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mercury	mg/Kg	0.2	0.4	0.3	0.2	0.2	0.2	0.2	0.1	0.1	0.02
Nickel	mg/Kg	18	8.6	18	12	9	22	13	9.8	8.6	ND
Potassium	mg/Kg	1500	910	1300	870	1300	1600	810	900	610	420
Sodium	mg/Kg	340	280	410	280	420	370	280	300	310	240
Silver	mg/Kg	1.6	ND	1.5	0.69	ND	1.4	0.7	ND	ND	ND
Tin	mg/Kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Titanium	mg/Kg	69	2	61	58	48	55	43	69	51	65
Vanadium	mg/Kg	19	8.5	14	11	7.6	18	9.6	9.2	7.1	6
Zinc	mg/Kg	150	36	200	120	42	140	110	43	65	
Oil & Grease	mg/Kg	930	1700	3047	976	725	1025	1082	ND	858	ND
Alkylphenols											
Bisphenol A	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total NP	ug/G	795	2485	930	547	169	494	212	ND	197	ND
Total NP1EO	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total NP2EO	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Octylphenol	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Hammel Wood Dam

Parameter	Unit	Above Dam						Hammel Woods Dam - Downstream					
		Core 1	Core 2	Ponar 1	Ponar 2	Ponar 3	Ponar 4	Core 1	Core 2	Ponar 1	Ponar 2	Ponar 3	Ponar 4
Ammonia Nitorgen	mg N/Kg	262	517	46	112	151	86	144	41	10	8	8	13
Total Kjeldahl Nitrogen	mg N/Kg	2560	3240	927	1150	3210	1620	1610	1160	460	74	394	574
Total Phosphours	mg N/Kg	1660	2380	888	1510	3690	4670	872	990	459	162	460	583
Total Solids	% Solids	54.2	51.1	64	61.1	43.4	49	52.2	58.3	76.7	84.3	83.2	77.1
Total Volatile Solids	% Solids	6.79	7.74	4.45	5.22	10.1	8.53	10.5	10.4	2.75	1.6	2.12	2.41
Total Organic Carbon	% C	7.4	3.3	6	3.4	0.2	8.1	3.5	0.6	1.2	0.7	0.5	1
Pesticides													
Aldrin	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
alpha-BHC	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
beta-BHC	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
delta-BHC	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
alpha-Chlordane	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
gamma-Chlordane	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
p,p'-DDD	ug/G	0.038	0.012	ND	ND	0.013	0.011	0.007	ND	ND	ND	ND	ND
p,p'-DDE	ug/G	0.012	0.009	ND	ND	0.008	0.006	ND	ND	ND	ND	ND	ND
p,p'-DDT	ug/G	ND	ND	ND	ND	ND	0.05	ND	ND	ND	ND	ND	ND
Dieldrin	ug/G	ND	ND	ND	ND	ND	ND	0.005	0.009	0.005	ND	ND	ND
Endrin	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endrin Aldehyde	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endrin ketone	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endosulfan I	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endosulfan II	ug/G	ND	ND	ND	ND	ND	ND	0.006	ND	ND	ND	ND	ND
Endosulfan Sulfate	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Heptachlor	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hept Epoxide	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Lindane	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methoxychlor	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCB	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Hammel Wood Dam (continued)

Parameter	Unit	Above Dam						Hammel Woods Dam - Downstream					
		Core 1	Core 2	Ponar 1	Ponar 2	Ponar 3	Ponar 4	Core 1	Core 2	Ponar 1	Ponar 2	Ponar 3	Ponar 4
Metals													
Aluminum	mg/Kg	8900	10000	5000	5200	8000	7900	6700	5500	4200	1300	3300	3600
Barium	mg/Kg	100	120	66	79	95	100	81	88	66	46	78	70
Beryllium	mg/Kg	0.6	0.66	0.45	0.5	0.59	0.56	0.56	0.46	0.44	0.26	0.4	0.39
Boron	mg/Kg	ND	ND	7	9.6	9.1	8.5	7.9	7.4	ND	ND	ND	ND
Cadmium	mg/Kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Calcium	mg/Kg	82000	84000	94000	160000	82000	89000	59000	90000	60000	99000	100000	110000
Chromium	mg/Kg	12	16	7.9	7	12	12	9	7.5	6	1.8	4.4	4.6
Cobalt	mg/Kg	6.7	7.4	ND	4	6.7	7.1	9.7	5.7	9.5	ND	6.2	5.1
Copper	mg/Kg	20	32	14	8.9	30	30	13	12	4.7	ND	2.4	1.9
Cyanide	mg/Kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Iron	mg/Kg	18000	22000	12000	11000	21000	24000	17000	14000	14000	6500	11000	11000
Lead	mg/Kg	31	43	21	18	38	33		16	23	10	17	11
Lithium	mg/Kg	16	16	14	17	14	14	12	14	7.9	11	9.4	9.9
Magnesium	mg/Kg	18000	18000	39000	44000	23000	22000	21000	20000	27000	52000	35000	28000
Manganese	mg/Kg	430	620	470	530	750	1000	540	490	630	500	630	560
Mercury	mg/Kg	0.2	0.2	0.1	0.1	0.2	0.2	0.1	0.1	0.04	0.02	0.04	0.03
Molybdenum	mg/Kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Silver	mg/Kg	ND	0.92B	ND	ND	0.82	ND	ND	ND	ND	ND	ND	ND
Sodium	mg/Kg	320	320	290	360	300	300	230	260	190	190	330	260
Nickel	mg/Kg	16	20	11	8.2	17	17	16	12	11	ND	ND	8.3
Potassium	mg/Kg	1300	1400	960	930	1300	1300	1000	990	720	410	610	690
Tin	mg/Kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Titanium	mg/Kg	37	40	34	39	49	51	62	38	55	24	50	46
Vanadium	mg/Kg	14	15	8.1	8.5	12	11	18	9.6	14	1.3	8.6	6.7
Zinc	mg/Kg	88	120	63	48	130	130	65	63	35	17	26	30
Oil & Grease	mg/Kg	916	849	728	720	1239	1180	625	787	ND	ND	617	869
Alkylphenols													
Bisphenol A	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total NP	ug/G	643	1105	202	944	764	879	428	360	ND	ND	ND	ND
Total NP1EO	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total NP2EO	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Octylphenol	ug/G	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Channahon Dam

Parameter	Unit	Above Dam							
		Core 1	Core 2	Core 3	Core 4	Core 5	Ponar 1	Ponar 2	Ponar 3
Ammonia Nitorgen	mg N/Kg	42	143	100	126	142	127	157	176
Total Kjeldahl Nitrogen	mg N/Kg	3220	2560	2460	2930	2750	3130	3260	3170
Total Phosphours	mg N/Kg	2380	1780	3840	3240	1510	3230	2400	2780
Total Solids	% Solids	44.6	48.2	49	45.6	48	39.6	33.9	35.6
Total Volatile Solids	% Solids	9.95	8.78	10.3	10.4	10.1	10.4	11.1	10.9
Total Organic Carbon	% C	8.7	3.3	3.8	3.8	3.8	6.4	3.9	4.1
Pesticides									
Aldrin	ug/G	ND	ND	ND	ND	ND	ND	ND	ND
alpha-BHC	ug/G	ND	ND	ND	ND	ND	ND	ND	ND
beta-BHC	ug/G	ND	ND	ND	ND	ND	ND	ND	ND
delta-BHC	ug/G	ND	ND	ND	ND	ND	ND	ND	ND
alpha-Chlordane	ug/G	ND	ND	ND	ND	ND	ND	ND	ND
gamma-Chlordane	ug/G	ND	ND	ND	ND	ND	ND	ND	ND
p,p'-DDD	ug/G	0.008	0.006	0.006	0.006	0.006	0.011	0.008	0.006
p,p'-DDE	ug/G	0.006	ND	0.004	0.005	0.005	0.007	0.008	0.005
p,p'-DDT	ug/G	0.029	0.023	0.019	0.050	0.028	0.022	0.027	0.035
Dieldrin	ug/G	ND	ND	ND	ND	ND	ND	ND	ND
Endrin	ug/G	ND	ND	ND	ND	ND	ND	ND	ND
Endrin Aldehyde	ug/G	ND	ND	ND	ND	ND	ND	ND	ND
Endrin ketone	ug/G	ND	ND	ND	ND	ND	ND	ND	ND
Endosulfan I	ug/G	ND	ND	ND	ND	ND	ND	ND	ND
Endosulfan II	ug/G	0.559	0.516	0.439	0.510	0.232	0.259	0.255	0.138
Endosulfan Sulfate	ug/G	ND	ND	ND	ND	ND	ND	ND	ND
Heptachlor	ug/G	ND	ND	ND	ND	ND	ND	ND	ND
Hept Epoxide	ug/G	ND	ND	ND	ND	ND	ND	ND	ND
Lindane	ug/G	ND	ND	ND	ND	ND	ND	ND	ND
Methoxychlor	ug/G	ND	ND	ND	ND	ND	ND	ND	ND
PCB (ug/G)	ug/G	ND	ND	ND	ND	ND	ND	ND	ND

Channahon Dam (continued)

Parameter	Unit	Above Dam							
		Core 1	Core 2	Core 3	Core 4	Core 5	Ponar 1	Ponar 2	Ponar 3
Metals									
Aluminum	mg/Kg	11000	11000	12000	11000	13000	11000	13000	10000
Barium	mg/Kg	120	110	110	110	110	120	120	110
Beryllium	mg/Kg	0.69	0.62	0.68	0.66	0.7	0.64	0.7	0.6
Boron	mg/Kg	10	8.8	11	ND	9	12	10	7.7
Cadmium	mg/Kg	2.7	ND	1.5	ND	ND	ND	0.76	1
Calcium	mg/Kg	56000	97000	53000	42000	52000	77000	55000	57000
Chromium	mg/Kg	34	13	23	15	17	18	19	19
Cobalt	mg/Kg	9.2	7.5	8.7	8.5	7.7	8.1	7.7	7.3
Copper	mg/Kg	48	22	32	25	26	39	40	37
Cyanide	mg/Kg	ND	ND	ND	ND	ND	ND	ND	ND
Iron	mg/Kg	27000	19000	24000	25000	23000	24000	26000	22000
Lithium	mg/Kg	18	16	16	16	19	17	20	16
Lead	mg/Kg	110	31	63	34	26	40	34	51
Magnesium	mg/Kg	15000	16000	13000	12000	13000	20000	17000	15000
Manganese	mg/Kg	410	520	440	590	340	660	580	500
Mercury	mg/Kg	0.7	0.2	0.4	0.2	0.3	0.1	0.2	0.4
Molybdenum	mg/Kg	0.33	ND	ND	ND	ND	ND	ND	ND
Nickel	mg/Kg	26	17	23	19	19	20	20	18
Potassium	mg/Kg	1600	1500	1600	1400	1800	1600	2000	1500
Silver	mg/Kg	1.2	0.68	1	0.87	0.86	1.3	1	1.2
Sodium	mg/Kg	330	300	270	260	240	290	270	270
Tin	mg/Kg	ND	ND	ND	ND	ND	ND	ND	ND
Titanium	mg/Kg	70	75	70	31	66	69	69	35
Vanadium	mg/Kg	19	17	19	19	21	17	20	15
Zinc	mg/Kg	250	93	170	110	110	150	150	150
Oil & Grease	mg/Kg	767	901	800	1038	1780	1218	676	912
Alkylphenols									
Bisphenol A	ug/G	ND	ND	ND	ND	ND	ND	ND	ND
Total NP	ug/G	ND	ND	ND	ND	ND	332	470	521
Total NP1EO	ug/G	ND	ND	ND	ND	ND	ND	ND	ND
Total NP2EO	ug/G	ND	ND	ND	ND	ND	ND	ND	ND
Octylphenol	ug/G	ND	ND	ND	ND	ND	ND	ND	ND

Channahon Dam (continued)

		Below Dam					
Parameter	**Unit**	**Ponar 1**	**Ponar 2**	**Ponar 3**	**Ponar 4**	**Ponar 5**	**Ponar 6**
Ammonia Nitorgen	mg N/Kg	19	26	13	15	7	9
Total Kjeldahl Nitrogen	mg N/Kg	1520	2280	219	663	29	690
Total Phosphours	mg N/Kg	814	653	718	501	358	748
Total Solids	% Solids	49.2	55.5	69.1	77.7	90.3	71.2
Total Volatile Solids	% Solids	8.28	7.23	5.39	3.13	1.34	3.83
Total Organic Carbon	% C	4.2	3.6	1.4	4.1	1.8	2
Pesticides							
Aldrin	ug/G	ND	ND	ND	ND	ND	ND
alpha-BHC	ug/G	ND	ND	ND	ND	ND	ND
beta-BHC	ug/G	ND	ND	ND	ND	ND	ND
delta-BHC	ug/G	ND	ND	ND	ND	ND	ND
alpha-Chlordane	ug/G	ND	ND	ND	ND	ND	ND
gamma-Chlordane	ug/G	ND	ND	ND	ND	ND	ND
p,p'-DDD	ug/G	0.007	ND	0.009	ND	ND	0.011
p,p'-DDE	ug/G	0.005		0.005	ND	ND	ND
p,p'-DDT	ug/G	ND	ND	ND	ND	ND	ND
Dieldrin	ug/G	ND	ND	ND	ND	ND	ND
Endrin	ug/G	ND	ND	ND	ND	ND	ND
Endrin Aldehyde	ug/G	ND	ND	ND	ND	ND	ND
Endrin ketone	ug/G	ND	ND	ND	ND	ND	ND
Endosulfan I	ug/G	ND	ND	ND	ND	ND	ND
Endosulfan II	ug/G	ND	ND	ND	ND	ND	ND
Endosulfan Sulfate	ug/G	ND	ND	ND	ND	ND	ND
Heptachlor	ug/G	ND	ND	ND	ND	ND	ND
Hept Epoxide	ug/G	ND	ND	ND	ND	ND	ND
Lindane	ug/G	ND	ND	ND	ND	ND	ND
Methoxychlor	ug/G	ND	ND	ND	ND	ND	ND
PCB (ug/G)	ug/G	ND	ND	ND	ND	ND	ND

Channahon Dam (continued)

Parameter	Unit	Below Dam					
		Ponar 1	Ponar 2	Ponar 3	Ponar 4	Ponar 5	Ponar 6
Metals							
Aluminum	mg/Kg	9000	7100	2300	2300	5500	5500
Barium	mg/Kg	78	92	74	74	53	65
Beryllium	mg/Kg	0.65	0.53	0.26	0.26	0.44	0.5
Boron	mg/Kg	9.2	7.6	ND	ND	ND	ND
Cadmium	mg/Kg	ND	ND	ND	ND	ND	ND
Calcium	mg/Kg	75000	130000	80000	80000	77000	94000
Chromium	mg/Kg	17	7.9	3.1	3.1	8.5	10
Cobalt	mg/Kg	5.6	4.6	4.7	4.7	5.2	5.2
Copper	mg/Kg	34	6.5	2.3	2.3	5.8	14
Cyanide	mg/Kg	ND	ND	ND	ND	ND	ND
Iron	mg/Kg	14000	13000	14000	14000	14000	14000
Lithium	mg/Kg	15	13	6.6	6.6	14	11
Lead	mg/Kg	49	34	18	18	19	35
Magnesium	mg/Kg	21000	20000	27000	27000	29000	31000
Manganese	mg/Kg	200	440	1600	1600	420	390
Mercury	mg/Kg	0.2	0.05	0.05	0.1	0.02	0.1
Molybdenum	mg/Kg	ND	ND	ND	ND	ND	ND
Nickel	mg/Kg	18	10	9.1	8.1	13	14
Potassium	mg/Kg	1300	1100	460	460	980	910
Silver	mg/Kg	0.66	ND	ND	ND	ND	ND
Sodium	mg/Kg	310	320	200	200	210	300
Tin	mg/Kg	ND	ND	ND	ND	ND	ND
Titanium	mg/Kg	49	39	65	65	43	41
Vanadium	mg/Kg	15	9.8	4.7	4.7	13	11
Zinc	mg/Kg	110	36	36	36	36	62
Oil & Grease	mg/Kg	1297	1057	806	883	582	795
Alkylphenols							
Bisphenol A	ug/G	ND	ND	ND	ND	ND	ND
Total NP	ug/G	ND	ND	ND	ND	ND	ND
Total NP1EO	ug/G	ND	ND	ND	ND	ND	ND
Total NP2EO	ug/G	ND	ND	ND	ND	ND	ND
Octylphenol	ug/G	ND	ND	ND	ND	ND	ND

EXHIBIT C

Philip W. Smith

THE FISHES OF ILLINOIS

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Distribution of the lake chub in Illinois.

Although recorded from Illinois by Jordan (1878), the record was generally overlooked by subsequent authors until the 1960's, when additional collections of the species were made at two sites in the shallow waters of Lake Michigan near Zion and Deerfield in Lake County.

Nocomis Girard

This distinctive eastern North American genus was for a time included as a subgenus in the catchall *Hybopsis*. Intensive study of the group by Ernest A. Lachner & Robert M. Jenkins (1971) in the last few years has more than doubled the number of described species, most of which have quite restricted distributions. Two species, which have been recognized for many years, occur in Illinois.

KEY TO SPECIES

1. Caudal spot large, rounded, and prominent; tail of juvenile usually red-orange; distance from front margin of eye to tip of snout 1.3 or more times the distance from front of eye to posterior margin of opercle; teeth 1, 4—4, 1; breeding male with nuptial tubercles confined to top of head; a prominent red spot behind eye .... *biguttatus*

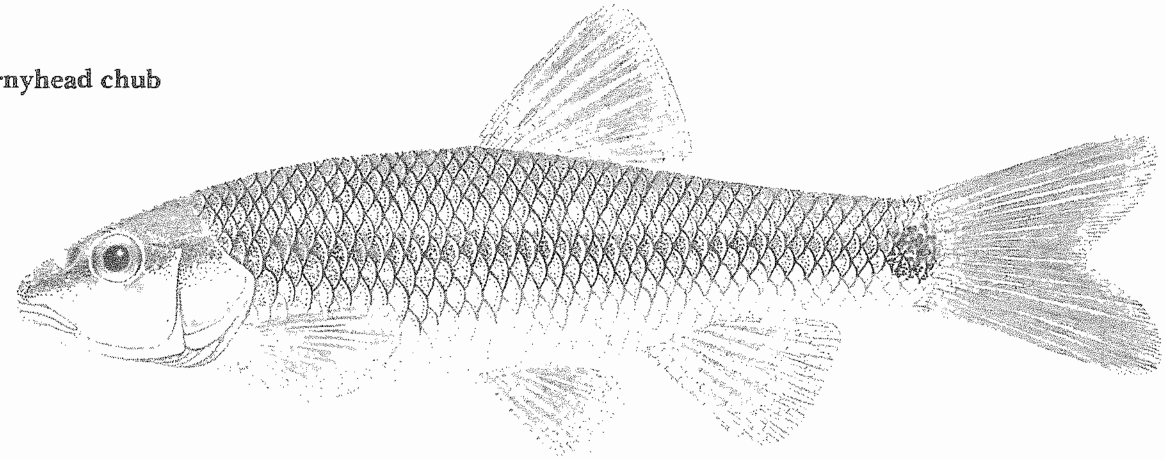
   Caudal spot, if present, small, irregular, and pale; tail of juvenile usually slate-gray; distance from front margin of eye to tip of snout less than 1.3 times the distance from front of eye to posterior margin of opercle; teeth 4—4; breeding male with nuptial tubercles extending onto snout; no red spot behind eye .... *micropogon*

Hornyhead chub
Nocomis biguttatus (Kirtland)

Semotilus biguttatus Kirtland 1841*b*:344 (type-locality: Yellow Creek, a tributary of Mahoning River, Ohio); Forbes 1884:75.
Ceratichthys biguttatus: Nelson 1876:45 (recorded from Illinois); Jordan 1878:62.
Hybopsis kentuckiensis: Large 1903:19; Forbes & Richardson 1908:167–170.
Nocomis biguttatus: O'Donnell 1935:481.
Hybopsis biguttata: Smith 1965:7.

Diagnosis.—The hornyhead chub is a terete stout-bodied minnow with a large head, a moderately large mouth, terminal barbels, 40–43 scales in the lateral line, the dorsal fin origin slightly behind the pelvic insertions, a yellowish or bronzy ground color, and usually an evident caudal spot. It is much like the river chub, but the two can be distinguished by the characters in the key. It somewhat resembles the creek chub, but it has terminal barbels, a smaller mouth, and larger scales. It differs from the lake chub in being more robust and having much larger scales. The young has a discrete, dusky lateral band, a prominent black caudal spot, and a red caudal fin. Small specimens that have lost the red color in preservative slightly resemble young stonerollers but can be distinguished from that species by the fleshy lower lip, shorter gut, and lack of irregular pigment patches on the

Hornyhead chub

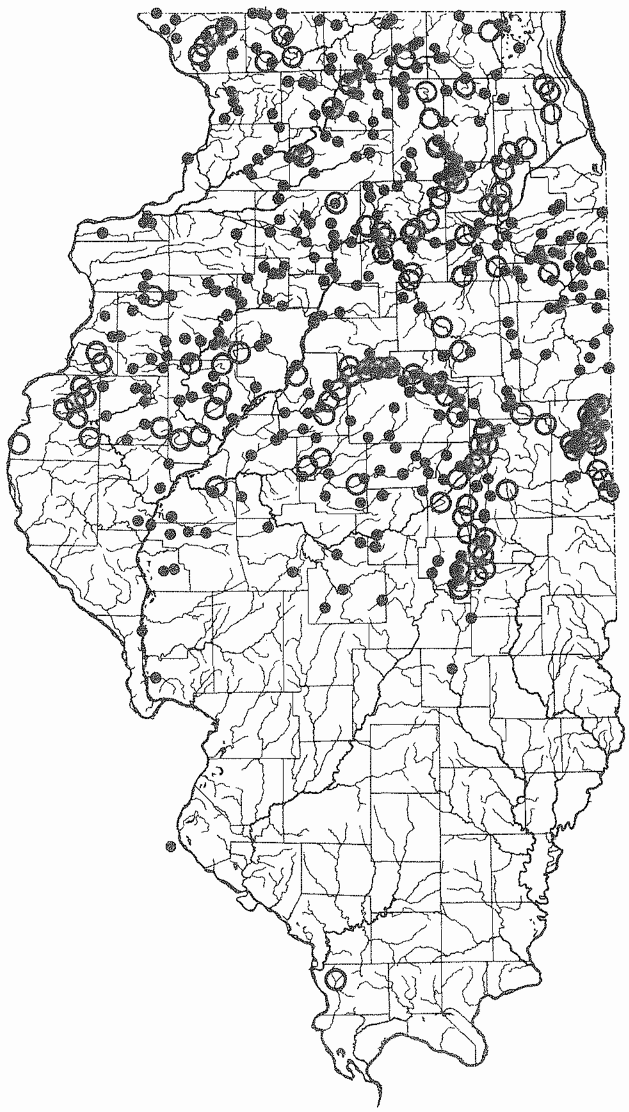


sides. The species attains a length of 200–230 mm (8 or 9 inches).

Variation.—The most thorough account of geographic variation is that of Lachner & Jenkins (1971). Their paper cites other published studies by themselves and others.

