BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

IN THE MATTER OF:	)	
	)	
WATER QUALITY STANDARDS AND	)	
EFFLUENT LIMITATIONS FOR THE	)	R08-09
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: ***See Attached Service List***

PLEASE TAKE NOTICE that I have filed today with the Illinois Pollution Control Board the Pre-filed testimony of Rob Sulski, Pre-filed testimony of Roy Smoger, Pre-filed testimony of Scott Twait and Pre-filed Testimony of Chris O. Yoder, by the Illinois Environmental Protection Agency, a copy of which is herewith served upon you.

ILLINOIS ENVIRONMENTAL
PROTECTION AGENCY

By: Deborah J. Williams
Assistant Counsel

Dated: 12/20/07

1021 North Grand Avenue East
P.O. Box 19276
Springfield, Illinois 62794-9276
(217) 782-5544

BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

IN THE MATTER OF:	)	
	)	
WATER QUALITY STANDARDS AND	)	
EFFLUENT LIMITATIONS FOR THE	)	R08-09
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	)	

Pre-filed Testimony of Rob Sulski

Good Morning. My name is Rob Sulski. I have been employed with the Illinois Environmental Protection Agency, referred to as Illinois EPA, for nearly 24 years. I earned a Bachelor of Arts degree in Biology and a Master of Science degree in Environmental Engineering at Southern Illinois University and have since participated in or spearheaded various post-college education and research programs in toxics, sediments, wastewater engineering, native ecosystem management and water quality standards, more recently in the subject of Use Attainability Analysis, referred to as UAA.

My work with Illinois EPA has been in Cook and its collar counties in the Bureau of Water's Des Plaines Regional Office. My first 19 years were spent primarily in water pollution control regulatory compliance matters where I became Illinois EPA's expert in the operations of Chicago area industries and wastewater treatment authorities and the Chicago Area Waterway System, referred to as the CAWS, to which they discharge. During that time I also organized or participated in special multi-agency sediment and aquatic bio-toxicity projects throughout the

CAWS. My last 5 years have been spent as Project Manager for the CAWS UAA and as a member of the technical staff for the Lower Des Plaines River UAA.

Also, I grew up and continue to live in the CAWS area and have on numerous occasions professionally and personally power boated every length of the CAWS; and I have fished, waded and paddled in and hiked and hunted along much of the CAWS and most of its tributaries.

As project manager for the CAWS UAA, I wrote the CAWS UAA contract Request for Proposal, assisted in selecting a UAA contractor, assembled a Stakeholder Advisory Committee and a special Health Advisory Sub-Committee to guide the UAA process, coordinated public outreach, participated in many of the data gathering surveys, made numerous presentations on the project to various professional organizations and assisted in the preparation of the proposal now before the Board.

The CAWS and Lower Des Plaines River have been classified in a distinct category separate from the remaining surface water resources in the State from the onset of the Illinois Environmental Protection Act, enacted in 1970 and the federal counterpart Clean Water Act, originally enacted as the Federal Water Pollution Control Act of 1972.

Illinois' water quality programs date back to the early years of the twentieth century. Much of the initial steps were undertaken in the Greater Chicago area to protect public health and the condition of Lake Michigan, the prime potable water source for the area. In the earlier days, public health focus

drove major public works initiatives to construct sewer systems and treatment facilities.

In the case of the CAWS and Lower Des Plaines River, not only was the resource heavily stressed by chemical and biological degradation, but the physical condition was fundamentally changed with reversal of natural drainage into Lake Michigan and construction of major new arteries directing drainage down the Lower Des Plaines River into the Illinois River Basin. This modified river system has served Illinois in excess of 100 years in multiple and to a great extent competing, perhaps even conflicting, ways.

Driven by state and federal laws, new water quality goals expressed in water quality standards and technology based wastewater treatment requirements were adopted. While aggressive standards were established for virtually all surface waters in Illinois, standards adopted for the CAWS and Lower Des Plaines River, so greatly stressed by historic and ongoing urban and industrial influences, reflected lower expectations. The first wave of regulations established in the 1970s have served us well. Those regulations drove 30 years worth of environmental progress, converting the CAWS and Lower Des Plaines River from a virtual ecological wasteland in prior times, into an environmental asset to the community. There was and continues to be sound reasoning to custom tailor water quality standards for this system to coincide with its own unique configuration and functions as we establish environmental uses and goals to achieve and protect its ecological and recreational potential. The system still must support other critical functions, particularly urban drainage, flood control

and navigation. Its potential continues to be somewhat tempered by its unique physical and habitat characteristics as well as lingering, albeit diminishing, legacy contamination from prior decades of neglect.