Ecology.—The hornyhead chub lives in clear, high-gradient creeks and small rivers with gravel or rubble bottoms. It avoids sluggish waters, silt bottoms, and large rivers. The young ascend vernal rivulets in early summer but return to the creek channel as water levels recede. The food, according to Forbes & Richardson (1908:169), includes both plant and animal materials and prey items as large as crayfishes. Reproduction in the species has been well described by Hankinson (1920, 1932) and Lachner (1952). The breeding male develops large white tubercles on top of its head, a swollen nape, and an ephemeral dusky lateral stripe, and the red spot behind the eye becomes bright crimson in contrast to the greenish cast of the rest of the head. In April and May the male constructs a large mound by picking up individual pebbles with its mouth and forming a dome-shaped nest of loose gravel, which the male guards. The female deposits several hundred eggs over the dome, as do females of several other species of minnows, thus providing an opportunity for hybridization between different species and even different genera. The young may attain a length of 75 mm (3 inches) at the end of the 1st year. Sexual maturity is reached at 2 or 3 years of age. Few individuals live longer than 3 years.

Distribution.—The hornyhead chub is a common species in clear, moderately fast, gravelly streams throughout the northern half of Illinois. It



Distribution of the hornyhead chub in Illinois.

was reported from some glacial lakes in northeastern Illinois by Forbes & Richardson (1908:169) but now appears to be limited to streams and absent from the Great Lakes drainage of Illinois. It also once occurred in streams of Union County (Forbes & Richardson 1908 atlas of maps), but efforts to rediscover the species anywhere in the southern half of the state have been unsuccessful even though it is common in Ozark streams of Missouri. The species is still widely distributed and common, but it is less common than formerly because so many streams have deteriorated in quality.

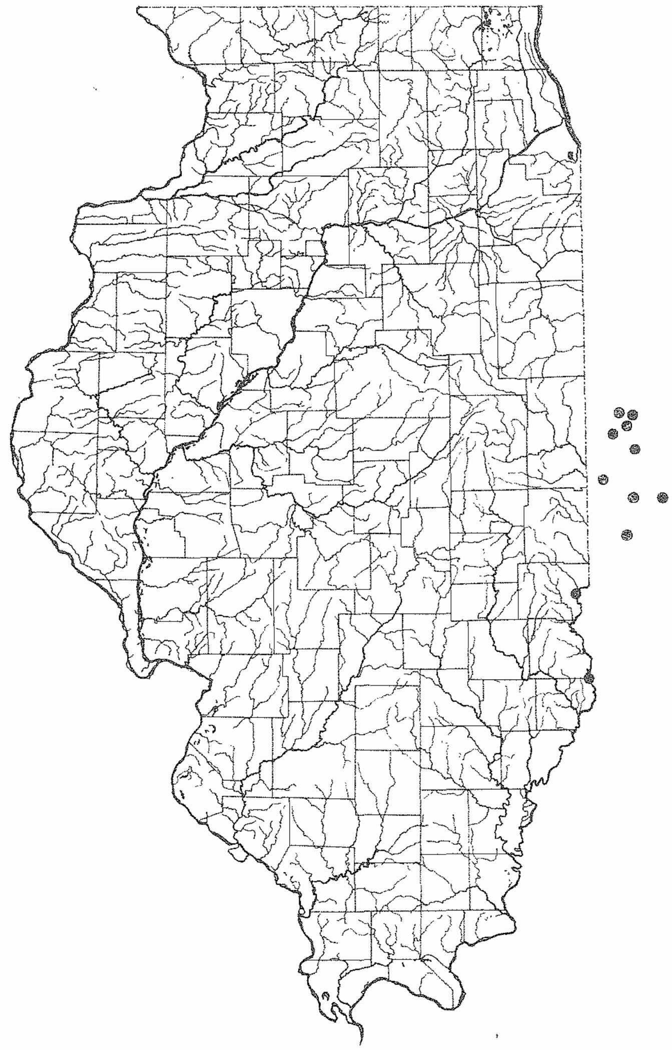
River chub
Nocomis micropogon (Cope)

Ceratichthys micropogon Cope 1864:277 (type-locality: Conestoga River, near Lancaster, Pennsylvania).
Nocomis micropogon: O'Donnell 1935:481 (recorded from Illinois).
Hybopsis micropogon: Smith 1965:7.

Diagnosis.—The river chub is a terete, stout-bodied minnow much like the hornyhead chub but differing from it in lacking a red tail as a juvenile, the red spot behind the eye as an adult, and a well-defined round caudal spot, and in having 4—4 teeth and having tubercles on the side of the head and snout of the breeding male. Its snout is longer and its eye is situated higher on the head than in the hornyhead chub. The young superficially resembles that of the creek chub, but they can be distinguished by the same characters that separate the creek chub and the hornyhead chub. The species attains a length of 250 mm (10 inches) or more.

Variation.—Lachner & Jenkins (1971) studied geographic variation in this species and in other members of the genus and summarized the results of their earlier studies.

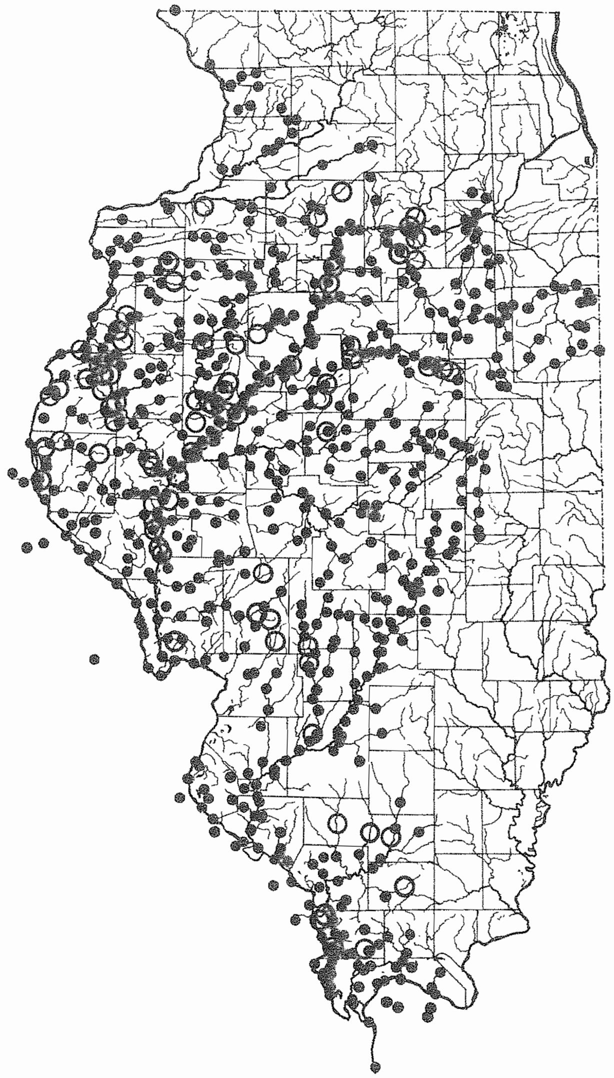
Ecology.—The river chub is similar to the hornyhead chub in habits but occurs in larger streams. It attains a slightly larger size. The breeding male develops swollen areas on the occipital and interorbital regions to produce a helmet-shaped head not found in the male hornyhead chub. The male does not develop the dark lateral band and light dorsal streak as does the hornyhead (Lachner 1952:440). The species may live as long as 5 years. Reproduction and growth in this species are similar to those of the hornyhead chub.



Distribution of the river chub in Illinois.

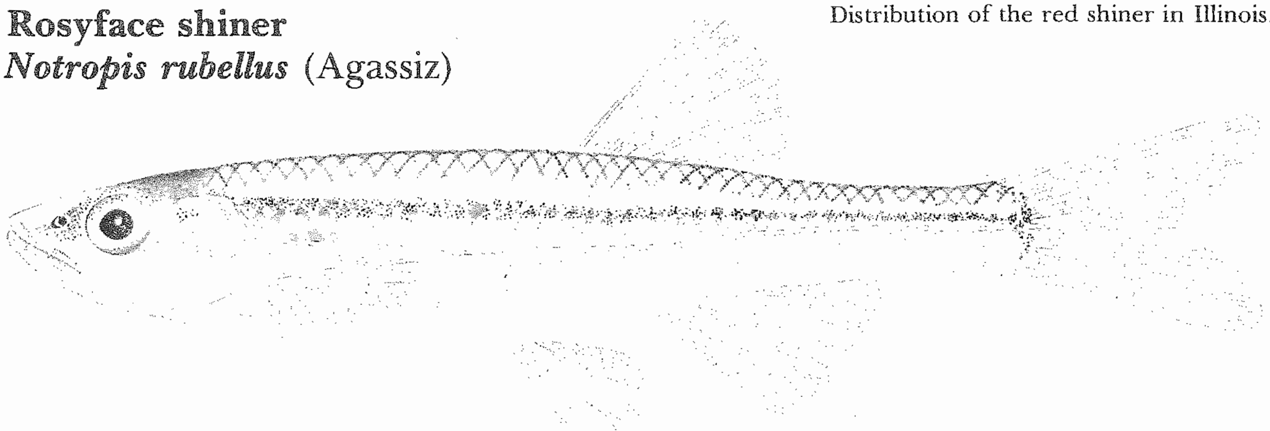
Distribution.—The river chub was first reported from streams of the Wabash River drainage (O'Donnell 1935:481). At present it is known to occur in fast water of the Wabash River proper at single localities in Clark and Lawrence counties, Illinois, but it is widely distributed and common in large creeks of adjacent Indiana. Its range in Illinois probably has not changed appreciably since the earliest fish catalogs were published. It was probably overlooked by earlier authors only because they failed to collect at sites where it occurred.

in the Wabash drainage and the northern and northeastern counties. An adult specimen from Channel Lake in Lake County is regarded as a bait-minnow introduction and is not plotted on the accompanying map. The species has gradually spread eastward across Illinois (Larimore & Smith 1963:332–333) and recently entered Indiana; still more recently it has penetrated the Wabash drainage in the upper reaches of the Middle Fork. It has hybridized with and ultimately supplanted the spotfin shiner in much of central Illinois and has displaced the steelcolor shiner to a lesser extent (Page & R. L. Smith 1970:271–272). In Clear Creek in southwestern Illinois, the red shiner and blacktail shiner have hybridized occasionally for many years. The red shiner is rare in ponds and artificial lakes and rather uncommon in large rivers although it does occur in the Mississippi River. Because of its wide ecological tolerances, the species is more generally distributed and more abundant than formerly. It has filled niches vacated by less tolerant minnows and through competition and hybridization has displaced populations of some of its relatives.



Distribution of the red shiner in Illinois.

Rosyface shiner
Notropis rubellus (Agassiz)



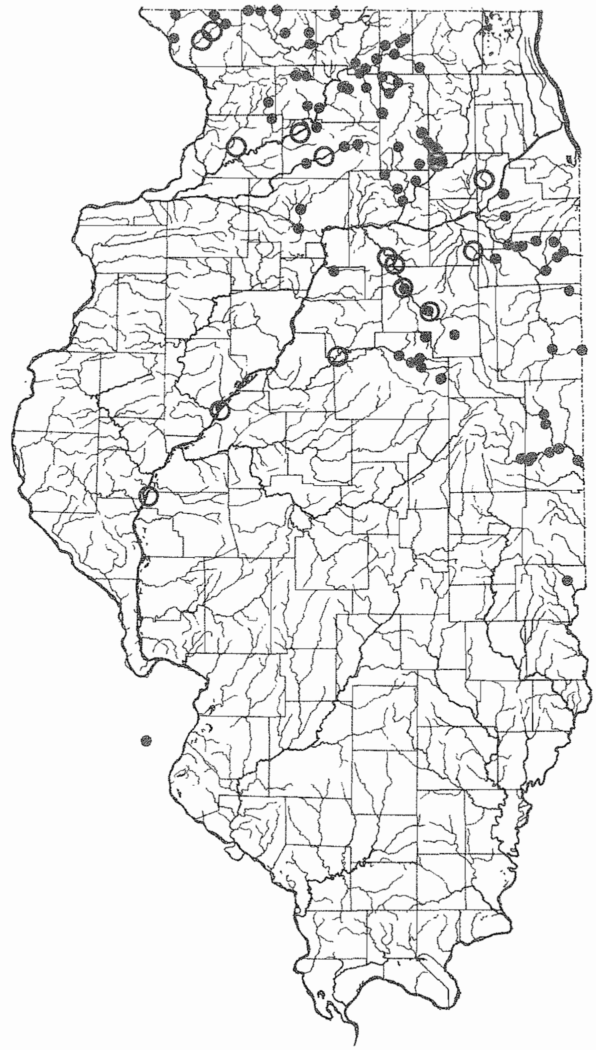
Alburnus rubellus Agassiz 1850:364 (type-locality: Sault Ste. Marie and the Pic [Ontario], Lake Superior).
Minnilus rubrifrons: Nelson 1876:47 (recorded from Illinois).
Notropis rubrifrons: Jordan 1878:60; Large 1903:18; Forbes & Richardson 1908:153–154; O'Donnell 1935:482.
Notropis dinemus: Forbes 1884:76 (part.).
Notropis rubellus: Smith 1965:7.

Diagnosis.—The rosyface shiner is an extremely slender and somewhat compressed shiner with a long and sharply pointed snout (longer than eye diameter), a bluish or greenish dorsum, an intense dusky lateral band, a silvery or white venter, 10–13 anal rays, 2, 4—4, 2 pharyngeal teeth, 36–40 lateral-line scales, a rounded dorsal fin situated well behind the pelvic fin insertions, fewer than 25 rows of predorsal scales, a large terminal and oblique mouth, and in the breeding male bright orange on the head, gill cleft margin, and pectoral fin bases. The species most closely resembles the emerald shiner, differing from it by the longer and sharply pointed snout and by the rounded rather than pointed dorsal fin. The young superficially resembles that of the redfin and ribbon shiners but can be distinguished from them by the snout shape, the larger predorsal scales (fewer than 25 rows), and by the gently decurved lateral line. The species attains a length of about 75 mm (3 inches).

Variation.—No studies of geographic variation have been published, and the rosyface shiner is currently regarded as a monotypic species. A closely related species (*N. micropteryx*) of Tennessee may be conspecific.

Ecology.—The rosyface shiner occurs in clear, fast large creeks and small rivers with bottoms of clean gravel. It schools in riffles and clear pools with silt-free substrates. Spawning occurs in May and probably early June. The finely tuberculate males have bright orange heads. The species aggregates in clear, clean-bottomed pools, and the males vigorously pursue and collide with the plain females. During these contacts, eggs are released and fertilized. Pfeiffer (1955) reported spawning in New York when water temperatures were between 21° and 25° C and described the spawning behavior in detail. The egg averages 1.5 mm in diameter. The rosyface shiner has been reported spawning over nests of common shiners, hornyhead chubs, and sunfishes by various authors. The food of the species, according to Starrett (1950), consists of aquatic and terrestrial invertebrates, bottom ooze, and some plant material.

Distribution.—The rosyface shiner occurs in large gravelly and clear streams throughout the northeastern counties of the state. It is intolerant of turbidity and silt and probably cannot stand high water temperatures during the summer months. Its range in Illinois is much the same as it has always been, but it is disappearing from streams that have been modified by impoundments and excessive siltation in recent years.



Distribution of the rosyface shiner in Illinois.

Silverband shiner
Notropis shumardi (Girard)

Alburnops shumardi Girard 1856:194 (type-locality: Arkansas River near Fort Smith, Arkansas).
Notropis illecebrosa: Hubbs & Bonham 1951:97 (recorded from Illinois).
Notropis shumardi: Smith 1965:7.

Diagnosis.—The silverband shiner is a nondescript pale olive minnow with a vague dusky lateral band over which is laid a silvery band; a rather slab-sided body; eight or nine anal rays; a large sharply pointed dorsal fin situated distinctly in advance of the pelvic fin insertions; 34–37 lateral-line scales; 2, 4—4, 2 pharyngeal teeth; a terminal and sharply oblique mouth; immaculate fins; and a thin

Head large, its length usually going four or fewer times into standard length; mouth large, upper lip thick and lower lip very thick, its posterior border forming a U-shaped curve; free edge of dorsal fin convex or straight edged 3

3. Pharyngeal teeth heavy and molarlike; occipital region flattened and snout squarish; eye large, diameter contained four or fewer times in head length of young specimens; caudal peduncle scales, usually 12 or 13 .... *carinatum*

Pharyngeal teeth thin and comblike; occipital region and snout bluntly rounded; eye small, diameter contained more than four times in head length of young specimens; caudal peduncle scales, usually 15 or 16 .... *valenciennesi**

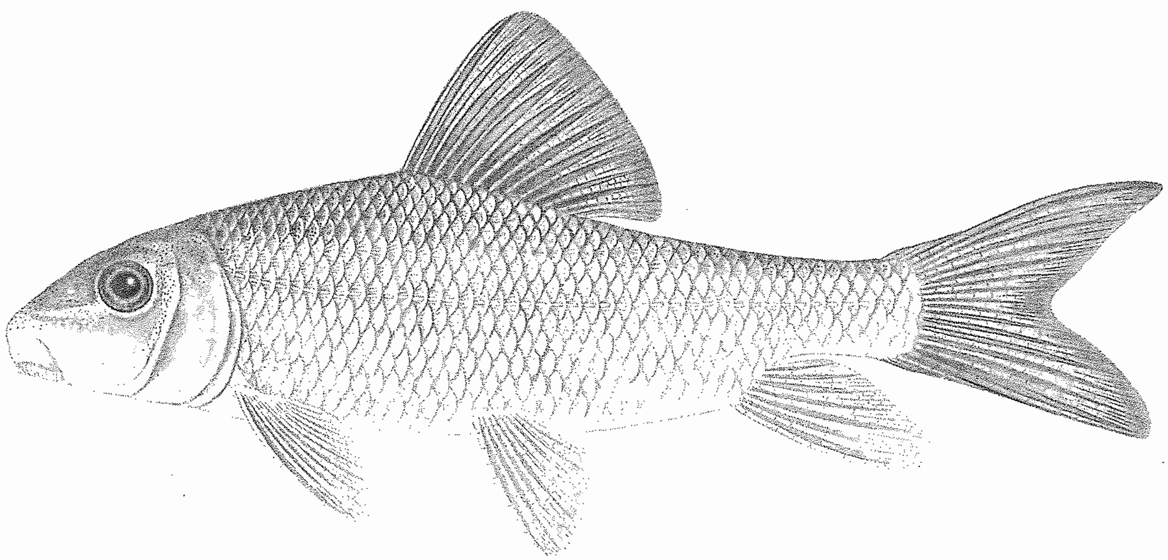
4. Dorsal fin rays, 15 or 16; free edge of dorsal fin straight or convex; body relatively deep, its greatest depth usually exceeding head length; lower lip distinctly bilobed, the cleft between the lobes forming an acute angle; lips somewhat papillose .... *anisurum*

Dorsal fin rays, 13 or 14; free edge of dorsal fin concave; body nearly terete; lower lip not distinctly bilobed and its posterior border usually forming a U-shaped curve; lips plicate 5

5. Scales in lateral line, 39–43; pelvic fin rays, usually nine; caudal peduncle stout, its depth usually contained 1.8 or fewer times in distance from caudal fin to front of anal fin; rear edge of lower lip distinctly U-shaped .... *erythrurum*

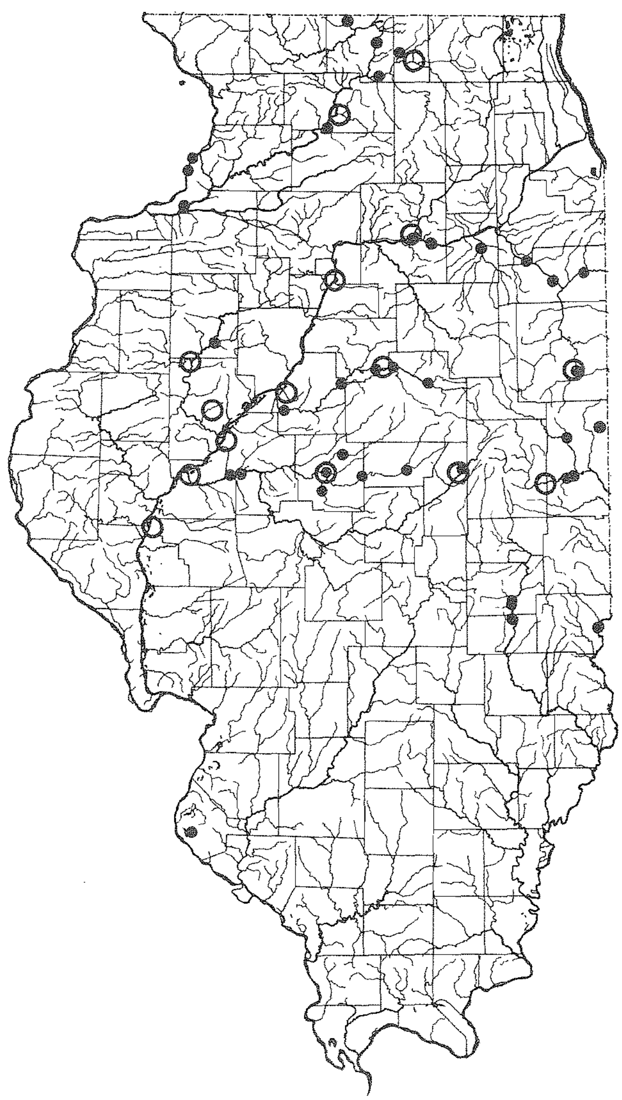
Scales in lateral line, 44–48; pelvic fin rays, usually 10 on one or both sides; caudal peduncle slender, its depth usually contained more than 1.8 times in distance from caudal fin to front of anal fin; rear edge of lower lip shallowly U-shaped .... *duquesnei*

Silver redhorse
Moxostoma anisurum (Rafinesque)



Catostomus anisurus Rafinesque 1820*a*:54 (type-locality: Ohio River); ?Kennicott 1855:594 (recorded from Illinois).
Teretulus carpio: Nelson 1876:49.
?*Teretulus velatus:* Nelson 1876:49.
?*Teretulus anisurus:* Nelson 1876:49.
Myxostoma carpio: Jordan 1878:63.
?*Myxostoma velatum:* Jordan 1878:64.
Moxostoma carpio: Forbes 1884:80.
Moxostoma anisurum: Large 1903:11; Forbes & Richardson 1908:89–90; O'Donnell 1935:479; Smith 1965:8.

Diagnosis.—The silver redhorse is a relatively deep-bodied (body depth going about three times into standard length and greater than greatest head length) redhorse with a slate-colored tail, whitish ventral fins, a convex or straight-edged dorsal fin usually containing 15 or 16 rays, and a full lower lip that is distinctly bilobed and somewhat papillose as well as plicate. The adult is readily distinguished from other species in the genus by the deep body shape (at the origin of the dorsal) and the convex dorsal fin. The young is most readily recognized by the distinctive lower lip, which has two strong lobes separated by a deep and acutely angled cleft. It differs from the river redhorse in lacking a red tail and spots on the scale bases of the back and sides, and in having a smaller and strongly bilobed lower lip. The species attains a length of slightly over 510 mm (20 inches).



Distribution of the silver redhorse in Illinois.

Variation.—A thorough analysis of variation in the species has been undertaken by Dr. Robert E. Jenkins of Roanoke College but is not yet published.

Ecology.—The silver redhorse is most common in long deep pools of medium-sized rivers. It is most often taken in deep, rather firm-bottomed pools that have undercut banks and tree roots protruding into the water. The most complete account of feeding and reproductive behavior in the species is that of Meyer (1962). In the Des Moines River he found the food to be almost entirely immatures of aquatic insects. Spawning occurred in early May in rather deep, clear riffles in the main channels. Many thousand eggs were produced by each female. Growth was rapid during the 1st year. Sexual maturity was reached at age five, and nine year classes were present in the population.

Distribution.—The silver redhorse is occasional in small and medium-sized rivers in northern and central Illinois but extremely rare in the southern half of the state. There is no real evidence of decimation because the species was seldom taken before the advent of electrofishing gear. It is likely that it was more abundant before siltation became so extensive and fluctuations in water level so drastic.

River redhorse
Moxostoma carinatum (Cope)

Placopharynx carinatus Cope 1870*b*:467 (type-locality: Wabash River, Lafayette, Indiana); Nelson 1876:49 (recorded from Illinois); Forbes 1884: 80; O'Donnell 1935:480.

Placopharynx carinatns: Jordan 1878:63 (misspelling).

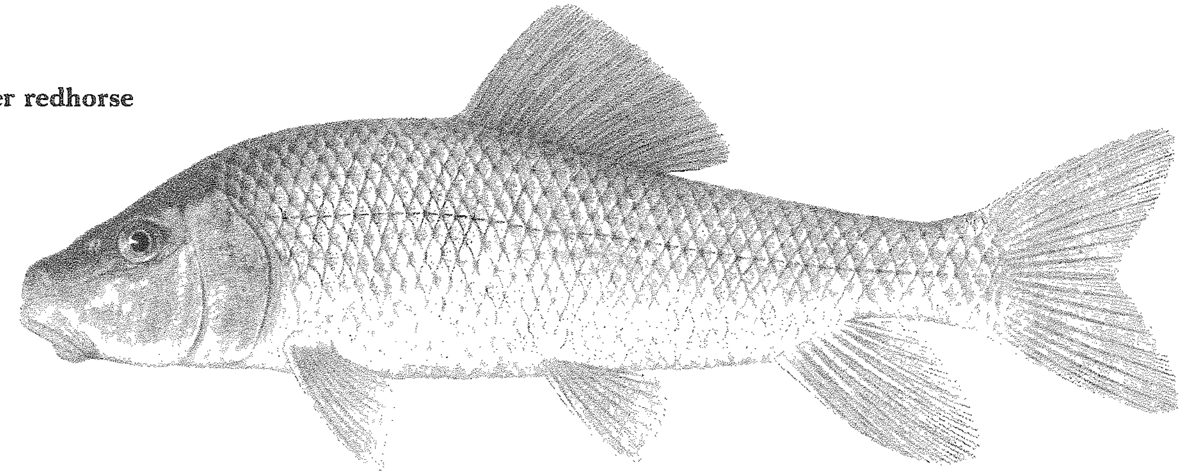
Placopharynx duquesnei: Large 1903:13; Forbes & Richardson 1908:93–94.

Moxostoma carinatum: Smith 1965:8.

Moxostoma valenciennesi: Smith 1965:8 (misidentification).

Diagnosis.—The river redhorse is a slightly compressed and red-tailed redhorse (the illustration in Forbes & Richardson—1908:93—was inadvertently colored gray) with dark spots on the scale bases of the back and sides, a large head (length contained fewer than four times in standard

River redhorse

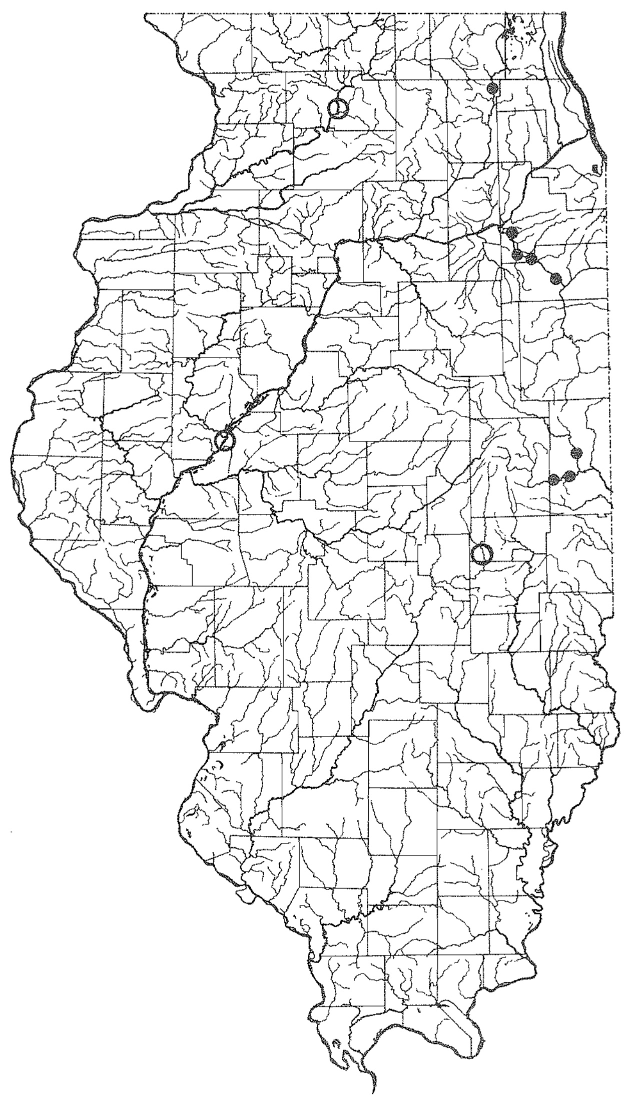


length), a large mouth and heavy plicate lips, posterior border of lower lip broadly U-shaped, the distal edge of the dorsal fin convex or with a straight edge, and pharyngeal teeth heavy and molarlike. The large head, squarish snout, large eye, and molariform teeth distinguish this species from the related but extirpated (in Illinois) greater redhorse. The juvenile most closely resembles that of the golden redhorse but can be separated from that species by the red tail, heavier lips, straight-edged dorsal fin, and molarlike pharyngeal teeth. A specimen 690 mm (27 inches) in total length was taken from the Fox River in 1958.

Variation.—As in other species of the genus, a study not yet published on variation has been done by Robert E. Jenkins of Roanoke College.

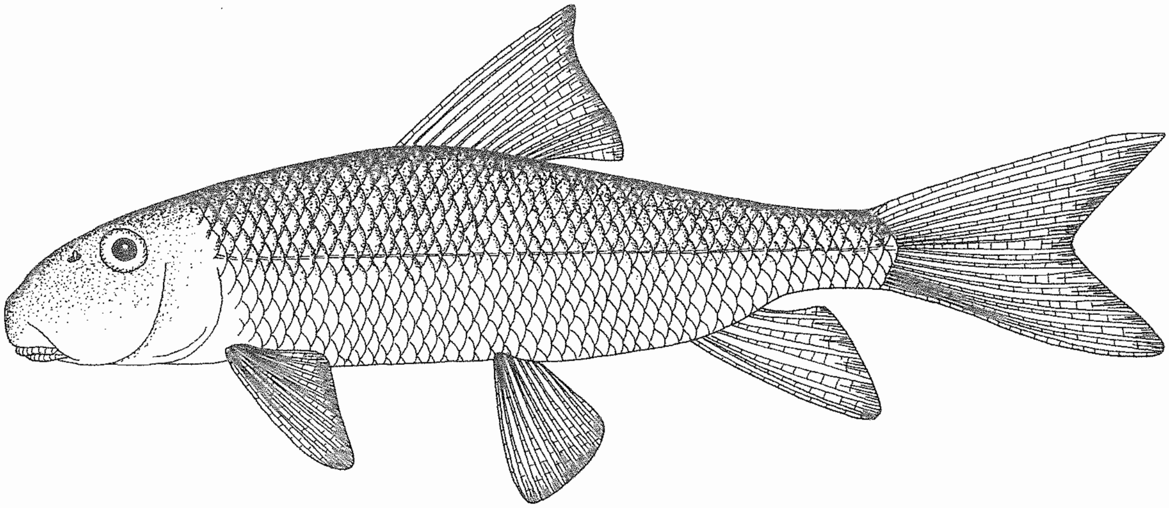
Ecology.—In Illinois this poorly known sucker occurs in deep, swift, gravelly riffles of small and medium-sized rivers and is seemingly intolerant of silty bottoms, turbid waters, and pollution. The specialized pharyngeal teeth of this species enable it to feed heavily on molluscs as well as benthic insects. Although a common species in some Ozark streams, little information is available on its reproduction. Carlander (1969:508–509) summarized unpublished data and noted that 12 age classes were present in Missouri populations.

Distribution.—No inferences can be drawn about the changes in status of the river redhorse, since it was known to Forbes & Richardson (1908) from only one locality and is known at present from only a few localities. The species is common in the Kankakee River but extremely uncommon elsewhere in the state.



Distribution of the river redhorse in Illinois.

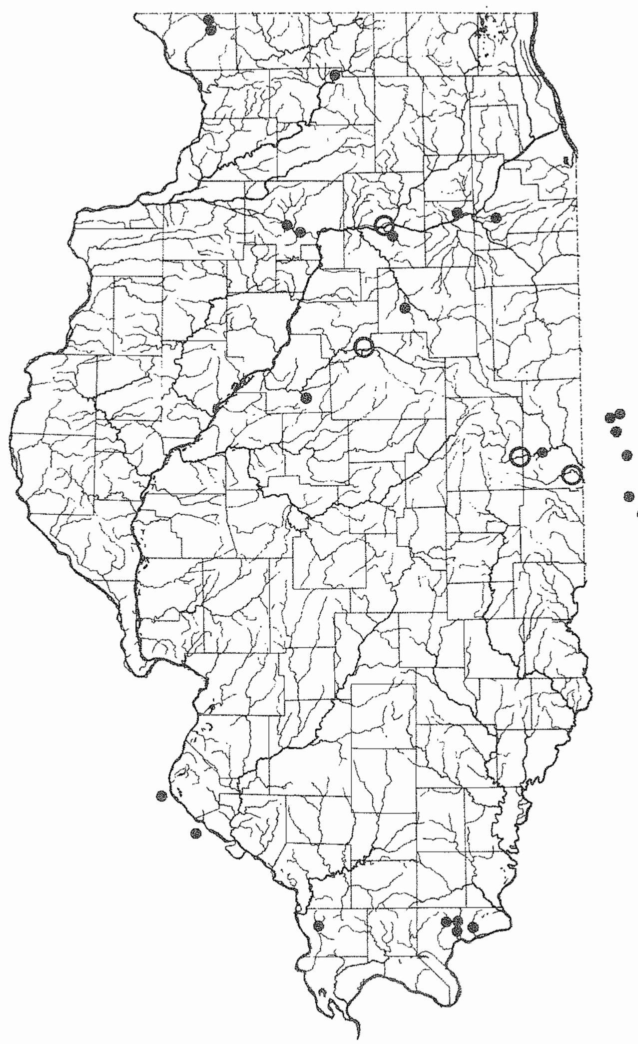
Black redhorse
Moxostoma duquesnei (Lesueur)



Catostomus duquesnii Lesueur 1817*b*:105 (type-locality: Ohio River at Pittsburgh, Pennsylvania); ?Kennicott 1855:594 (recorded from Illinois).
Moxostoma aureolum: Forbes & Richardson 1908: 90–91 (part.).
Moxostoma duquesnii: Hubbs 1930:23 (name resurrected, recorded from Illinois).
Moxostoma duquesnei: Smith 1965:8.

Diagnosis.—The black redhorse is a terete and gray-tailed redhorse with 44–48 lateral-line scales, a slender caudal peduncle (its least depth contained 1.8 times or more in the distance from the caudal base to the front of the anal fin), a rather small mouth, lips relatively thin and plicate, the rear edge of lower lip shallowly U-shaped to straight edged, and the snout rounded rather than squarish. The snout of the breeding male lacks tubercles. This species most closely resembles the golden redhorse, especially when young, but it has head-body proportions and a mouth structure suggesting the northern redhorse. The best character for distinguishing it from the golden redhorse is its higher lateral-line scale count and from the northern redhorse, the slate-colored tail and relatively longer head. The species is usually less than 380 mm (15 inches) in length.

Variation.—This species was not recognized until Hubbs (1930) resurrected the name *duquesnei* from the synonymy of *M. erythrurum.* It is said to have 10 pelvic fin rays in one or both fins, but most Illinois specimens have only 9. A study of variation in the species by Dr. Robert E. Jenkins is as yet unpublished.

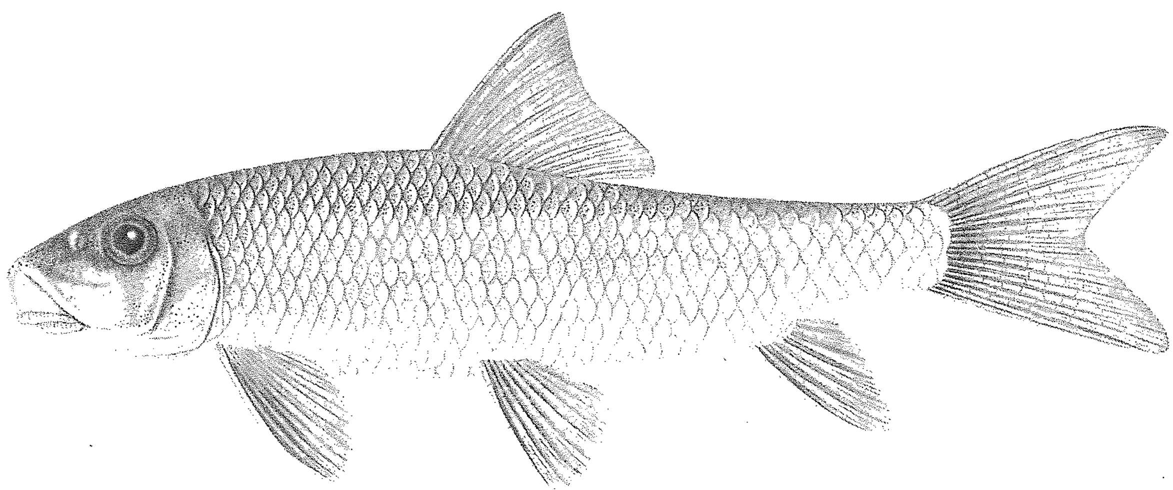


Distribution of the black redhorse in Illinois.

Ecology.—The black redhorse occurs in clean, high-gradient creeks and rivers and probably has always been uncommon in Illinois. It is less tolerant of pollution, siltation, and turbidity than are most other suckers and thus differs from them somewhat in feeding and reproductive habits. An excellent account of its life history in Missouri streams was published by Bowman (1970). Like other redhorses, it feeds in schools near the bottom. Spawning, which is similar to that of related species, occurs in rather deep, clear riffles over gravel or rubble. The species lives 8–10 years.

Distribution.—The black redhorse occurs sporadically in the northern half of the state and in some of the high-gradient and little modified streams in the Shawnee Hills of southern Illinois. It is uncommon everywhere except in Lusk Creek in Pope County and Big Creek in Hardin County. No inferences can be drawn about changes in its distribution, since it has evidently always been rare in this state, but several specimens have been found mixed with Forbes and Richardson's "*Moxostoma aureolum*" taken between 1883 and 1901.

Golden redhorse
Moxostoma erythrurum (Rafinesque)



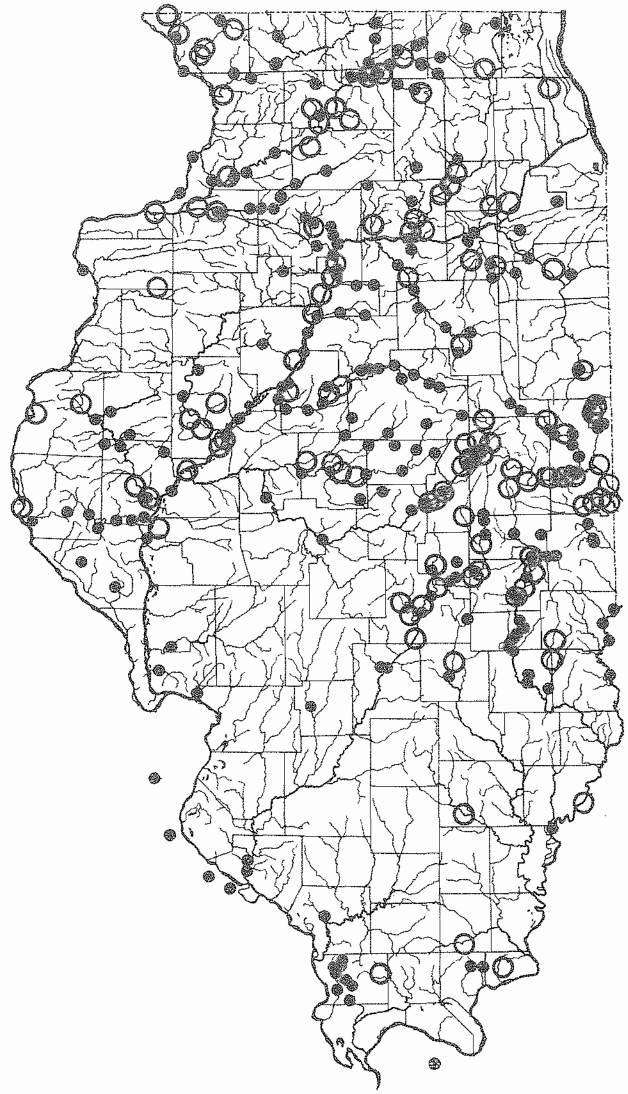
Catostomus erythrurus Rafinesque 1818*d*:355 (type-locality: Ohio River).
?*Teretulus duquesnii:* Nelson 1876:49 (recorded from Illinois).
Teretulus macrolepidotum: Nelson 1876:49.
?*Myxostoma macrolepidotum* var. *duquesnii:* Jordan 1878:63.
Moxostoma macrolepidotum: Forbes 1884:80.
Moxostoma aureolum: Large 1903:12; Forbes & Richardson 1908:90–91; O'Donnell 1935:479.
Moxostoma erythrurum: Smith 1965:8.

Diagnosis.—The golden redhorse is a terete and gray-tailed redhorse with a relatively large head and mouth, plicate lips that form a V- or U-shaped curve posteriorly, a rather thin lower lip, a squarish snout, usually 39–43 lateral-line scales, a concave dorsal fin, and a rather thick caudal peduncle (its least depth contained fewer than 1.8 times in the distance from the caudal base to the front of the anal fin). It is most like the black redhorse, differing primarily in the lower lateral-line scale count, stouter caudal peduncle, larger mouth, squarish snout, and tuberculate snout (in the breeding male). It differs from the river redhorse in having a slate-colored tail, a smaller head and mouth, a concave dorsal fin, and thin comblike pharyngeal teeth. Very small young are sometimes difficult to distinguish from those of other redhorse species and young spotted suckers. The species is said to attain a length of more than 610 mm (2 feet), but most adults are under 380 mm (15 inches).

Variation.—Considerable individual variation is found in young specimens. Dr. R. E. Jenkins of Roanoke College studied variation in the species and will presumably soon publish his results.

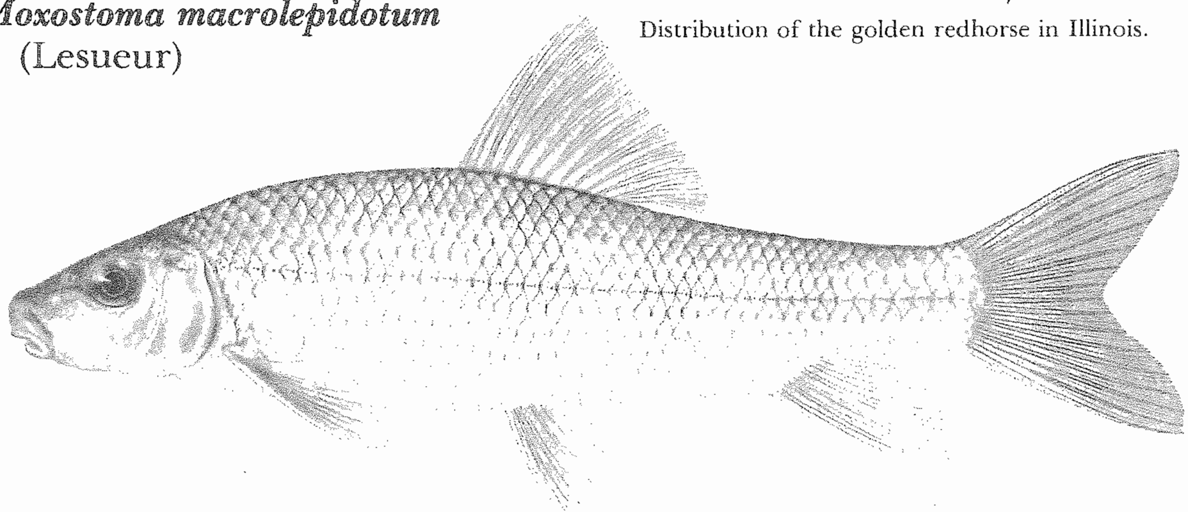
Ecology.—The golden redhorse is the most widespread and common species in the genus but is seldom found in large rivers, where the shorthead redhorse is relatively common. The preferred habitat is raceways and firm-bottomed pools of creeks and small rivers. Like other species, the golden redhorse feeds on bottom ooze, molluscs, and benthic insects. Spawning occurs in April and May in riffles. The reproductive behavior is similar to that of other redhorses. A life-history study was published by Meyer (1962); other details have been summarized by Carlander (1969:511–514).

Distribution.—The species occurs in all parts of the state except those south-central Illinois counties having predominantly clay soils and low-gradient creeks. It is abundant in most of northern and central Illinois but somewhat decimated in the streams west of the Illinois River. The species is probably as widely distributed as formerly but less abundant because of the deterioration of water quality and the siltation of many streams.



Distribution of the golden redhorse in Illinois.

Shorthead redhorse
Moxostoma macrolepidotum (Lesueur)



Catostomus macrolepidotus Lesueur 1817*b*:94 (type-locality: Delaware River).