The original standards adopted in the 1970s have been reviewed periodically over the years and from time to time modest modifications were made. There was, however, no comprehensive review or revision undertaken until the multiyear effort the Illinois EPA initiated in the year 2000 which has resulted in the proposal before the Board in today's proceeding. To a great extent this effort and this proceeding are attributable to the direct support of U.S. EPA's Region V Water Division and many of its professional staff. Region V provided funding to support the scientific experts supporting our work: Aquanova; Hey and Associates; Camp, Dresser and McKee and the Midwest Biodiversity Institute. IEPA would like to take this opportunity to thank both our contractors and Region V staff. Likewise, other participants, including the Metropolitan Water Reclamation District of Greater Chicago, Midwest Generation, the City of Chicago, Friends of the Chicago River and the Alliance for the Great Lakes, not only participated in public review and stakeholder discussions, but also incurred their own expenses to provide information we utilized in our review. While differing perspectives remain and several participants in our public review continue to oppose some of provisions of our petition; nevertheless, Illinois EPA appreciates their support and participation in the review process we conducted to get to this point.

Illinois EPA made a conscious decision at the outset of our review to promote and accommodate public input and participation. Open public work groups were established for both the Lower Des Plaines River study and the Chicago Area Waterway System UAA. Illinois EPA staff and contractors were available to the public at meetings and work products were presented in draft form for discussion and comment.

The focus of my pre-filed testimony will be on: 1) describing a UAA and the 6 UAA factors, 2) defining the boundaries of the CAWS and Lower Des Plaines River that is subject to this proposal, 3) summing up the conclusions reached in the UAAs, 4) describing some of the studies and data taken into account during the UAAs, 5) defining the proposed recreational and aquatic life uses, 6) designating the waterway reaches to which the uses would apply, 7) describing the effluent and waterway management controls that would be necessary to achieve the designated uses, and 8) explaining the technical feasibility and economic reasonableness of implementing the management controls.

Use Attainability Analysis

U.S. EPA's water quality standards regulations found in 40 C.F.R. 131.10(j) require states to conduct a UAA when designating uses which do not meet the goals of the Clean Water Act, or when designating new subcategories of uses which require less stringent criteria.

A UAA is a federal model for conducting a structured scientific assessment of the factors affecting the attainability of uses. A UAA takes into

consideration physical, chemical, biological, and economic factors. The analysis determines whether a waterbody can meet CWA goals, and if not, identifies which specific UAA factors preclude meeting such goals. The analysis then goes on to identify attainable uses for the waterbodies. After the conclusion of the UAA analysis, Illinois EPA proceeded to define designated uses for the waterbodies and formulate standards to protect such uses.

There are six reasons or "factors" identified in the UAA model that could individually or collectively preclude a waterbody from achieving Clean Water Act goals. The 6 factors are: 1) naturally occurring pollutant concentrations prevent the attainment of the use; or 2) natural, ephemeral, intermittent, or low flow conditions or water levels prevent the attainment of the use, unless these conditions may be compensated for by the discharge of sufficient volume of effluent discharges without violating State water conservation requirements to enable uses to be met; or 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; or 4) dams, diversions or other types of hydrologic modifications preclude the attainment of the use, and it is not feasible to restore the water body to its original condition or to operate such modification in a way that would result in the attainment of the use; or 5) physical conditions related to the natural features of the water body, such as the lack of a proper substrate, cover, flow, depth, pools, riffles, and the like, unrelated to water quality, preclude attainment of aquatic life protection uses; or 6) controls more

stringent than those required by the effluent standards of sections 301(b) and 306 of the Act would result in widespread economic and social impact.

CAWS and Lower Des Plaines Waterways

The CAWS and Lower Des Plaines River, as evaluated in the UAAs, consist of 13 waterbodies and five controlling structures stretching from Lake Michigan to the Interstate-55 bridge crossing on Des Plaines River near Channahon. For use designation purposes, the waterbodies are subdivided into 17 reaches. Starting at the far north end, the CAWS begins at the Wilmette Pumping Station and Controlling Works on the artificially constructed North Shore Channel at Lake Michigan in Wilmette. The CAWS ends and Lower Des Plaines River begins just south of the Lockport Lock and Power House at the Elgin, Joliet and Eastern Railroad bridge crossing over Des Plaines River in Joliet. The 17 waterbody reaches of the CAWS and Lower Des Plaines River are defined on pages 27 through 30 of the Statement of Reasons.