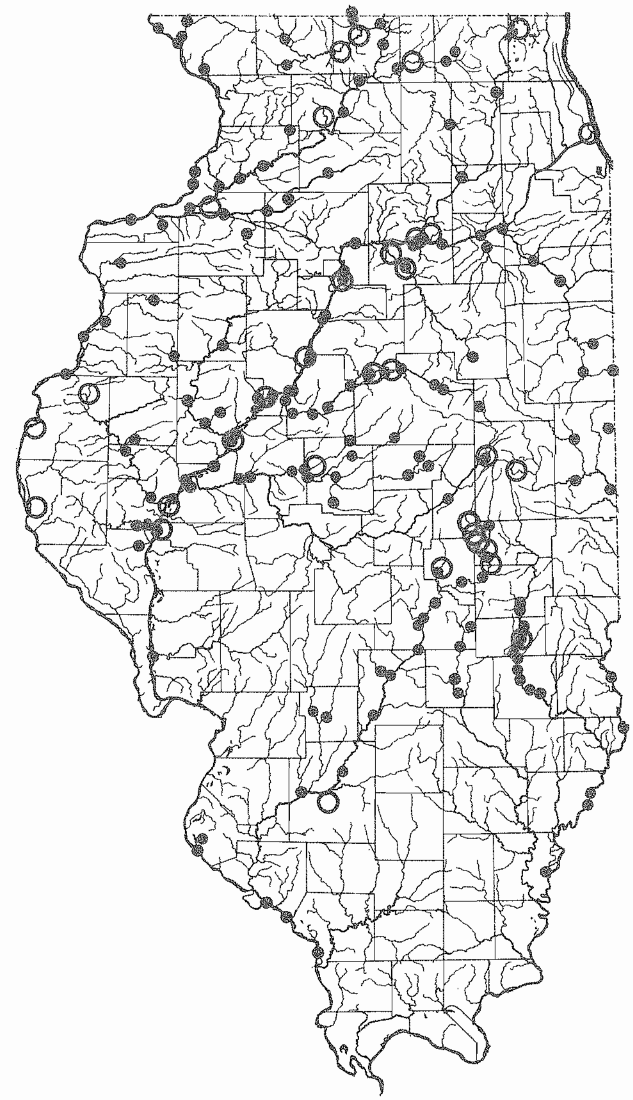
?*Catostomus aureolus:* Kennicott 1855:594 (recorded from Illinois).

Teretulus aureolum: Nelson 1876:49.
Myxostoma aureoleum: Jordan 1878:63.
Moxostoma aureolum: Forbes 1884:80.
Moxostoma macrolepidotum: Large 1903:12; Smith 1965:8.
Moxostoma breviceps: Forbes & Richardson 1908: 91–92.
Moxostoma lesueurii: O'Donnell 1935:480.

Diagnosis.—The shorthead redhorse is a somewhat compressed and red-tailed redhorse with rows of dark spots (on the scale bases) on the back and sides, a small head (its length usually going into the standard length well over four times), a small mouth with thinly plicate lips and some cross striae, and a lower lip that is straight edged posteriorly. The combination of red tail, short head, and small mouth serves to distinguish the adult from all other Illinois suckers. The small young may resemble young black and golden redhorses, but tail fin color and mouth shape permit identification of most juveniles. The species attains a length of 610 mm (2 feet), but most adults are much smaller.

Variation.—Several nominal species close to the shorthead redhorse have been shown to be conspecific by Dr. R. E. Jenkins of Roanoke College. Presumably they will be regarded as southeastern subspecies, but the study has not yet been published. The nominate subspecies (*M. m. macrolepidotum*) occupies all of this state except southwestern and southeastern Illinois. Material from the Mississippi River below the mouth of the Missouri is referable to the Ozark subspecies, *M. m. pisolabrum,* but when more specimens are available, the southwestern Illinois population may be found to consist of *macrolepidotum* X *pisolabrum* intergrades. Specimens from the Wabash and Embarras rivers are intergrades between *M. m. macrolepidotum* and *M. m. breviceps.*

Ecology.—The shorthead redhorse occurs in rivers, including the Mississippi, but is rarely found in creeks. The preferred habitat is deep raceways and firm-bottomed pools with some flow. While clear, fast water over a gravel bottom is the optimal habitat, the species is sometimes taken in turbid waters and in bays of large rivers where there is little current. Its feeding and reproductive habits are similar to those of other redhorses. Its life history in the Des Moines River has been described by Meyer (1962). Burr & Morris (1977) reported over a hundred shorthead redhorse spawning off a sandbar in a high-gradient northeastern Illinois stream in mid-May. They observed no territoriality or aggressive displays. Groups of three to seven with the female in the middle or below the males, violently rolled and undulated until troughlike nests were formed in the sand and gravel. The spawning site was shared by white suckers and northern hog suckers in similar-sized groups. The tuberculate shorthead redhorse captured were all 5 years old.



Distribution of the shorthead redhorse in Illinois.

Distribution.—The species occurs in all parts of the state except extreme southern Illinois. It is widely distributed and, although less common than the golden redhorse, apparently more general in occurrence now than formerly, probably because it has greater ecological tolerance than other species in the genus.

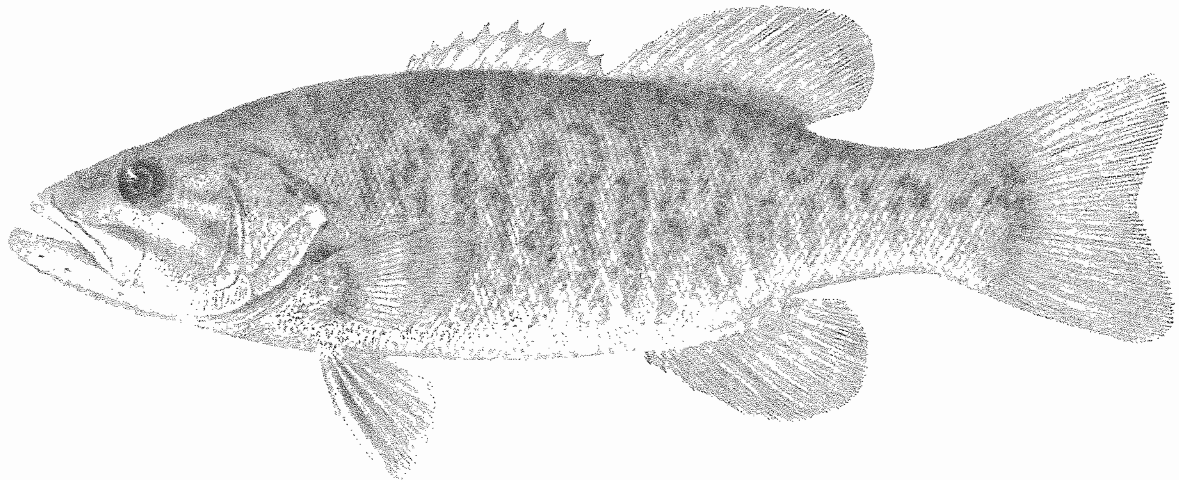
half height of longest spines; mouth large, the maxilla extending behind eye in adult; caudal fin not tricolored in juvenile .... *salmoides*

Shallow notch between spinous and soft dorsal fins, free edge of first dorsal fin curved but not hemispherical, spines 8 and 9 more than half height of longest spines; mouth small, the maxilla not extending behind eye; caudal fin tricolored in juvenile, with a band of orange-yellow and a white margin distally 2

2. Ground color olive-green or brown with a series of brown vertical bars along sides or without markings; sides below lateral line without thin, dark horizontal stripes; scales, usually more than 67 in lateral line ...... *dolomieui*

Ground color whitish, yellowish, or pale olive with a series of dark, nearly confluent blotches that forms a distinct lateral band; sides below lateral line with several thin, dark horizontal stripes; scales larger, usually fewer than 66 in lateral line .... *punctulatus*

Smallmouth bass
Micropterus dolomieui Lacépède

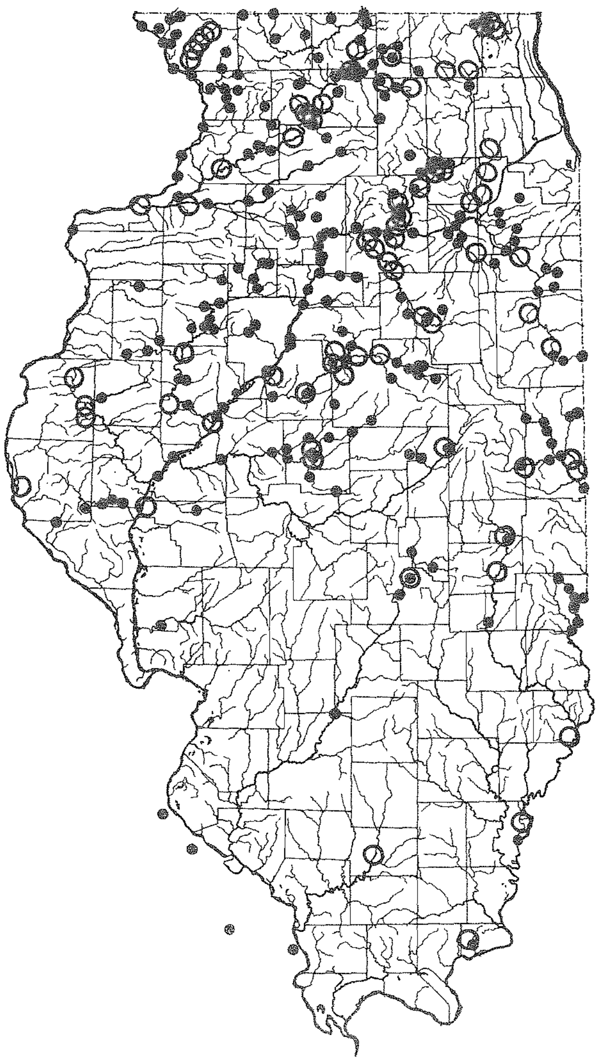


Micropterus dolomieu Lacépède 1802:324 (type-locality: not given); Large 1903:25; Forbes & Richardson 1908:263–266; O'Donnell 1935:486.
Centrarchus fasciatus: Kennicott 1855:594 (recorded from Illinois).
Micropterus salmoides: Nelson 1876:37; Jordan 1878: 44.
Micropterus dolomiei: Forbes 1884:67 (misspelling).
Micropterus dolomieui: Smith 1965:10.

Diagnosis.—The smallmouth bass is a somewhat compressed bass, dark olive or yellowish brown, without prominent markings on the sides or with vague dark vertical bars, dark stripes across the cheeks, a gently curved spinous dorsal fin broadly joined to the soft dorsal, usually more than 67 scales in the lateral line, and a moderate-sized mouth (the end of the upper jaw usually not extending behind the eye), and without a lateral band or rows of longitudinal stripes on the lower sides. The absence of a lateral band or row of nearly confluent blotches and the dark pigmentation distinguish the species from the largemouth and spotted basses. The darkly pigmented young has a tricolored caudal fin like that of the spotted bass except that it lacks the black caudal spot. The species attains a length of more than 510 mm (20 inches), but in Illinois adults over 300 mm (12 inches) are unusual.

Variation.—For several years the population at the southwestern edge of the species' range was recognized as a separate subspecies (*M. d. velox*), but Bailey (*in* Harlan & Speaker 1956:336) recommended that it not be given nomenclatorial status.

Ecology.—The smallmouth bass occurs in clear, gravelly or rocky rivers that have moderate to fast current and remain relatively cool during the summer months. Although a lake species farther north, in Illinois it is predominantly a stream fish that lurks near cover in large clear pools. A large fishery literature exists for the species, and a great deal of experimental work on the species has been done by Dr. R. W. Larimore and other members of the Section of Aquatic Biology, Illinois Natural History Survey. For an excellent summary of the ecology of the smallmouth bass, see Emig (*in* Calhoun 1966:354–366). The species feeds on crustaceans, insects, and other fishes and has a voracious appetite. Spawning occurs in May or June over saucer-shaped nests excavated in gravel. From 2,000 to several thousand eggs are guarded by the male, who continues to guard the school of black, tadpole-like fry for a day or so. Hatching times depend on water temperature, and hatching may require as little as 2 or 3 days. The adults have rather circumscribed home ranges. They may live more than 10 years and are usually sexually mature in 3 or 4 years.



Distribution of the smallmouth bass in Illinois.

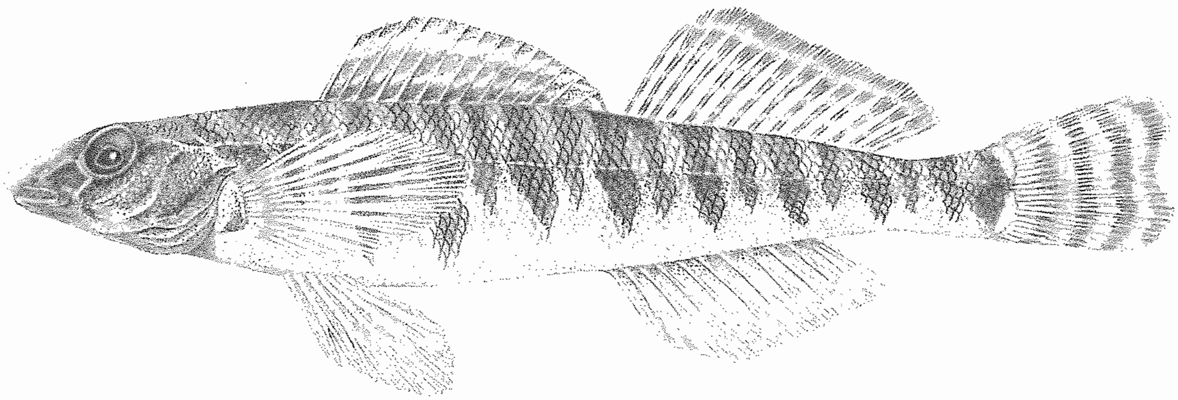
Distribution.—The smallmouth bass is widely distributed and common in suitable habitats throughout the northern two-thirds of Illinois but extremely sporadic in the southern third and absent from many areas. Despite its present general distribution in northern and central Illinois, it was more generally distributed formerly. Siltation, fluctuating water levels, and a general deterioration of water quality have contributed to its decline in the state.

Spotted bass
Micropterus punctulatus (Rafinesque)

Calliurus punctulatus Rafinesque 1819:420 (type-locality: Ohio River).
Micropterus salmoides: Forbes & Richardson 1908: 267–269 (part.).
Micropterus pseudaplites: O'Donnell 1935:486 (recorded from Illinois).
Micropterus punctulatus punctulatus: Smith 1965:10.

Diagnosis.—The spotted bass is a rather compressed bass, pale olive, with a black or brown lateral band or row of nearly confluent blotches, dark stripes across the cheeks, several longitudinal rows of dark dots on the lower sides, a gently curved spinous dorsal fin broadly joined by the soft dorsal, usually less than 67 scales in the lateral line, and a moderate-sized mouth (the end of the upper jaw usually does not extend behind the eye). The adult resembles the largemouth bass in color and pattern but differs in lacking the sickle-shaped spinous dorsal fin and in having longitudinal rows of dark dots on the lower sides and a smaller mouth. The young differs from the young largemouth in having a black caudal spot, a tricolored tail, and more prominent cheek stripes. It differs from the young smallmouth bass in having a black caudal spot, a black or brown lateral band rather than vertical bars, and a pale ground color. The species attains a length of more than 500 mm (20 inches), but in Illinois adults more than 310 mm (12 inches) are rare.

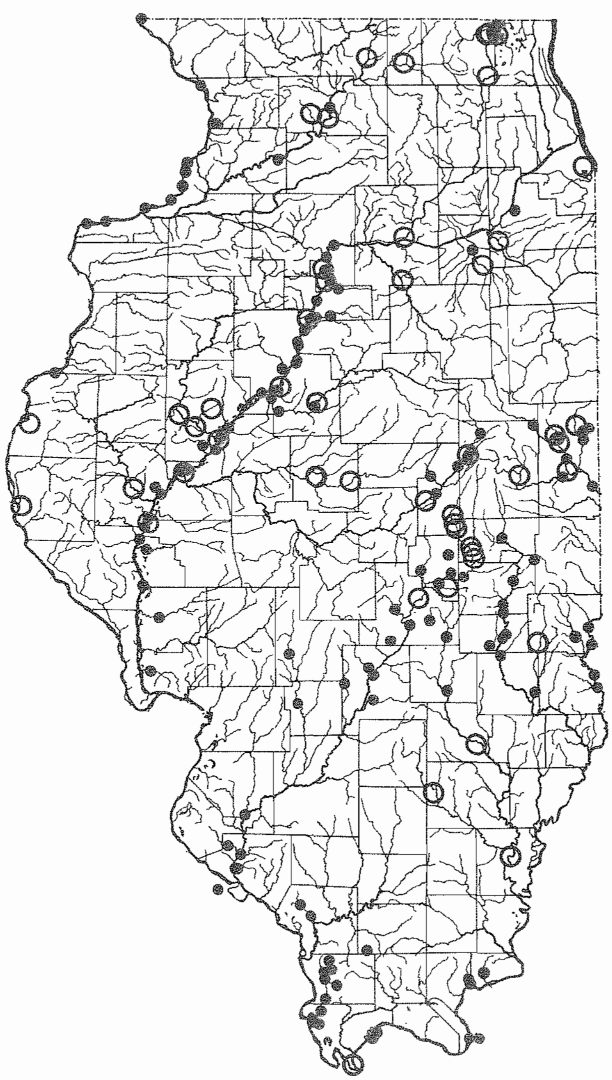
Logperch
Percina caprodes (Rafinesque)



Sciaena caprodes Rafinesque 1818*d*:354 (type-locality: Ohio River).
Percina caprodes: Nelson 1876:36 (recorded from Illinois); Jordan 1878:39; Large 1903:26; Forbes & Richardson 1908:282–283; O'Donnell 1935: 488.
Percina manitou: Jordan 1878:39 (possible in Illinois).
Hadropterus evermanni: Forbes & Richardson 1908: 284–285; Hubbs 1926:60 (= logperch X blackside darter hybrid).
Alvordius evermanni: O'Donnell 1935:488.
Percina caprodes (Rafinesque) subspecies: Smith 1965:10.

Diagnosis.—The logperch is a cylindrical darter, pale straw color or olive, with 15–25 narrow vertical bands of black or brown (usually every other band extending below the lateral line), a conspicuous median caudal spot, a pointed and conical snout extending well beyond the mouth, and 80 or more lateral-line scales. The combination of the terete body, conical snout, and distinctively ringed pattern easily distinguishes this species from all other Illinois percids. The species attains a length of about 180 mm (7 inches).

Variation.—Three subspecies exert influences in Illinois, and much of the state is a broad area of intergradation among them. Logperch in the northern third of the state are *P. c. semifasciata;* those in southwestern Illinois show characteristics of *P. c. carbonaria,* which intergrades with *P. c. caprodes* in eastern and southern Illinois. No recent studies of geographic variation have been published, and the species needs a critical revision. Several species in the complex have been recog-



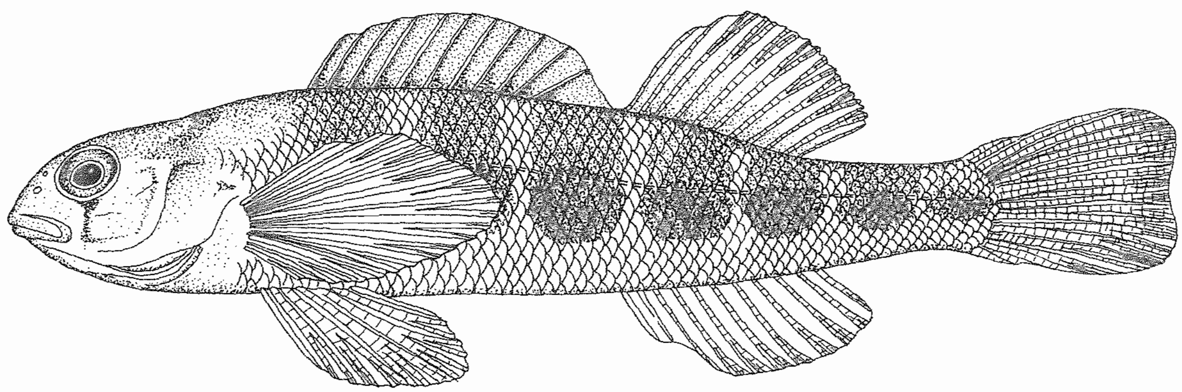
Distribution of the logperch in Illinois.

nized in recent years, and names in the synonymy have been resurrected for them or new names have been proposed.

Ecology.—The logperch prefers clear riffles over mixed sand and gravel in large creeks and rivers, but it also occurs in clear bottomland lakes, pools of streams, and low-gradient large rivers. In the riffle habitat it frequently hides in brush and log jams, and hence its common name. Where the bottom is sand, it may bury itself except for its eyes in the fashion of sand darters. The food consists primarily of immatures of aquatic insects (Thomas 1970:8–12), but, as in other darter species, the small young feeds on microcrustaceans. In searching for food, the logperch uses its conical snout to overturn rocks. Spawning occurs in April over gravel in strong riffles. The mating pair partially buries the eggs by their vigorous spawning vibrations. Various aspects of the life history of the logperch have been described by several authors. The most detailed accounts are those of Winn (1958*a* and 1958*b*). The species lives for more than three years.

Distribution.—The logperch occurs in all parts of the state where streams are large and stable enough to provide habitat. It is particularly common in the sluggishly flowing and sand-bottomed Illinois River and its associated lakes. Although it is widely distributed and locally common, it has been somewhat decimated in the state because of the destruction of habitats and the deterioration of water quality in many streams and lakes.

Gilt darter*
Percina evides (Jordan & Copeland)



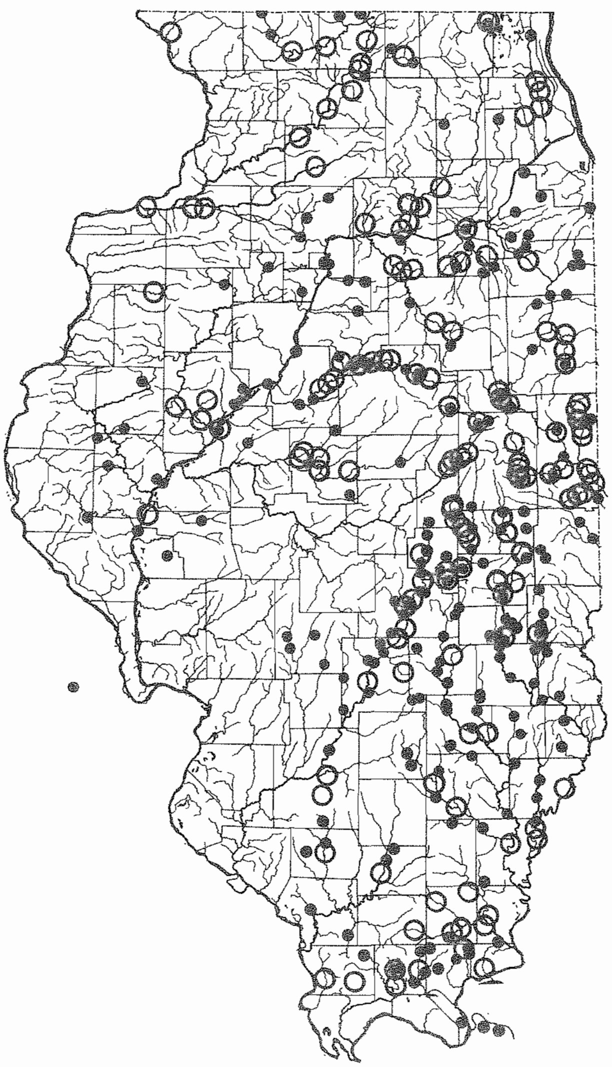
Alvordius evides Jordan & Copeland *in* Jordan 1877*c*:51 (type-locality: White River near Indianapolis, Indiana).
Etheostoma evides: Nelson 1876:36 (expected in southern Illinois).
Ericosoma evides: Jordan 1878:39 (known only from Indiana); O'Donnell 1935:489.
Hadropterus evides: Forbes 1884:65 (recorded from Illinois); Large 1903:27; Forbes & Richardson 1908:288–289.
Percina evides: Smith 1965:12 (extirpated, not collected since 1932).

Diagnosis.—The gilt darter is a stout-bodied darter nearly unique among species of *Percina* in possessing bright reds and blues on the body and having dorsal saddles directly above the lateral blotches and often confluent with them. The species has 11–13 dorsal spines, two anal spines, usually 55–65 lateral-line scales, naked cheeks, a frenum, and the gill covers slightly connected at the isthmus. The breeding male has five to eight blue-green vertical bands, coppery red interspaces, an orange breast, orange dorsal fins, blue-black anal and pelvic fins, and a pair of orange spots at the caudal base. The species attains a length of about 75 mm (3 inches).

Variation.—Dr. Robert F. Denoncourt of York College analyzed geographic variation in the spe-

Hadropterus aspro: Forbes 1884:65; Large 1903:27; Forbes & Richardson 1908:286–288.
Hadropterus evermanni: Forbes & Richardson 1908: 284–285; Hubbs 1926:60 (= logperch X blackside darter hybrid).
Alvordius evermanni: O'Donnell 1935:488.
Percina maculata: Smith 1965:10.

Diagnosis.— The blackside darter is a moderately slender darter, pale olive green or grayish-yellow above and whitish below, with 8–10 squarish black saddles well separated from 6–10 rectangular lateral blotches; a well-developed teardrop; a small and inky black, median caudal spot; a small black spot in the anterior rays of the first dorsal fin; 13–15 dorsal spines; two anal spines; 65–75 lateral-line scales; the upper lip bound to the snout by a well-developed frenum; and gill covers not connected at the isthmus. The breeding male darkens, becomes more yellowish, and has a more intense pattern. The species most closely resembles the dusky darter but differs in having the median black dot on the caudal peduncle, gill covers free at the isthmus, and a strong teardrop, and in lacking a downward expansion of the terminal lateral blotch. The small young lacks the teardrop but otherwise can be distinguished by the characters just listed. The species attains a length of about 100 mm (4 inches).



Distribution of the blackside darter in Illinois.

Variation.—No subspecies have been described for this rather wide-ranging species, and no trends in geographic variation are known.

Ecology.—The blackside darter is most abundant in firm-bottomed pools of creeks and small rivers, but it sometimes ascends into headwaters. According to Thomas (1970:8–12), who did a study of a population in the Kaskaskia River, its food consists of immatures of aquatic insects and small crustaceans. Spawning occurs in May in gravelly or coarse sand riffles. The details of spawning behavior are summarized in Winn (1958*a* and 1958*b*). Growth and population structure were discussed by Thomas (1970:12–16). The species is known to live for almost four years.

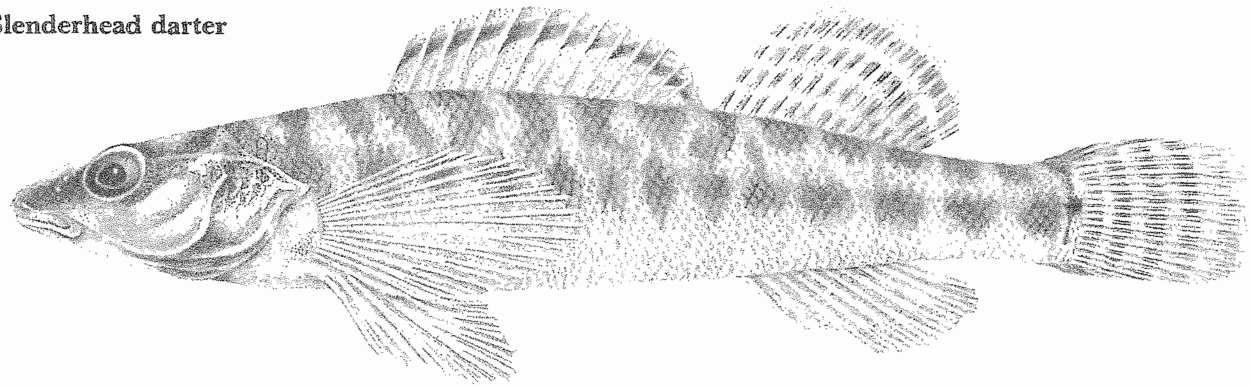
Distribution.—The blackside darter occurs in all parts of Illinois, but it is far more generally distributed in the eastern than in the western part of the state. Although still common in the eastern half of the state, it shows evidence of considerable decimation even there. It must have once been extremely abundant in the small, clear, meandering, prairie streams of Illinois.

Slenderhead darter
Percina phoxocephala (Nelson)

Etheostoma phoxocephalum Nelson 1876:35 (type-locality: Illinois River and its tributaries, Illinois).
Alvordius phoxocephalus: Jordan 1878:39; O'Donnell 1935:488.
Hadropterus phoxocephalus: Forbes 1884:65; Large 1903:27; Forbes & Richardson 1908:285–286.
Percina phoxocephala: Smith 1965:10.

Diagnosis.—The slenderhead darter is a slender darter, tan or pale olive, with dim and irregular

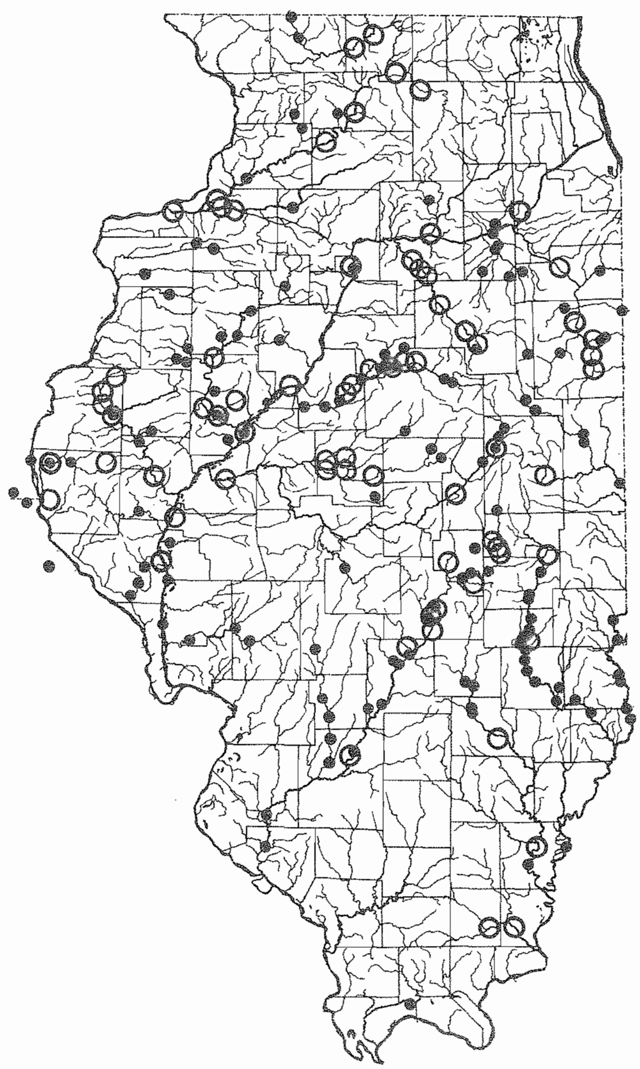
Slenderhead darter



brown saddles well separated from 10–12 vague and more or less confluent blotches of greenish or brownish color along the sides, a prominent preorbital stripe but usually no teardrop, a discrete median caudal spot of black, a dark humeral spot, a submarginal row of orange spots in the first dorsal fin, a much-produced snout, the upper lip bound to the snout by a frenum, gill covers rather broadly connected at the isthmus, 60–70 lateral-line scales, 12 or 13 dorsal spines, and two anal spines. The breeding male becomes very dusky over the body and fins, and its dorsal rays are outlined with yellow. The pattern is intensified but except for the overall duskiness is not too different from that of the adult female. The body and head shape and the distinctive pattern set this species off from other Illinois darters, and even the small young is easily recognized. The species attains a length of about 100 mm (4 inches).

Variation.—No subspecies are recognized, and there is evidently little geographic variation in this species, which has a relatively small range. Specimens from southern Illinois occasionally have a weakly developed teardrop.

Ecology.—The preferred habitat is shallow raceways and riffles over sand-gravel bottoms in medium-sized to large rivers. The slenderhead darter occasionally occurs in primarily sand-bottomed raceways, but rarely can be found over silty bottoms. It generally avoids small streams but may be present there when water levels are low. Its food has been extensively studied in Illinois by Thomas (1970:8–12) and Page & Smith (1971) and is similar to that of other large darters. It spawns during a short time, usually in the first half of June, over fast gravelly raceways. Reproductive details and other aspects of its life history were studied by

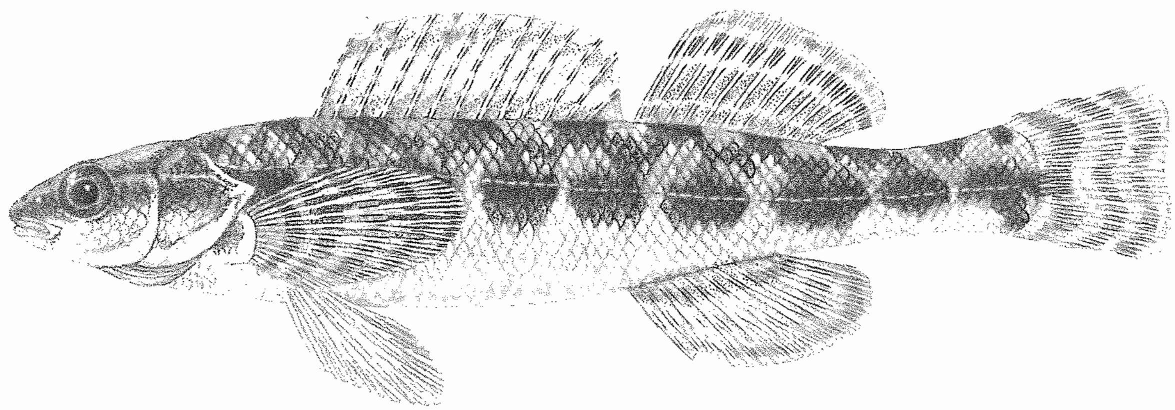


Distribution of the slenderhead darter in Illinois.

Page & Smith (1971). The species usually lives less than 3 years.

Distribution.—The slenderhead darter is statewide and generally distributed except in extreme southern and northern Illinois. It is locally common but has been extirpated from several streams in the state as a result of siltation or deterioration of water quality.

Dusky darter
Percina sciera (Swain)



Hadropterus scierus Swain 1883:252 (type-locality: Bean Blossom Creek, Monroe County, Indiana); Large 1903:27 (recorded from Illinois); Forbes & Richardson 1908:289–290.
Serraria sciera: O'Donnell 1935:489.
Percina sciera: Smith 1965:10.

Diagnosis.—The dusky darter is a moderately slender darter, pale olive green or grayish-yellow above and whitish below, with 8–10 squarish black saddles well separated from 7–10 blackish lateral blotches; the terminal lateral blotch expanded downward and fused with the lowermost of three caudal spots, the median caudal spot not more intense than the spots above and below it; no teardrop; no blotches in the first dorsal fin; 13–15 dorsal spines; two anal spines; usually 57–70 lateral-line scales; the upper lip bound to the snout by a well-developed frenum; and gill covers moderately connected at the isthmus. The breeding male darkens overall, and the lateral blotches become broad lateral bands. In the breeding male a pale orange band is present on the distal margin of the first dorsal fin, and its posterior membranes develop a blackish blotch. The species most closely resembles the blackside darter but lacks the inky black, median caudal spot and teardrop and has moderately connected gill membranes and the distinctively expanded, terminal lateral blotch. The young is easily distinguished by the nature of the last lateral blotch. The species attains a length of about 110 mm (4½ inches).

Variation.—Studies of geographic variation in the species were published simultaneously by Hubbs & Black (1954) and Hubbs (1954), the latter recognizing the population in the Guadalupe River system of Texas as a distinct subspecies. The Illinois subspecies is *P. s. sciera.*

Ecology.—The dusky darter occupies deep raceways and riffles over a predominantly gravel bottom in medium-sized to large rivers. It is intolerant of turbidity, silt, and pollution, and is usually found only in channels with moderate to fast current. Its food consists primarily of midge and blackfly larvae but includes immature stages of other aquatic insects. Spawning occurs in late May and early June, when water levels are normal, over gravel in fast riffles and raceways. The feeding and reproductive habits as well as other aspects of the life history were studied in detail by Page & Smith (1970). Most individuals are sexually mature in their 2nd year, and although the species is known to live more than 4 years, most of them survive barely past their 3rd year.

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EXHIBIT D

MICROHABITAT PREFERENCES OF SELECTED STREAM FISHES AND A COMMUNITY-ORIENTED APPROACH TO INSTREAM FLOW ASSESSMENTS

by

Luther P. Aadland
Chantel M. Cook
Mary T. Negus
Henry G. Drewes
Charles S. Anderson

Minnesota Department of Natural Resources
Section of Fisheries

TABLE 12. Species-life stages which preferred deep pools (>=150 cm deep) in the Zumbro (Z) or Snake (S) river. Number of observations (N) refers to the total number collected in the river or rivers indicated. Life stages listed are adult (A), juvenile (J), young of the year (Y), fingerling 60-99 mm (FI), fry <60 mm (FR), and spawning (S).

Common name	Scientific name	Life stage	N	River
Cyprinidae				
Common shiner	*Notropis cornutus*	Y	31	S
Spotfin shiner	*Notropis spilopterus*	A	323	S
Catastomidae				
Golden redhorse	*Moxostoma erythrurum*	A	26	S,Z
Silver redhorse	*Moxostoma anisurum*	J	16	S
White sucker	*Catastomus commersoni*	A	6	S
Ictaluridae				
Channel catfish	*Ictalurus punctatus*	A	7	S,Z
Centrarchidae				
Black crappie	*Pomoxis nigromaculatus*	A	21	Z
Black crappie	*Pomoxis nigromaculatus*	J	87	Z
Bluegill	*Lepomis macrochirus*	J	169	Z
Largemouth bass	*Micropterus salmoides*	Y	133	Z
Smallmouth bass	*Micropterus dolomieui*	A	74	Z
Percidae				
Johnny darter	*Etheostoma nigrum*	Y	12	S
Yellow perch	*Perca flavescens*	A	14	Z

TABLE 13. Species-life stages which preferred raceways (60-149 cm deep, >=30 cm/s velocity) in the Zumbro (Z), Snake (S), or Yellow Medicine (YH=spring high flow) river. Number of observations (N) refers to the total number collected in the river or rivers indicated. Life stages listed are adult (A), juvenile (J), young of the year (Y), fingerling 60-99 mm (FI), fry <60 mm (FR), and spawning (S).

Common name	Scientific name	Life stage	N	River
Cyprinidae				
Carp	*Cyprinus carpio*	A	23	YH
Catastomidae				
Northern hog sucker	*Hypentellium nigricans*	A	295	Z
Shorthead redhorse	*Moxostoma macrolepidotum*	A	562	S,Z
Shorthead redhorse	*Moxostoma macrolepidotum*	J	188	S,Z
Ictaluridae				
Stonecat	*Noturus flavus*	A	12	S
Centrarchidae				
Smallmouth bass	*Micropterus dolomieui*	A	32	S
Smallmouth bass	*Micropterus dolomieui*	J	204	S
Percidae				
Log Perch	*Percina caprodes*	S	8	Z

TABLE 14. Species-life stages which preferred slow riffles (<60 cm deep, 30-59 cm/s velocity) in the Zumbro (Z), Snake (S), or Yellow Medicine (Y, YL=summer low flow, YH=spring high flow) river. Number of observations (N) refers to the total number collected in the river or rivers indicated. Life stages listed are adult (A), juvenile (J), young of the year (Y), fingerling 60-99 mm (FI), fry <60 mm (FR), and spawning (S).

Common name	Scientific name	Life stage	N	River
Cyprinidae				
Bluntnose minnow	*Pimephales notatus*	A	50	S
Carp	*Cyprinus carpio*	Y	8	S
Creek chub	*Semotilis atromaculatus*	Y	122	Z
Common shiner	*Notropis cornutus*	A	225	Z
Common shiner	*Notropis cornutus*	S	8	Z
Central stoneroller	*Campostoma anomalum*	A	1979	Y,Z
Central stoneroller	*Campostoma anomalum*	J	864	Z
Emerald shiner	*Notropis atherinoides*	A	4016	Z
Hornyhead chub	*Nocomis biguttatus*	A	46	S,Y
Largescale stoneroller	*Campostoma oligolipis*	A	64	YL
Largescale stoneroller	*Campostoma oligolipis*	J	25	YL
Longnose dace	*Rhinichthys cataractae*	A	324	S
Longnose dace	*Rhinichthys cataractae*	S	25	Z
Mimic shiner	*Notropis volucellus*	A	38	Z
River shiner	*Notropis blennius*	A	1899	Z
Sand shiner	*Notropis stramineus*	A	630	Z
Sand shiner	*Notropis stramineus*	S	26	Z
Spotfin shiner	*Notropis spilopterus*	A	2413	YL
Spotfin shiner	*Notropis spilopterus*	Y	1513	YL
Spotfin shiner	*Notropis spilopterus*	S	111	Z
Suckermouth minnow	*Phenacobius mirabilis*	A	8	Z
Catastomidae				
Golden redhorse	*Moxostoma erythrurum*	J	7	Z
Golden redhorse	*Moxostoma erythrurum*	S	9	Z,YH
Greater redhorse	*Moxostoma valenciennesi*	S	16	YH
Northern hog sucker	*Hypentellium nigricans*	A	49	S,YH
Northern hog sucker	*Hypentellium nigricans*	J	17	S,YL
Northern hog sucker	*Hypentellium nigricans*	S	31	Z,YH
River redhorse	*Moxostoma carinatum*	A	35	S
Shorthead redhorse	*Moxostoma macrolepidotum*	Y	443	Z
Silver redhorse	*Moxostoma anisurum*	Y	45	Z
White sucker	*Catastomus commersoni*	J	1254	Z
White sucker	*Catastomus commersoni*	Y	1647	Z
Ictaluridae				
Stonecat	*Noturus flavus*	J	6	YL
Centrarchidae				
Smallmouth bass	*Micropterus dolomieui*	J	15	Y
Percidae				
Banded darter	*Etheostoma zonale*	A	109	YL
Banded darter	*Etheostoma zonale*	Y	6	YL
Blackside darter	*Percina maculata*	Y	48	Z
Blackside darter	*Percina maculata*	A	6	S,YL

Table 14 (continued)

Common name	Scientific name	Life stage	N	River
Fantail darter	*Etheostoma flaballare*	A	24	YL
Fantail darter	*Etheostoma flaballare*	Y	5	YL
Johnny darter	*Etheostoma nigrum*	Y	465	Z
Log Perch	*Percina caprodes*	Y	29	Z
Rainbow darter	*Etheostoma caeruleum*	A	29	YL
Rainbow darter	*Etheostoma caeruleum*	Y	9	YL
Slenderhead darter	*Percina phoxocephala*	A	169	YL,Z

TABLE 15. Species-life stages which preferred fast riffles (<60 cm deep, >=60 cm/s velocity) in the Zumbro (Z), Snake (S), or Yellow Medicine (Y, YL=summer low flow, YH=spring high flow) river. Number of observations (N) refers to the total number collected in the river or rivers indicated. Life stages listed are adult (A), juvenile (J), young of the year (Y), fingerling 60-99 mm (FI), fry <60 mm (FR), and spawning (S).

Common name	Scientific name	Life Stage	N	River
Cyprinidae				
Central stoneroller	*Campostoma anomalum*	Y	1178	Z
Longnose dace	*Rhinichthys cataractae*	A	409	Z
Longnose dace	*Rhinichthys cataractae*	Y	69	Z
Catastomidae				
Northern hog sucker	*Hypentellium nigricans*	J	176	YH,Z
Shorthead redhorse	*Moxostoma macrolepidotum*	A	48	YH
Shorthead redhorse	*Moxostoma macrolepidotum*	S	159	YH
Ictaluridae				
Stonecat	*Noturus flavus*	J	23	S
Stonecat	*Noturus flavus*	Y	14	S
Centrarchidae				
Smallmouth bass	*Micropterus dolomieui*	FI	60	S
Percidae				
Banded darter	*Etheostoma zonale*	A	1178	Z,YH
Banded darter	*Etheostoma zonale*	S	57	Z,YH
Banded darter	*Etheostoma zonale*	Y	121	Z,YH
Blackside darter	*Percina maculata*	A	16	Z
Gilt darter	*Percina evides*	A	8	S
Gilt darter	*Percina evides*	Y	8	S
Log perch	*Percina caprodes*	A	736	Z,S
Rainbow darter	*Etheostoma caeruleum*	A	82	Z,YH
Rainbow darter	*Etheostoma caeruleum*	S	31	Z,YH
Slenderhead darter	*Percina phoxocephala*	A	88	S,YH
Slenderhead darter	*Percina phoxocephala*	S	42	Z,YH
Fantail darter	*Etheostoma flaballare*	S	12	YH

Shallow pool guild

The shallow pool guild was made up largely of shiners (*Notropis spp.*), young-of-the-year suckers (Catostomidae), and sunfishes (Table 10). Habitat used by these fishes was usually found along the channel margin (Table 4).

Medium pool guild

The medium pool guild consisted of sunfishes, adult cyprinids and many of the predatory fishes (Table 11). Medium pools had a variety of cover and substrate types (Table 5). Many of the members of this guild were relatively ubiquitous, and were found in different habitat types in different rivers.

Deep pool guild

Members of the deep pool guild included several shiners (*Notropis* spp.), sunfishes, suckers and channel catfish (Table 12). These fish used the deepest water available (Table 6). Many of the deep pool guild members are species which do not typically occur in streams without lake influence or are ubiquitous in their habitat use. Channel catfish adults are the exception to this generalization and were consistently found in the deepest available pools in all study streams.

Raceway guild

The raceway guild was comprised of juvenile and adult suckers (northern hog sucker and *Moxostoma* spp.) and, in the Snake river, by juvenile and adult smallmouth bass (Table 13). These fishes used areas which had moderate velocity and depth, large substrates and boulder or no cover (Table 7). Raceways had relatively low species diversity but probably possessed the highest fish biomass of the habitat types since they had high densities of large fishes.

Slow riffle guild

Slow riffles were preferred by more species-life stages than any of the other habitat types. Adult and young of the year darters (*Etheostoma* spp.), adult and juvenile stonerollers (*Campostoma* spp.), adult and spawning shiners, and adult and spawning suckers typified riffle assemblages (Table 14). The habitat used by these fishes was shallow with moderate to high velocities, gravel, cobble, or rubble substrate and vegetation or boulder cover (Table 8).

Fast riffle guild

Fast riffles were preferred by juvenile and adult longnose dace, adult, young of the year and spawning darters, spawning shorthead redhorse and juvenile northern hog sucker (Table 15). These species-life stages were found in the highest velocity areas which were shallow and had cobble or rubble substrates, and boulder or vegetation cover (Table 9).