CAWS and Lower Des Plaines UAA Conclusions

AquaNova and Hey and Associates, referred to as AquaNova, the contractor for the Lower Des Plaines UAA, found that at least three of the six UAA factors are applicable to portions of Lower Des Plaines River, including the irreversible human caused conditions and circumstances described in UAA factors 3, 4 and 5 that limit aquatic life potential and preclude possibilities for safe primary contact recreation.

AquaNova recommended setting a bacteria standard to protect two new recreational uses. The first recreational use was in the Upper Dresden Island

Pool. AquaNova recommended that it should not be considered a zone for primary contact recreation. The report states that primary contact recreation should be infrequent or accidental because of the effluent dominated nature of the river and the risks associated with navigation traffic. Illinois EPA proposes adopting AquaNova's recommendation of designating Upper Dresden Island Pool as Incidental Contact Recreation Water.

The second recreational use was for the Brandon Pool. AquaNova recommended that is should protect for recreation, but recognized the fact that primary contact either did not exist or would be very rare and incidental. The contractor recommended a standard should be set at the least restrictive allowed by the draft national criteria document. After consideration, Illinois EPA decided that the Brandon Pool warranted no recreational use protection because of public access limitations and unacceptable risks to human safety associated with large water vessel traffic.

AquaNova also recommended adopting two new aquatic life uses. The first aquatic life use was for the Upper Dresden Island Pool which recognized reduced biotic integrity due to impoundment. The second aquatic life use was for Brandon Pool which recognizes the severity and irreversibility of the physical structure of Brandon Pool along with a dissolved oxygen standard appropriate for this use.

In making our recommendations, Illinois EPA took into account additional habitat and aquatic life data not available at the conclusion of the AquaNova's

contract obligations towards the Lower Des Plaines UAA. The additional data is found in Attachments MM, R and S of the Statement of Reasons.

Camp, Dresser and McKee, referred to as CDM, the contractor for the CAWS UAA concluded that while water quality in the CAWS was for the most part meeting Illinois' General Use numerical standards, none of the waterbodies could achieve Clean Water Act goals due to limitations described in the 6 UAA factors. The primary parameters not meeting General Use numerical standards in the CAWS are temperature, dissolved oxygen and bacteria. As a result, CDM recommended two recreational and two aquatic life uses for assignment to the waterways. One recommended recreational use would protect for hand-powered boating and wading and the second would apply to reaches where only commercial and power boating may safely occur. Illinois EPA has since renamed and redefined the recommended uses, including adding a third use, Non-recreational Use.

CDM recommended two aquatic life uses, one composed of a fisheries consisting of some important sport fish species; and another where straight-walled, deep-draft shipping channels limit the fisheries to predominantly tolerant species.

CDM further concluded that several waterway and effluent management controls would need to be implemented before all of the CAWS could achieve the recommended use designations.

Illinois EPA's proposed use designations incorporate additional habitat and aquatic life and recreational data not available at the conclusion of CDM's

contract obligations towards the CAWS UAA. The additional data can be found in Attachments S and MM of the Statement of Reasons.

Supporting Studies and Other Information

Illinois EPA relied on both the AquaNova and CDM reports and additional studies and reports obtained after the conclusion of the contracted UAA work to determine the attainability of the proposed recreational and aquatic-life uses and to formulate standards to protect such uses. The reports and data relied on by Illinois EPA can be found in the various Attachments to the Statement of Reasons.

The recreational use attainment determinations were initially based on existing use information obtained during aircraft-, boat- and postcard-conducted surveys; during meeting and phone solicitations; and by networking with the stakeholder groups. In order to explore whether other recreational uses could be attained, Illinois EPA reviewed several local ordinances and sent a letter to all agencies owning or leasing land along the CAWS. The letter was sent to Metropolitan Water Reclamation District of Greater Chicago (referred to MWRDGC), municipalities, park districts and forest preserve districts and solicited information concerning any and all recreational and other use opportunities within and along the CAWS planned for the foreseeable future. None of the responses to the letter contained definitive plans for new uses that do not already exist.

Additional habitat and aquatic-life data was generated by Midwest Biodiversity Institute for U.S. EPA and by EA Engineering, Science and

Technology for Midwest Generation. The additional data, included as Attachments S and MM of the Statement of Reasons, were taken into consideration in defining and designating the aquatic life uses contained in Illinois EPA's proposal.