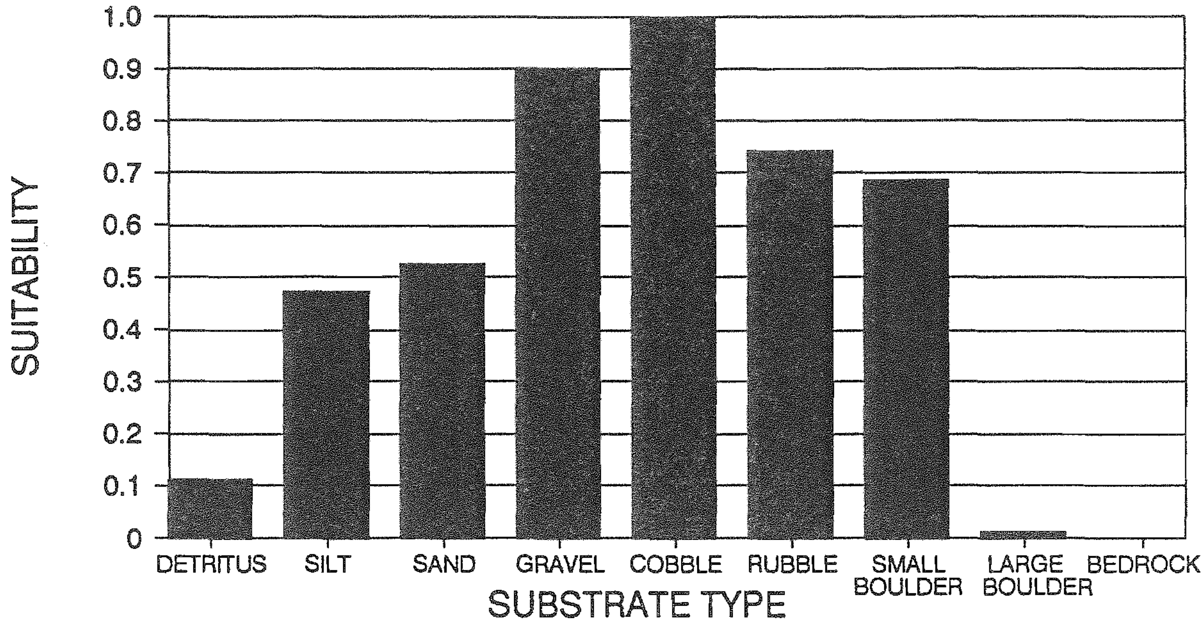

FIGURE 77. Dominant substrate preference of adult log perch (>or=60 mm) in the Zumbro and Snake rivers (number of individuals=736, number of samples=177).

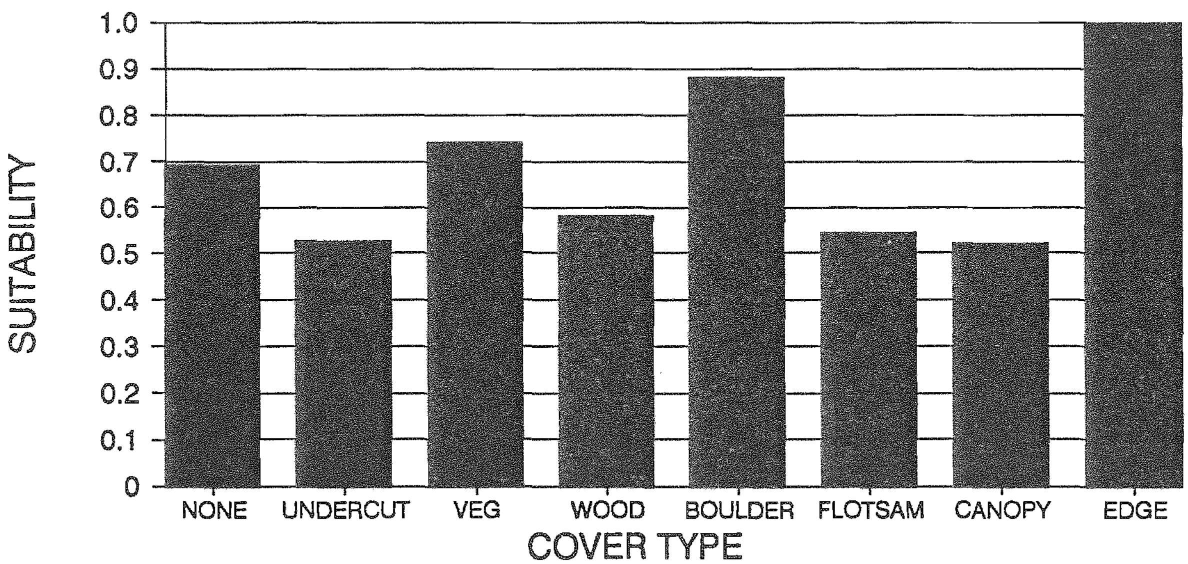

FIGURE 78. Cover preference of adult log perch (>or=60 mm) in the Zumbro and Snake rivers (number of individuals=736, number of samples=177).

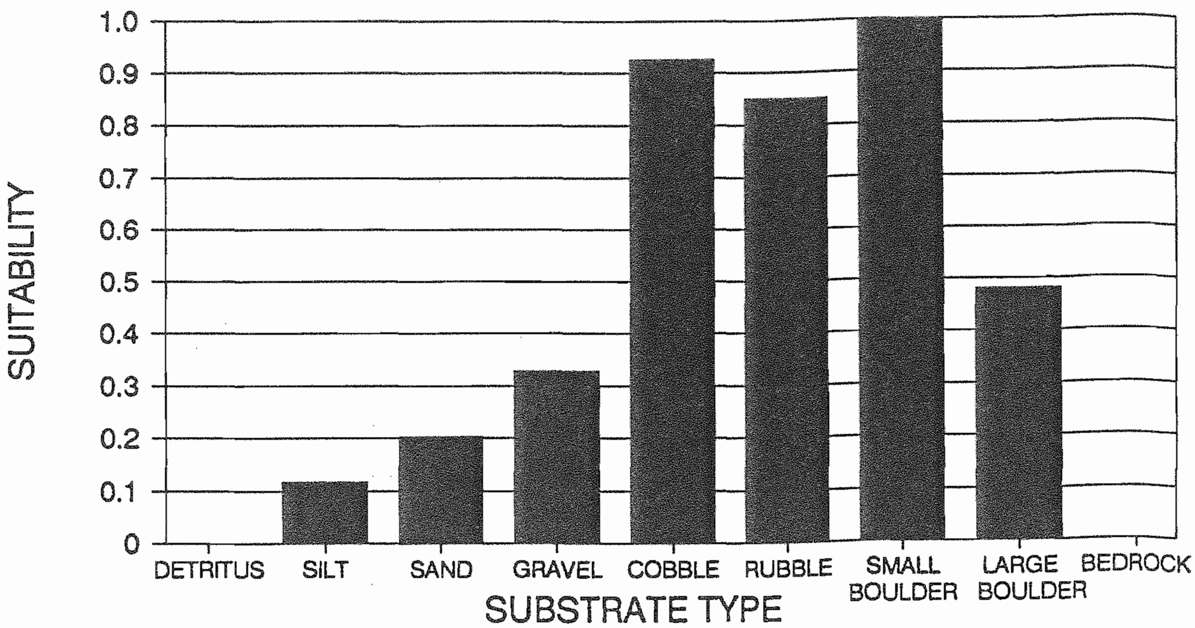

FIGURE 105. Dominant substrate preference of adult slenderhead darters (>or=40 mm) in the Zumbro, Snake, and Yellow Medicine rivers (number of individuals=257, number of samples=126).

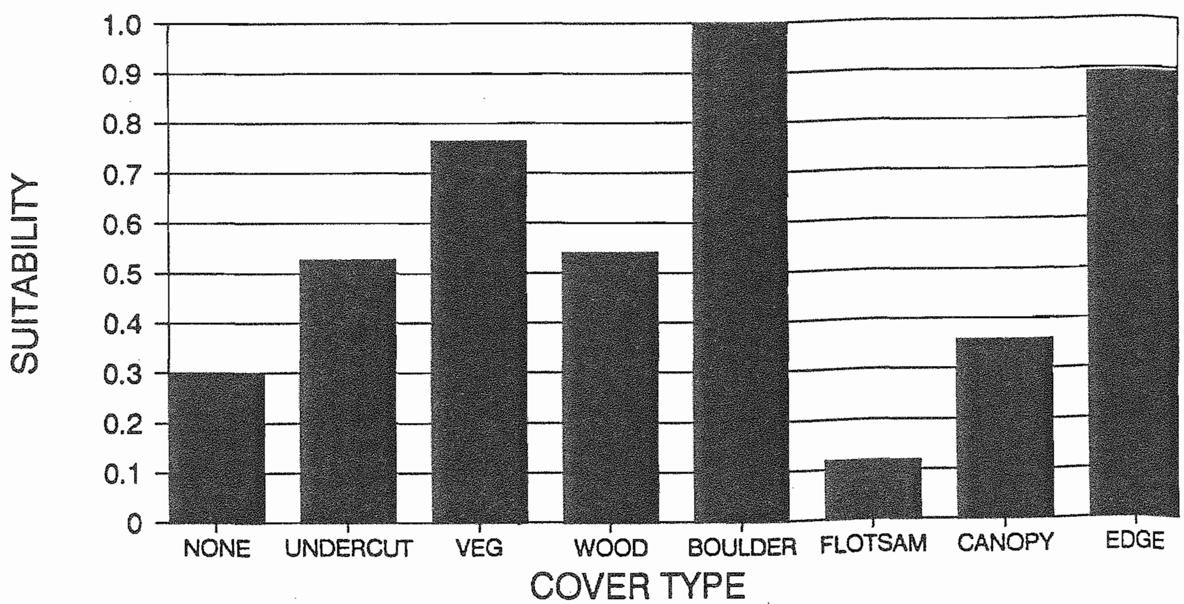

FIGURE 106. Cover preference of adult slenderhead darters (>or=40 mm) in the Zumbro, Snake, and Yellow Medicine rivers (number of individuals=257, number of samples=126).

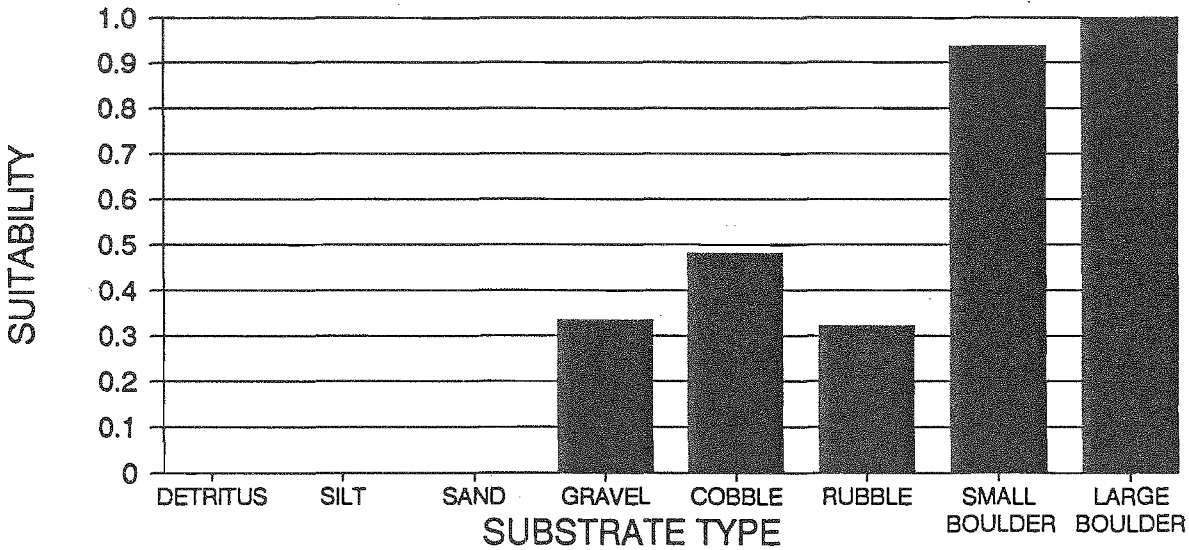

FIGURE 109. Dominant substrate preference of spawning slenderhead darter in the Yellow Medicine and Zumbro rivers (number of individuals=42, number of samples=19).

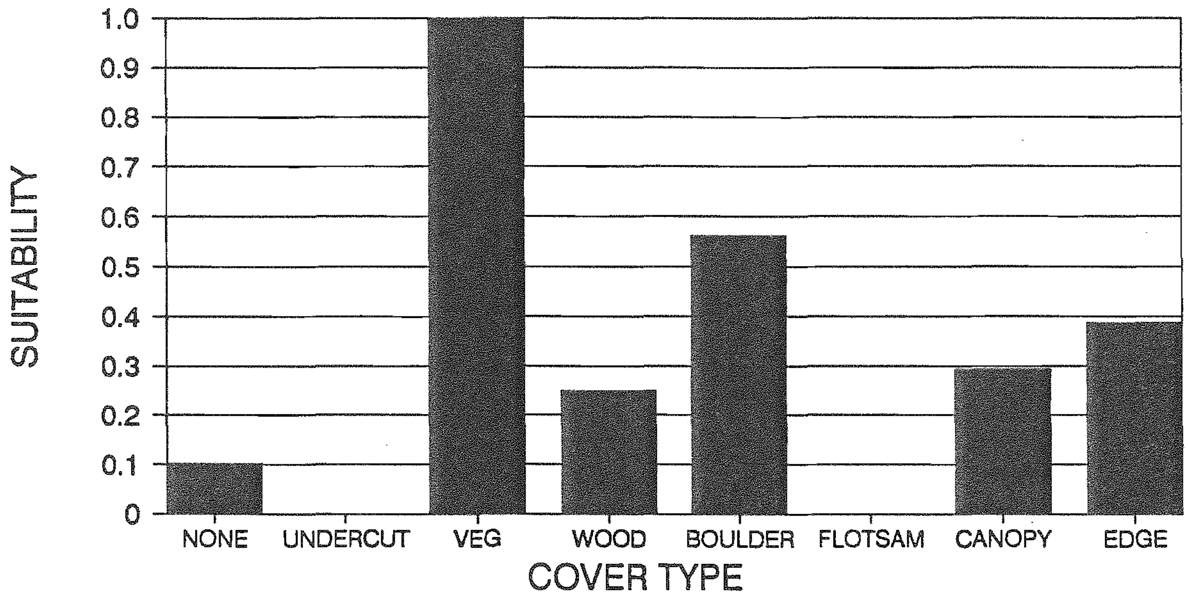

FIGURE 110. Cover preference of spawning slenderhead darter in the Yellow Medicine and Zumbro rivers (number of individuals=42, number of samples=19).

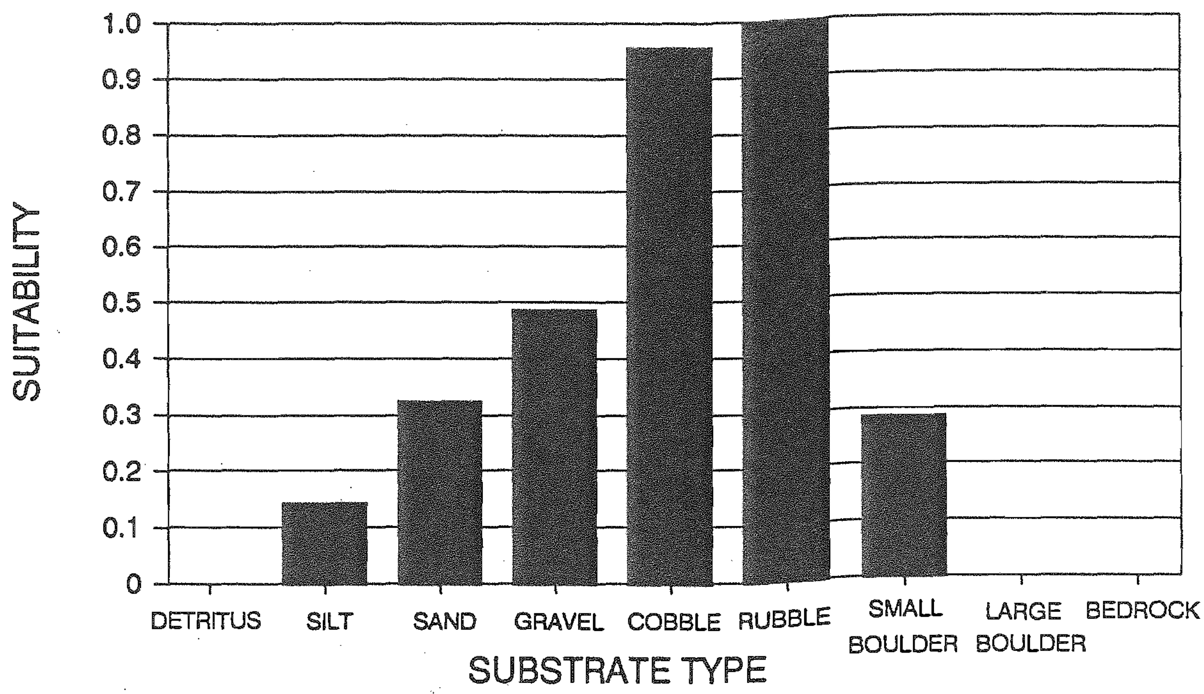

FIGURE 121. Dominant substrate preference of adult shorthead redhorse (>250 mm) in the Zumbro river (number of individuals=357, number of samples=106; weighted data).

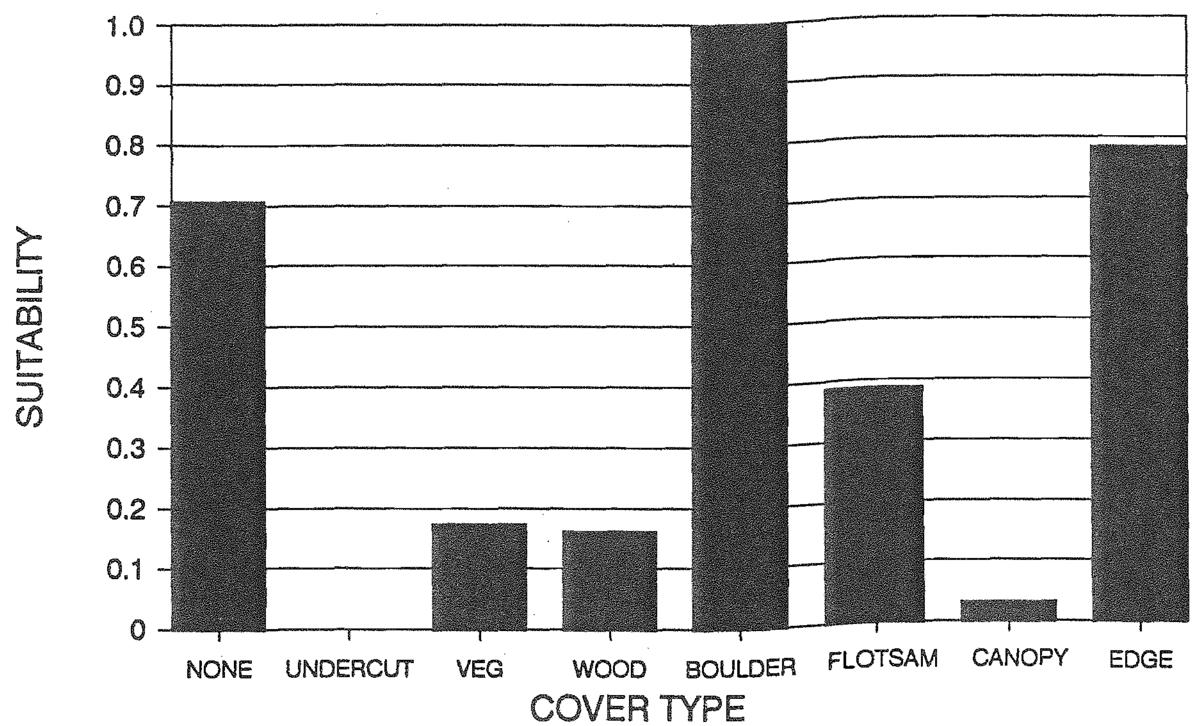

FIGURE 122. Cover preference of adult shorthead redhorse (>250 mm) in the Zumbro river (number of individuals=357, number of samples=106; weighted data).

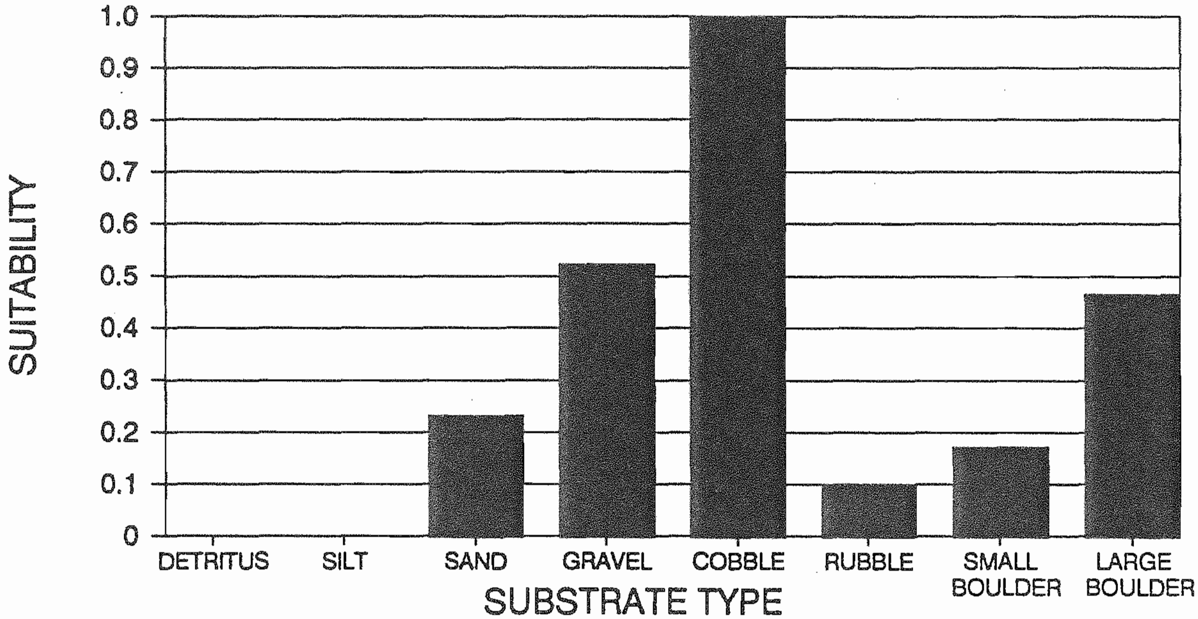

FIGURE 125. Dominant substrate preference of spawning shorthead redhorse in the Yellow Medicine and Zumbro rivers (number of individuals=160, number of samples=20).

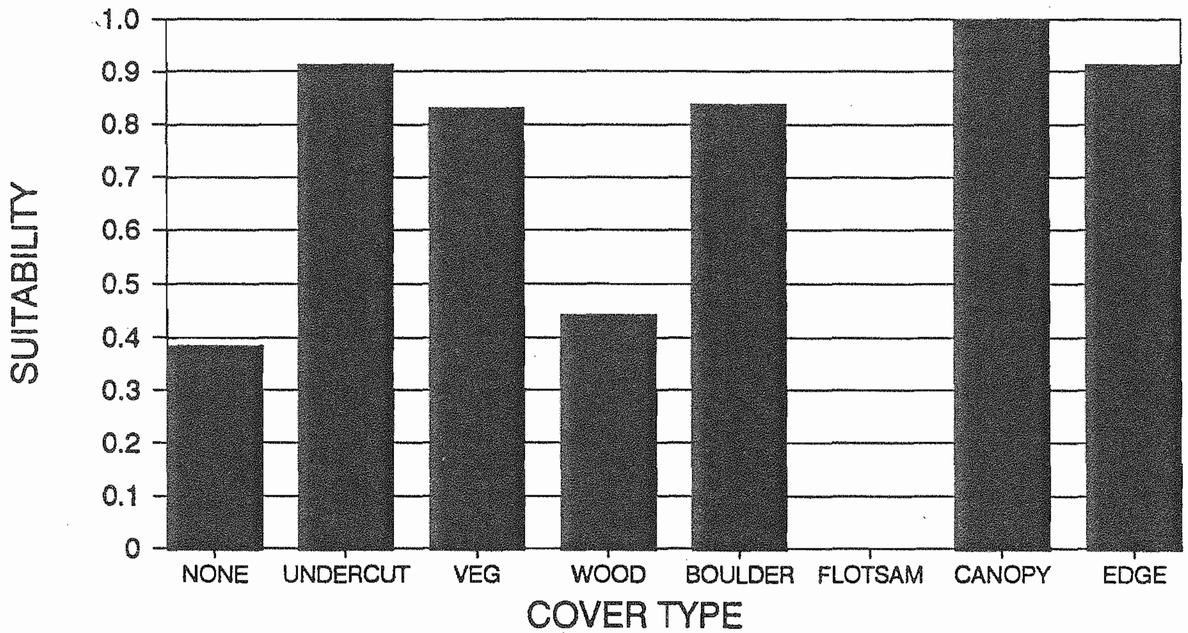

FIGURE 126. Cover preference of spawning shorthead redhorse in the Yellow Medicine and Zumbro rivers (number of individuals=160, number of samples=20).

EXHIBIT E

Yoder, C.O. and E.T. Rankin. 1996. Assessing the condition and status of aquatic life designated uses in urban and suburban watersheds, pp. 201-227. *in* Roesner, L.A. (ed.). Effects of Watershed Development and Management on Aquatic Ecosystems, American Society of Civil Engineers, New York, NY.

Assessing the Condition and Status of Aquatic Life Designated Uses in Urban and Suburban Watersheds

Chris O. Yoder and Edward T. Rankin[1]

Abstract

Ohio EPA employs biological, chemical, and physical monitoring and assessment techniques in biological surveys in order to meet three major objectives: 1) determine the extent to which use designations assigned in the Ohio Water Quality Standards (WQS) are either attained or not attained; 2) determine if use designations assigned to a given water body are appropriate and attainable; and 3) determine if any changes in key ambient biological, chemical, or physical indicators have taken place over time, particularly before and after the implementation of point source pollution controls or best management practices for nonpoint sources. Biological criteria are one of the principal assessment tools by which the status of water bodies is determined in Ohio. The results of biological monitoring in selected small urban Ohio watersheds shows a tendency towards lower biological index scores with an increasing degree of urbanization and allied stressors, becoming more severe as other impact types such as combined sewer overflows (CSOs) and industrial sources coincide. Out of 110 sampling sites examined only 23% exhibited good, very good, or exceptional biological index scores. Of the sites classified as being impacted by urban sources, only two sites (4.5%) attained the applicable biological criteria. Poor or very poor scores occurred at the majority of the urban impacted sites (85%). More than 40% of suburban sites were impaired with many reflecting the impact of new developments for housing and commercial uses. The results demonstrate the degree of degradation which exists in most small urban Ohio watersheds and the difficulties involved in dealing with these multiple and diffuse sources of stress. Well designed biological surveys using standardized methods and calibrated indicators can contribute essential

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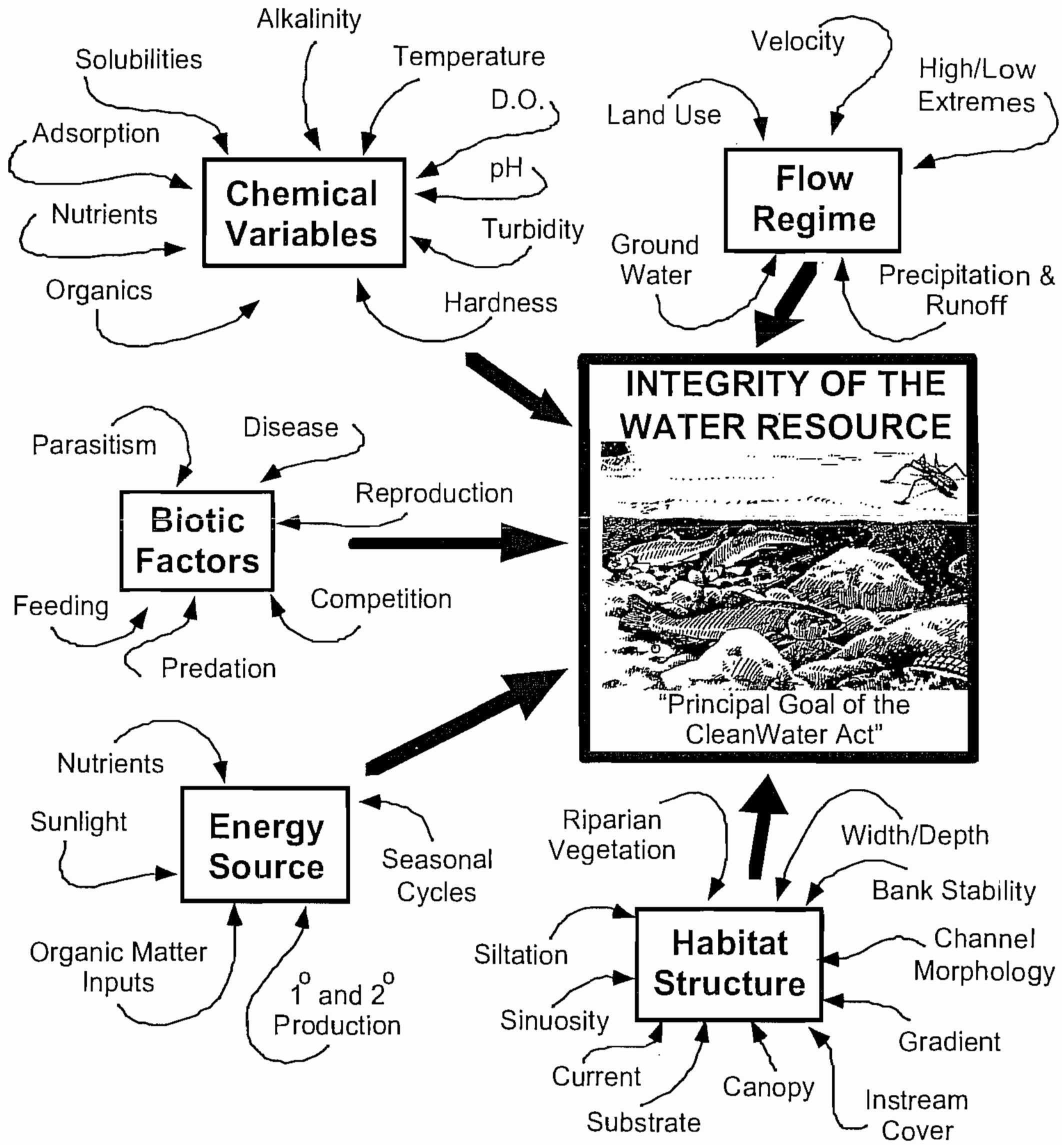

Figure 1. The five principal factors, with some of the important chemical, physical, and biological subcomponents, that influence and determine the integrity of surface water resources (modified from Karr et al. 1986).

While much attention is generally paid to toxic substances in urban nonpoint source runoff, evidence suggests that non-toxic impacts are also significant, at least in Ohio and the midwest. Sedimentation (or siltation) resulting from urban and other land use activities is a major impact from urban nonpoint sources and was the second leading cause of impairment (from all sources) identified by the 1994 Ohio Water Resource Inventory (Ohio EPA 1994). Since 1988, this cause category has surpassed ammonia and heavy metals, classes of pollutants most commonly associated with point sources, in rank. Sedimentation is responsible for more impairment (over 1400 miles of stream and rivers and 23,000 acres of lakes, ponds, and reservoirs) than any other category except organic enrichment/dissolved oxygen (D.O.), with which it is closely allied in both urban and agricultural areas.

Watershed impermeability has recently been suggested as an overall indicator of the level of "watershed stress" in terms of being correlated with an increasing degradation of aquatic life (Schueler 1994; Arnold and Gibbons 1996). Imperviousness has been correlated with an increased risk of impairment not only due to adverse effects on watershed hydrology, but as a product of other impacts such as contaminated runoff, more frequent spills, and increasingly severe habitat impacts which correspond to this stressor indicator. In the two papers we reviewed on this subject, watershed imperviousness was negatively correlated with the condition of the aquatic biota with degradation becoming significant at 25-30% within a watershed. While we did not quantify this factor in our Ohio urban/suburban watershed examples (Figures 4 and 5) it seems plausible that imperviousness would be correlated with the results, particularly for small watersheds.

Use Attainability Issues in Urban and Suburban Ohio Watersheds

An emerging issue of increasing importance related to the preceding discussion and to the restoration and management of small urban watersheds is that of use attainability. An important objective of the biosurveys conducted by Ohio EPA is to determine the appropriate and attainable aquatic life use designation. If the results of the sampling and data analysis suggest that an existing use designation is inappropriate (or the stream is presently unclassified) an appropriate use is then recommended. These recommendations are proposed in a WQS rulemaking procedure and adopted after consideration of public input.

The issue of urban and suburban development and the effects of each on aquatic life use attainment in rivers and streams has increased in importance within the surface water programs at Ohio EPA. Small watersheds in established, older urban settings are particularly at issue because of regulatory concerns such as CSOs and stormwater management. As was amply demonstrated by our Ohio examples (Figures 4 and 5), small streams in historically developed urban areas are not only impaired, but severely so. This is generally due to multiple factors including chemical effects, physical habitat modifications, lack of sustained flows during normally recurring dry weather periods, higher peak flows during wet weather periods, and watershed scale modifications of land use characteristics. Overlapping regulatory programs such as NPDES permits for point sources, CSO and sanitary sewer overflow (SSO) control and remediation, stormwater management, and construction site management are commonplace throughout Ohio. The regulatory and/or management requirements associated with each are driven, in part, by the Ohio WQS. In our efforts to develop strategies to protect and restore designated uses the question of use attainability frequently arises. It is widely perceived that the restoration of designated aquatic life uses consistent with the goals of the CWA (*i.e.*, WWH) in intensively urbanized areas is neither practical nor attainable. This in itself can present a premature barrier to the management goal of restoring full use attainment or upgrading use designations for waters now classified for less than CWA goal uses.

The assignment of appropriate and attainable aquatic life uses is a challenge that Ohio EPA has dealt with over the past 20 years. Our approach has relied heavily on experience with observing biological responses to different types of impacts and the habitat assessment provided with the QHEI. Generally speaking if the QHEI reveals that instream habitat is sufficient *on a watershed or reach length scale* to support an assemblage of aquatic life consistent with the WWH use, that use is adopted. Classification of waters to a less than CWA goal use designation such as MWH or LRW requires a showing that the WWH biocriteria are not attained and that habitat is an overriding and precluding factor in the non-attainment. In effect it must be demonstrated that the WWH use is not attainable in the foreseeable future. Rankin (1995) has shown at what point habitat becomes a precluding factor by examining the various attributes of the QHEI which correlate with WWH attainment and non-attainment at sites where non-habitat impacts are minimal. Figure 7 exemplifies this phenomenon by contrasting ranges of IBI values that correspond to the five narrative categories with the ratio of modified:warmwater habitat attributes (as defined by Rankin 1989) which increases as habitat becomes deficient in terms of being able to support an assemblage of aquatic life consistent with the WWH biocriteria. As the predominance of modified habitat attributes increase to a modified:warmwater ratio of greater than 1.0-1.5 the likelihood of having IBI scores consistent with the WWH use declines. This relationship bears out better where the QHEI score and attributes ratios are analyzed on a reach length or watershed scale (Rankin 1995).

The decision to assign a less than CWA goal use (*e.g.*, MWH or LRW) must also meet the conditions prescribed by the U.S. EPA WQS regulations (40 CFR, Part 131) that restoring to a higher designated use would result in widespread, adverse social and economic impacts or the higher use is not attainable due to irretrievable effects of anthropogenic origin or natural conditions. The most frequently used reason for assigning either the MWH or LRW uses in Ohio is due to irretrievable physical effects. For example, the MWH use designation applies in situations of wide-spread stream habitat modifications for agricultural drainage purposes (*e.g.*, channelization) *and* where that activity is sanctioned by state and/or federal law. Less frequently encountered habitat modifications include run-of-river impoundment by low head dams, or heavy sedimentation due to non-acidic mine drainage and where reclamation activities are not expected. The LRW use applies to cases of severe, watershed-wide drainage modifications and acidic mine drainage where reclamation activities are not expected. With the exception of isolated instances of direct channelization, the most frequently encountered situation with small urban streams is the severe disruption of local habitat such as riparian encroachment and removal, replacement of the natural substrate with artificial materials (*e.g.*, concrete, rock-basket gabions), and broad scale watershed modifications. In such cases the QHEI scores are frequently reflective of poor or very poor habitat quality yielding extremely high modified:warmwater habitat ratios (Fig. 7). In such cases flow conditions may also be ephemeral or inadequate to support any except the most tolerant forms of aquatic life, or the stream is virtually eliminated by culverting. Such situations are relatively easy to diagnose and assignment of the LRW use is the result.

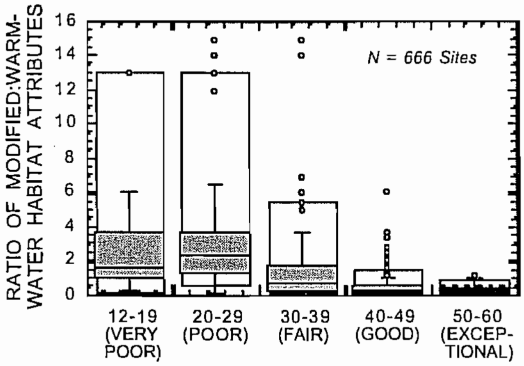

Figure 7. Relationship between the ratio of modified:warmwater habitat attributes and ranges of the IBI corresponding to the five narrative categories of biological community performance. The data is from a set of least impacted and habitat modified reference sites throughout Ohio. This analysis employs a box-and-whisker plot showing the median, interquartile, maximum, minimum, 90th and 10th percentile, and outlier IBI values.

The situation is different when the habitat evaluation indicates that sufficient warmwater attributes are present to suggest attainment of WWH is possible. In such cases WWH is viewed as attainable (as the data from several of our small urban/suburban watersheds suggest) even though the aquatic communities only perform in the poor or very poor ranges. As previously mentioned the impairment may be due to sources which theoretically could be abated or sufficiently controlled, thus resulting in the full restoration of the WWH use. The key point here is that uses are based on potential, not the present-day biological attainment status. However, the challenges of managing stressors such as spills, runoff, and CSOs is daunting because of the diffuse nature of these sources and the periodicity of their influence. In some of our urbanized watersheds the attainability of the WWH use has recently come into question even when the QHEI data suggests that WWH is attainable. This issue has become more complicated in light of the recent information about the potential of imperviousness to influence biological performance in urban watersheds (Schueler 1994; Arnold and Gibbons 1996).

Managing CSOs is a growing challenge for Ohio EPA and other local, state, and federal agencies. Current policy involves the establishment of a state-specific strategy and implementation of nine minimum controls by major CSO entities. In some of the major CSO communities of Ohio, questions have been raised about the attainability of the WWH biological criteria and how this might eventually affect CSO abatement strategies. While these questions may have merit in light of the recent literature concerning imperviousness and our own findings about the extent of aquatic life impairment in small urban watersheds, it would be premature to in effect "give up" on WWH attainment without first implementing the nine minimum CSO controls. In addition, resolving this issue will involve an examination of many other factors in addition to imperviousness on a broad geographic scale. Until this type of exploratory research is completed making fundamental changes to the use designation process would be premature.

Applications to the Management of Urban Watersheds

Steedman (1988) observed the IBI to be negatively correlated with urban land use. The land use within the 10-100 km^2 of a site was the most important in predicting the IBI which suggests that "extraneous" information was likely included if whole watershed land use information was used. Thus, scale will be another important consideration in the assessment of urban watersheds. Steedman (1988) also discovered that the condition of the riparian zone was an important covariate with land use, in addition to other factors such as sedimentation and nutrient enrichment. A model relationship between land use and riparian zone quantity and the IBI was developed. This relationship provided the basis to predict when the IBI would decline below a certain threshold level based on combinations of riparian zone quantity and percent of urbanization. In the Steedman (1988) study the domain of degradation for Toronto area streams ranged from 75% riparian removal at 0% urbanization to 0% riparian removal at 55% urbanization. These results indicate that it is possible to establish the bounds within which the combination of watershed land use and riparian zone quantity must be maintained in order to attain a target level of biological community performance as measured by the IBI. It seems plausible that such relationships could be established for many other watersheds provided the

EXHIBIT F

Valley Creek, Alabama UAA

Abstract

Complexity: Simple
Region: 4
Type of Action: Assign limited warmwater fishery use
131.10(g) Factors: 3, 5

In this 2001 use attainability analysis (UAA), the Alabama Department of Environmental Management (ADEM) provided evidence to support the proposed change for the upper segment of Valley Creek from Agricultural and Industrial Water Supply (A&I) to Limited Warmwater Fishery (LWF). The corresponding water quality criteria are more stringent for waters classified as LWF than for A&I waters. The key element of the LWF classification establishes seasonal uses and water quality criteria for waters that otherwise cannot maintain the more protective Fish & Wildlife (F&W) classification year-round. The LWF classification does not fully meet the water quality uses and criteria associated with the "fishable/swimmable" goal, and therefore a UAA was necessary. In the UAA, ADEM provided information on the physical, biological, and chemical characteristics of Valley Creek; water quality data from sampling stations; discharge monitoring reports from the point source dischargers; and water quality modeling results. EPA approved the revision to Alabama's water quality standards to reclassify Upper Valley Creek for LWF and Lower Valley Creek for F&W.

Background

The Valley Creek watershed is in north-central Alabama. Valley Creek originates in Birmingham and flows west to Bankhead Lake, an impoundment of the Black Warrior River. Valley Creek is 46 miles long and has a total drainage area of 257 square miles. Its tributaries include Blue Creek, Fivemile Creek, and Opossum Creek; all of which are designated for Fish and Wildlife (F&W) use with the exception of Opossum Creek, which is designated for Agricultural and Industrial Water Supply (A&I) use.

> ***The best uses of LWF waters include:*** agricultural irrigation, livestock watering, industrial cooling, and process water supply, and any other use except fishing, bathing, recreational activities, or as a source of water supply for drinking or food-processing purposes.
> ***The best uses of F&W waters include:*** fishing, propagation of fish, aquatic life, and wildlife, and any other use except swimming and water-contact sports or as a source of water supply for drinking or food-processing.

In August 2000 the Alabama Department of Environmental Management's (ADEM's) Environmental Management Commission adopted new water quality standards regulations that eliminated the Industrial Operations use classification. At that time the use designation of Valley Creek was changed to A&I. In 2001 ADEM conducted a use attainability analysis (UAA) to provide evidence to support a proposed use classification change for Upper Valley Creek from A&I to limited warmwater fishery (LWF). Because LWF is not a "fishable/swimmable" use as defined in Clean Water Act (CWA) section 101(a)(2), the proposed change requires a UAA. At that time ADEM also proposed that Lower Valley Creek be classified for the F&W use, which meets the goals of CWA section 101(a)(2).

Attainment of the F&W use in Upper Valley Creek is precluded by two of the 40 CFR 131.10(g) factors:

> **Factor 3:** Human caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place.

Factor 5: Physical conditions related to the natural features of the waterbody, such as the lack of a proper substrate, cover, flow, depth, pools, riffles, and the like, unrelated to water quality, preclude the attainment of aquatic life protection.

Limited Warmwater Fishery Classification

ADEM developed the LWF use classification in 2000 to establish seasonal uses and water quality criteria for waters that otherwise could not maintain the F&W criteria year-round. All provisions of the F&W use apply to the LWF use, with the exception of the criteria for dissolved oxygen (DO), bacteria, and chronic aquatic life. Table 1 provides the key differences between the F&W and LWF uses.

Table 1. Differences between F&W and LWF Uses

Classification	Criteria		
	Dissolved oxygen	Bacteria (fecal)	Chronic aquatic life
F&W	≥5.0 mg/L	For freshwater Geometric mean: ≤1000/100 mL	7-day, 10-year ($7Q_{10}$) low flow used to establish the chronic aquatic life criteria for point source discharges
		For freshwater Geometric mean: ≤200/100 mL (Incidental water contact and recreation, June through September)	
LWF	≥3.0 mg/L[a]	For Freshwater Geometric mean: ≤1000/100 mL[b]	7-day, 2-year ($7Q_2$) low flow used to establish the chronic aquatic life criteria for point source discharges

[a] Criterion applies May–November. Dissolved oxygen criterion associated with F&W classification is used December–April.

[b] Bacteriological criteria for incidental water contact and recreation during June–September are not required.

Water Quality Impairment and Pollutant Sources in the Upper Valley Creek

The Opossum Creek watershed is one of the most highly industrialized areas of Birmingham, and it contributes point source and nonpoint source pollutants to Valley Creek. In addition, a number of land uses in the Valley Creek watershed have the potential to degrade water quality. In Upper Valley Creek, industrial and commercial activities and residential land uses adversely affect water quality. The upper segment exhibits characteristics typical of an urban stream, including poor habitat, degraded water quality, and stressed biological communities due to the large amounts of impervious landscape. In addition, much of the stream has been concrete-lined, adding to algae production and fluctuations in DO.

Key Characteristics of Upper Valley Creek
• Poor DO levels • High pathogen levels • Elevated BOD • Elevated nutrient concentrations

This segment has poor DO levels, high pathogen levels, and elevated biochemical oxygen demand (BOD) and nutrient concentrations.

Three point sources operating under National Pollutant Discharge Elimination System (NPDES) permits are located in the Valley Creek watershed. The Valley Creek wastewater treatment plant (WWTP) is on Valley Creek, and two other point sources are on Opossum Creek.

Conditions in Lower Valley Creek

In the lower segment, the area is primarily rural, with silvicultural, agricultural, and mining land uses. The lower segment has improved chemical, physical, and biological conditions suitable for classification as F&W use.

Data Collection and Analysis

ADEM, the U.S. Geological Survey (USGS), and EPA conducted water quality monitoring. In a 1989 study, EPA examined biological conditions in Village, Valley, Opossum, and Fivemile creeks. Opossum Creek was cited as having poor habitat and deposits of tar-like substances, with growth impairment to the fathead minnow. In addition, the study showed mortality to daphnia at two sampling points on Valley Creek. A biological survey conducted by EPA in 1997 documented degraded habitat at two of three sampling stations in Upper Valley Creek (habitat scores of 66 and 64 versus 118 in the reference F&W stream), and fewer fish species were reported than in the lower segment. On the basis of this information, EPA suggested that Upper Valley Creek would need significant enhancements to improve stream habitat and removal of excess nutrients to be able to achieve the F&W designated use.

USGS data from the Birmingham Watershed Project confirmed the water quality impacts that EPA and ADEM had found. Sampling at several locations from 1998 to 2001 showed that sewer overflows, leaking sewer lines, and other regulated and nonregulated stormwater runoff were contributing the high pathogen loads. EPA, USGS, and ADEM data showed that conditions improved downstream such that F&W uses could be met in Lower Valley Creek. USGS benthic macroinvertebrate data from 1999–2000 showed poor taxa richness in Upper Valley Creek, consistent with the degraded physical and chemical characteristics. These data exhibited:

- Poor Ephemeroptera, Plecoptera, or Trichoptera (EPT) family richness and poor total taxa richness at both sampling sites
- Low benthic invertebrate diversity and low fish community diversity (Shannon's index of diversity)
- Absence of sculpin (intolerant of contaminated waters) and spotted sucker (intolerant of turbid or silty waters)

In a review of these data, EPA concluded that the aquatic community structure showed degraded water quality, negatively affected by anthropogenic impacts in the watershed over an extended period.

In another study, USGS monitored DO at three stations on Valley Creek. One station was monitored continuously, and DO concentrations at that site ranged from 3.8 to 19.6 mg/L. The daily minimum concentrations at the site were between 4 and 5 mg/L for 39 days between June 25, 2000 and February 22, 2001, with concentrations less than 4 mg/L on one day. Dissolved oxygen measurements at two other sampling sites reached as low as 3.3 and 4.3 mg/L. In a 1998 survey, EPA and ADEM found DO concentrations less than 5 mg/L at a sampling gauge 5 miles upstream from the Valley Creek WWTP. This station was downstream of a channelized stream segment, which provides an ideal surface for periphytic and other microbial growths that produce a large diurnal swing in DO through photosynthesis and respiration.

ADEM conducted water quality modeling for the three point sources to predict the effluent limits needed to meet the various use classifications (A&I, LWF, and F&W). Modeling showed that LWF would be achievable in Upper Valley Creek through effluent limits on the three point sources (with the most stringent limits on the Valley Creek WWTP). ADEM also considered discharge monitoring report data from the facilities and found that at the time of the UAA, the Valley Creek WWTP was operating at very efficient levels and providing a high degree of treatment. ADEM concluded that the Valley Creek WWTP would be able to achieve effluent limits for the LWF, and that the F&W designation would require much more stringent limits for the summer months. With the LWF classification, each facility would be required to conduct chronic toxicity biomonitoring.

ADEM also provided an analysis that showed highly elevated bacteria levels and demonstrated correspondence of bacteria levels with the patterns of precipitation in the Valley Creek watershed. This pattern indicates a strong relationship to nonpoint sources.

Conclusion

The biological health of Valley Creek is dependant on good physical and hydrological characteristics, including proper flow, adequate zones, and diverse substrate. The urbanization of the watershed has fostered habitat destruction through erosion, channelization, concrete substrate, and excessive light and heat penetration.

In their UAA document, ADEM concluded, in part:

> Leaking sewer lines, domestic animals and wildlife populations, and leaking septic tanks are nonpoint sources of both nutrients and bacteria to Valley Creek. Sewer overflows are also a source of both nutrients and bacteria to Village Creek that is driven by precipitation. The Valley Creek WWTP currently achieves an extremely high level of treatment. Jefferson County is estimated to expend $800 million to resolve sewer overflows and replace leaking sewer lines. It is anticipated that this substantial capital investment will improve water quality.
>
> It is not currently possible to determine the percent contribution from the known categories of nonpoint sources, nor is it possible to project the degree of success in terms of measurable water quality improvements that will result from ongoing efforts to resolve sewer overflows and replace leaking sewer lines. The available information suggests that the magnitude of nutrient and bacteria levels, the variety of sources, and the physical characteristics of the waterbody indicate that the F&W use classification is not attainable, and the highest attainable use is LWF. Therefore, F&W is not designated at this time as a result of a combination of human-caused conditions (that may not be feasible to fully remedy) and natural physical conditions of the watershed unrelated to water quality (e.g., high water table). However, as new information becomes available that pertains to attainability of the F&W use classification, it will be considered and water quality standards revised accordingly.

EPA approved the revision of Alabama's water quality standards to include the new classification of LWF for Upper Valley Creek and F&W for Lower Valley Creek. This is an example of a UAA for both aquatic life and recreational uses for an urbanized stream, where significant investment is being made to improve water quality, and the results are anticipated to reach certain goals but may still fall short of a full "fishable/swimmable" designated use.

References

ADEM. 2001. *Use Attainability Analysis: Valley Creek.* Alabama Department of Environmental Management.

USEPA. 2002. Section 303(c) Review of State-adopted Use Classifications. Memorandum from Gail Mitchell to James Giatanna. U.S. Environmental Protection Agency, Region 4, Atlanta, GA.

EXHIBIT G

IEPA Log No.: **C-0147-06**
CoE appl. #: **200600014**

Public Notice Beginning Date: **November 15, 2006**
Public Notice Ending Date: **December 15, 2006**

Section 401 of the Federal Water Pollution Control Act
Amendments of 1972

Section 401 Water Quality Certification to Discharge into Waters of the State

Public Notice/Fact Sheet Issued By:

Illinois Environmental Protection Agency
Bureau of Water
Watershed Management Section
1021 North Grand Avenue East
Post Office Box 19276
Springfield, Illinois 62794-9276
217/782-3362

Name and Address of Discharger: New Lenox State Bank Land Trust No. 222, 215 Cottonwood Place, New Lenox, IL 60451

Discharge Location: Section 15, T35N, R11E of the 3rd P.M. in Will County within New Lenox

Name of Receiving Water: Unnamed Wetland Drainageways

Project Description: Construction of a 71.3 acre commercial development will impact 4.07 acre of wetlands. Mitigation for these impacts will be through the purchase of 6.105 acre of wetland credits from the Mink Creek Wetland Mitigation Bank.

The Illinois Environmental Protection Agency (IEPA) has received an application for a Section 401 water quality certification to discharge into the waters of the state associated with a Section 404 permit application received by the U.S. Army Corps of Engineers. The Public Notice period will begin and end on the dates indicated in the heading of this Public Notice. The last day comments will be received will be on the Public Notice period ending date unless a commenter demonstrating the need for additional time requests an extension to this comment period and the request is granted by the IEPA. Interested persons are invited to submit written comments on the project to the IEPA at the above address. Commenters shall provide their names and addresses along with comments on the certification application. Commenters may include a request for public hearing. The certification and notice number(s) must appear on each comment page.

The attached Fact Sheet provides a description of the project and the antidegradation assessment.

The application, Public Notice/Fact Sheet, comments received, and other documents are available for inspection and may be copied at the IEPA at the address shown above between 9:30 a.m. and 3:30 p.m. Monday through Friday when scheduled by the interested person.

If written comments or requests indicate a significant degree of public interest in the certification application, the IEPA may, at its discretion, hold a public hearing. Public notice will be given 30 days before any public hearing. If a Section 401 water quality certification is issued, response to relevant comments will be provided at the time of the certification. For further information, please call Thaddeus Faught at 217/782-3362.

TJF:0147-06PN.doc

Wetland B is approximately 1.67 acres and is located in the middle of the project site. This wetland also originated at a culvert under U.S. Route 30 and has a well-defined channel until forking into shallow depressions. The wetland is dominated by box elder, silver maple, hackberry, sandbar willow, and elderberry. The FQI for this wetland is 12.3 with a Native Mean C value of 2.1.

Wetland C is located on the east side of the property and continues off-site to the east and north. The wetland is approximately 2.18 acres in size. The wetland is a depressional drainageway that originates at a culvert under U.S. Route 30 and conveys water north. The vegetation consists of both forested wetland and scrub-shrub wetland dominated by reed canary grass, cattail, box elder, silver maple, rice cut grass, elderberry, gray dogwood, and common reed. The FQI for this wetland is 16.0 with a Native Mean C value of 2.4.

Hickory Creek has a 7Q10 flow of 3.5 cfs at this location and is a General Use water. Hickory Creek, Waterbody Segment GG-02, is found on the 2006 Illinois 303(d) list. It is listed as non-supportive of aquatic life and primary contact. The potential causes for the impairment include chloride, alteration in stream-side vegetative covers, flow regime alterations, sedimentation/siltation, silver, total dissolved solids, total suspended solids, zinc, total nitrogen, total phosphorus, aquatic algae, and fecal coliform. The potential sources of the impairment include combined sewer overflows, municipal point source discharges, urban runoff/storm sewers, channelization, impacts from hydrostructure flow regulation/modification, site clearance (land development or redevelopment), and other unknown sources. Hickory Creek is rated as a "C" stream under the Agency's Biological Stream Characterization (BSC) system. Hickory Creek is not listed as a biologically significant water body in the Illinois Natural History Survey publication Biologically Significant Illinois Streams.

Identification of Proposed Pollutant Load Increases or Potential Impacts on Uses.

The pollutant load increases that would occur from this project include some possible increases in suspended solids during the construction of the project and a possible increase in contaminants associated with urban parking lot run-off. Erosion control measures will need to be utilized to minimize any increase in suspended solids. BMPs will need to be constructed to treat the parking lot run-off. The proposed impact of the wetlands will eliminate the current habitat. Utilization of chloride containing materials for deicing would increase the level of chlorides discharged from the stormwater detention facility.

Fate and Effect of Parameters Proposed for Increased Loading.

The increase in suspended solids will be local and temporary. Erosion control measures will be utilized to minimize any increase and prevent additional impact. The creation of the wetland-bottom stormwater management facility and proposed best management practices as listed above will slow and treat the stormwater runoff from the proposed development. The applicant will not allow the use of chloride containing deicing materials on the site, thereby, not increasing the level of chlorides discharged from the project site. Mitigation for the wetland impacts is proposed through the purchase of 6.105 acres of wetland mitigation credits from the Mink Creek Wetland Mitigation Bank located in the lower Des Plaines River watershed.

Purpose and Anticipated Benefits of the Proposed Activity.

This project will allow the construction of a commercial and retail development providing more economic and employment opportunities for the community.

Assessments of Alternatives for Less Increase in Loading or Minimal Environmental Degradation.

The construction of the proposed project will follow guidelines set forth by the Agency and COE. Erosion control measures need to be implemented to prevent additional impacts. The applicant considered eight alternative site locations for the proposed project within the New Lenox area. The alternative parcels considered were rejected for a variety of reasons including greater wetland impacts, insufficient acreage for a large scale retail development, parcel not for sale, property under contract with another developer, property contains high quality archaeological and forest resources, and/or the property would require rezoning that is not supported by the Village of New Lenox. The applicant has also reviewed alternative site plans for the preferred site on U.S. Route 30. These alternatives were rejected as they did not meet the desired purpose of the project of a large unified commercial development, provided inadequate stormwater detention, and/or directly or indirectly impacted all three wetlands. The applicant considered alternatives for the proposed wetland mitigation. On-site mitigation was considered not desirable, as no area exists on the property with suitable soils and topography to create a high quality wetland with appropriate buffers while still maintaining the proposed purpose of the project. Alternative mitigation within the Hickory Creek watershed is not possible as the land along the creek is owned by other private or public entities and is not available to the applicant. The least intrusive alternative would be to not develop the parcel and not impact the wetlands. This is not an acceptable alternative given that this is a useful project and will provide the community with additional economic and employment opportunities.

Summary Comments of the Illinois Department of Natural Resources, Regional Planning Commissions, Zoning Boards or Other Entities.

In a letter from Rick Pietruszka dated March 11, 2002, IDNR indicated that there are no records of state-listed threatened or endangered species, Illinois Natural Area Inventory sites, dedicated Illinois Nature Preserves or registered Land and Water Reserved in the vicinity. Consultation is terminated.

In a letter from Robert Schanzle dated May 26, 2006, IDNR stated that there are no records of stated listed species or natural areas in close proximity to the project site. The site was recently inspected by an IDNR biologist who reports that the jurisdictional areas to be filled consist of eroding drainageways and associated low quality wetland areas. It does not appear that the project will result in the loss of significant fish or wildlife habitat. IDNR notes that the applicant proposes to mitigate the loss of jurisdictional waters through the purchase of credits at a 1.5:1 basis from a mitigation bank and to implement various BMPs on site. Given the limited fish and wildlife impacts associated with the project and the adequacy of the mitigation plan, IDNR has no objections to the issuance of a Department of the Army permit.

In a letter from Kevin Pierard dated June 1, 2006, the United States Environmental Protection Agency (USEPA) noted that Hickory Creek is listed on the 2004 Illinois 303(d) List as an impaired waterbody. USEPA request that the project be mitigated at a higher mitigation ratio than similar project in unimpaired waters. USEPA also requests that the mitigation occur within the same sub-watershed as the impact.

In a letter dated July 18, 2006, Mr. Thomas McArdle of Christopher B. Burke Engineering, Ltd, on behalf of the applicant, responded to these letters. With regards to the concerns about potential adverse impacts to Hickory Creek water quality, the applicant is proposing the Best Management Practices reference above to slow surface runoff, filter particulate matter on-site with vegetated swales and a vegetated stormwater management facility, detain the stormwater on-site to reduce the downstream flashiness in the Hickory Creek tributaries and promote the uptake of nutrients. A 5-year Best Management Practices Maintenance and Monitoring Plan will be implemented to verify that the BMPs are installed and maintained properly and in perpetuity. With regards to the proposed wetland mitigation, Mr. McArdle states that the Mink Creek Wetland Mitigation Bank is located within the lower Des Plaines watershed, as is the project site, within Will County near Weber Road and Airport Road. The bank is located approximately 13 miles from the project site. On-site mitigation was considered not desirable, as no area exists on the property with suitable soils and topography to create a high quality wetland with appropriate buffers while still maintaining the proposed purpose of the project. Alternative mitigation within the Hickory Creek watershed is not possible, as the applicant does not own suitable land for the creation of a wetland mitigation area.

Agency Conclusion.

This assessment was conducted pursuant to the Illinois Pollution Control Board regulation for Antidegradation found at 35 Ill. Adm. Code 302.105 (Antidegradation standard). We find that the proposed activity will result in the attainment of water quality standards. All technically and economically reasonable measures to avoid or minimize the extent of the proposed increase in pollutant loading have been incorporated into the proposed activity. This activity will benefit the community at large by providing more economic and employment opportunities. The proposed activity is therefore compliant with the Antidegradation standard.

Electronic Filing - Received, Clerk's Office, 03/19/2012
** * * * * PC# 1286 * * * * **

EXHIBIT H

QUALITY ASSURANCE AND FIELD METHODS MANUAL

Illinois Environmental Protection Agency
Bureau of Water
Division of Water Pollution Control
Planning Section

SECTION D: SPECIAL STREAM SURVEYS

Revised 1996

2.0 INTENSIVE BASIN SURVEYS

The intensive basin survey section of the Quality Assurance and Field Methods Manual provides standardized guidelines and quality control procedures for the collection of water quality, fisheries, macroinvertebrates, habitat quality, and sediment chemistry data.

2.1 Objectives

The chemical, physical and biological quality of selected Illinois riverine systems are assessed state-wide by an annual program conducted by the Illinois Environmental Protection Agency (IEPA) and the Illinois Department of Natural Resources (IDNR). Objectives of this Cooperative Intensive Basin Survey Program are to:

1. Facilitate planning and prudent allocation of limited State resources in the monitoring and evaluation of all significant interior Illinois river systems.

2. Determine the potential for sport fishing opportunities and fisheries management, assess the status of Illinois lotic resources, identify where those resources exist, and determine the need for legislation for their protection.

3. Assess the level of attainment of designated use support categories in Illinois streams and the cause and source of any impairments for reporting required under Section 305(b) of the Clean Water Act.

4. Determine the presence of toxic materials in fish and aquatic sediments and the sources of these contaminants.

5. Establish a uniform aquatic resource database for agencies with regulatory authority and responsibility for environmental management and focus greater emphasis on the importance of Illinois aquatic resources via Biological Stream Characterization (BSC) system activities.

2.2 Biological Stream Characterization (BSC)

Water, sediment, biological and stream habitat data are collected from a number of stations within a given river basin. This data is used to support Biological Stream Characterization or BSC ratings of stream quality. The BSC is a five-tier stream classification system predicated primarily on Index of Biotic Integrity (IBI) values for fish community samples. The five BSC stream quality categories and IBI values used to derive the ratings are provided below:

BSC Categories	IBI Values
A - Unique aquatic resource	51 - 60
B - Highly valued aquatic resource	41 - 50
C - Moderate aquatic resource	31 - 40
D - Limited aquatic resource	21 - 30
E - Restricted aquatic resource	$\leq$ 20

EXHIBIT I

IEPA Log No.: **C-0413-08**
CoE appl. #: **2007-688**

Public Notice Beginning Date: **June 12, 2009**
Public Notice Ending Date: **July 6, 2009**

Section 401 of the Federal Water Pollution Control Act
Amendments of 1972

Section 401 Water Quality Certification to Discharge into Waters of the State

Public Notice/Fact Sheet Issued By:

Illinois Environmental Protection Agency
Bureau of Water
Permit Section
1021 North Grand Avenue East
Post Office Box 19276
Springfield, Illinois 62794-9276
217/782-3362

Name and Address of Discharger: CenterPoint Properties – 1808 Swift Drive, Oak Brook, IL 60523

Discharge Location: Near Joliet in Will County.

Name of Receiving Water: Wetlands, Cedar Creek and tributary of Cedar Creek North

Project Description: Proposed development of an intermodal facility comprised of rail yard, lead track, tail track, and associated roadway improvements.

The Illinois Environmental Protection Agency (IEPA) has received an application for a Section 401 water quality certification to discharge into the waters of the state associated with a Section 404 permit application received by the U.S. Army Corps of Engineers. The Public Notice period will begin and end on the dates indicated in the heading of this Public Notice. The last day comments will be received will be on the Public Notice period ending date unless a commenter demonstrating the need for additional time requests an extension to this comment period and the request is granted by the IEPA. Interested persons are invited to submit written comments on the project to the IEPA at the above address. Commenters shall provide their names and addresses along with comments on the certification application. Commenters may include a request for public hearing. The certification and notice number(s) must appear on each comment page.

The attached Fact Sheet provides a description of the project and the antidegradation assessment.

The application, Public Notice/Fact Sheet, comments received, and other documents are available for inspection and may be copied at the IEPA at the address shown above between 9:30 a.m. and 3:30 p.m. Monday through Friday when scheduled by the interested person.

If written comments or requests indicate a significant degree of public interest in the certification application, the IEPA may, at its discretion, hold a public hearing. Public notice will be given 30 days before any public hearing. If a Section 401 water quality certification is issued, response to relevant comments will be provided at the time of the certification. For further information, please call Darren Gove at 217/782-3362.

DRG:C-0413-08_401 PN and FS_23Jul08.docx small portion of woodland/savanna restoration. A 50-foot wooded riparian corridor along Jackson Creek will remain and be enhanced as part of the project.

The proposed project will extend Baseline Road in a straight line through the JTA. This roadway alignment will result in 64 acres of direct impacts and the equivalent of 233 acres of indirect noise impacts to grassland bird habitat based on the analysis conducted by Dr. Kim Chapman of Applied Ecological Services. The JTA provides habitat for numerous grassland birds including some state endangered and threatened species. The applicant proposes to mitigate these impacts to grassland bird habitat through the restoration or enhancement of approximately 278 acres of grassland bird habitat at Midewin National Tallgrass Prairie. The four parcels selected for the proposed mitigation will contribute to the restoration of 2,400 acres of grassland bird habitat at Midewin. The grassland bird habitat mitigation has been coordinated through the U.S. Fish and Wildlife Service (USFWS) and the Illinois Department of Natural Resources (IDNR).

Identification and Characterization of the Affected Water Body.

Jackson Creek has a zero 7Q10 flow and is a General Use water. Jackson Creek, Waterbody Segment IL_GC-02, is listed in the Illinois Integrated Water Quality Report and Section 303(d) List – 2006 and the Partially Approved 2008 Illinois Integrated Water Quality Report and Section 303(d) List as fully supporting aquatic life uses. The creek at this location is an enhanced waterbody pursuant to the dissolved oxygen water quality standard. Using the 2008 Illinois Department of Natural Resources publication Integrating Multiple Taxa in a Biological Stream Rating System, the Jackson Creek at this location is not listed as a biologically significant stream. It has received an integrity rating of "C" within the project area.

Cedar Creek has a zero 7Q10 flow and is a General Use water. Cedar Creek, Waterbody Segment IL_GD, has not been evaluated by the Illinois EPA Surface Water Monitoring Unit. The creek is not an enhanced waterbody pursuant to the dissolved oxygen water quality standard. Using the 2008 Illinois Department of Natural Resources publication Integrating Multiple Taxa in a Biological Stream Rating System, Cedar Creek is not listed as a biologically significant stream nor has it received an integrity rating. The applicant conducted a creek corridor assessment along the portion of Cedar Creek within the project site. The results of this assessment indicated that the banks of Cedar Creek displayed signs of moderate to severe undercutting at several locations. There are also areas of intense erosion where runoff from adjacent agricultural fields concentrated and entered the creek. Sections of the creek have also been channelized. The width and type of vegetated buffer varied throughout the section of creek. Areas of wooded buffer contained mature cottonwood, box elder, and hackberry. Herbaceous vegetation was dominated by reed canary grass and Hungarian Brome.

Cedar Creek North Tributary has a zero 7Q10 flow and is a General Use water. Cedar Creek North Tributary has not been evaluated by the Illinois EPA Surface Water Monitoring Unit. The tributary is not an enhanced waterbody pursuant to the dissolved oxygen water quality standard. Using the 2008 Illinois Department of Natural Resources publication Integrating Multiple Taxa in a Biological Stream Rating System, Cedar Creek North Tributary is not listed as a biologically

EXHIBIT J

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Map Center: Get Address - Land Plat Size - Street View - Google Earth 3D - Area Photographs

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Latitude and Longitude of a Point

Note: Right click on a **blue marker** to remove it.

Clear/Reset All Markers Center Red Marker

Get the Latitude and Longitude of a Point

When you click on the map, move the marker or enter an address the latitude and longitude coordinates of the point are inserted in the boxes below.

Latitude:

Longitude:

	Degrees	Minutes	Seconds
Latitude:			
Longitude:			

Show Point from Latitude and Longitude

Use this if you know the latitude and longitude coordinates of a point and want to see where on the map the point is.

Use: **+** for *N* Lat or *E* Long **-** for *S* Lat or *W* Long.
Example: +40.689060 -74.044636
Note: Your entry should not have any embedded spaces.

Decimal Deg. Latitude: +41.55936

Decimal Deg. Longitude: -88.08092

Show Point

Example: **+34 40 50.12** for *34N 40' 50.12"*

	Degrees	Minutes	Seconds
Latitude:			
Longitude:			

Show Point