Attainable Recreational Uses

The UAA findings support that recreational uses attainable on and in the CAWS and Lower Des Plaines River in the foreseeable future are synonymous with those uses that exist in the waterways today. The UAA concluded that primary contact recreation is not attainable and that for some reaches, incidental and non-contact uses are not attainable in the UAA study area due to irreversible human caused conditions and circumstances described in UAA Factors 3 and 4. Therefore, Illinois EPA is proposing three distinct recreational uses of Incidental Contact, Non-Contact and Non-Recreational to address the varying levels of human contact with the CAWS and Lower Des Plaines River Waters.

Incidental Contact Recreational Use is any recreational activity in which human contact with the water is incidental and in which the probability of ingesting appreciable quantities of water is minimal, such as fishing, commercial boating, small craft recreational boating, and any limited contact associated with shoreline activity such as wading. Primary Contact recreational activities were not found to be attainable in these waters.

A small portion of the CAWS is currently designated as General Use along with the presumption that primary contact recreation is an attainable use. These reaches are: Chicago River, North Shore Channel from the MWRDGC North

Side Wastewater Treatment Works to Lake Michigan, and Calumet River from the O'Brien Lock and Dam to Lake Michigan. Based on the findings of the CAWS UAA, it is Illinois EPA's intention with this rulemaking to remove these waterway segments from the General Use designation and group them with the other reaches of the CAWS and Lower Des Plaines River. The CAWS UAA demonstrates through recreational surveys and other investigations that primary contact does not occur and is not attainable in North Shore Channel and Chicago River. The recreational assessment conducted in the northern portion of the Calumet River was not as intense as was performed in the remainder of the CAWS due to the dangers of navigating the waterway in a small craft; nevertheless, no primary contact recreation is believed to occur in Calumet River. The reach of Calumet River from Torrence Avenue to the O'Brien Lock and Dam is being proposed for designation as Incidental Contact Recreation, because some smaller craft recreational boating occurs there. The remaining Torrence Avenue to Lake Michigan reach of Calumet River is being designated for Non-Contact Recreation as defined below.

Non-Contact Recreational Use is any recreational or other water use in which human contact with the water is unlikely, such as pass through commercial and recreational navigation, and where physical or flow conditions make direct human contact unlikely or dangerous. Illinois EPA has designated Calumet River from Lake Michigan to Torrence Avenue for Non-Contact Recreational Use due to the regularity of power boat navigation to and from Lake Michigan and the marinas located along Calumet and Little Calumet Rivers.

The third category of use pertaining to recreation is Non-recreational Use. Non-Recreational Use waters do not support primary contact, incidental contact or non-contract recreation due to physical or flow conditions or other restrictions. Illinois EPA has concluded that Chicago Sanitary and Ship Canal downstream of its junction with Calumet-Sag Channel and the Brandon Pool are not approaite for Incidental Contact or Non-contact Recreational Uses. These waters are dominated by shipping traffic, are composed of vertical-walled, deep-draft channels and are lined with private industrial facilities that do not allow public access to the waterways. Attached to the Statement of Reasons is a map delineating the designated uses proposed.

Attainable Aquatic Life Uses

Illinois EPA's UAA findings are that the aquatic life uses attainable in most of the CAWS and Lower Des Plaines River in the foreseeable future are affected by one or more of the 6 UAA factors. In some reaches the attainable uses are synonymous with those uses that exist in the waterways today. In other reaches, the existing aquatic life falls short of its attainable biological potential. In reaches where attainable uses are not being met Illinois EPA has concluded that low dissolved oxygen and high temperatures are major water quality constraints.

From the information gathered, Illinois EPA is recommending three levels of biological potential in the CAWS and Lower Des Plaines River; and that two of the three levels do not meet the Clean Waters Act's aquatic life goal due to conditions described in UAA Factors 3, 4 and 5. The three attainable levels of biological potential apply in specific waters defined as: 1) Upper Dresden Island

Pool Aquatic Life Use Waters, 2) Chicago Area Waterway System Aquatic Life Use A Waters and 3) Chicago Area Waterway System and Brandon Pool Aquatic Life Use B Waters.

Upper Dresden Island Pool Aquatic Life Use Waters are capable of minimally maintaining aquatic life populations consisting of individuals of tolerant, intermediately tolerant, and intolerant types that are adaptive to the unique flow conditions necessary to maintain navigational use and upstream flood-control functions of the waterway system.

Upper Dresden Island Pool waters have more diverse habitat conditions than Use A or Use B waters. The pool is an earthen bank reach with fixed aquatic and overhanging riparian vegetation and other zones of refugia for aquatic life. Its midstream channel is generally about 15 feet deep and in most areas flanked on one or both sides by littoral zones with sand-gravel substrate. It also contains some islands and shallow tributary mouths and deltas. Upper Dresden Island Pool is subject to recurring impacts from navigation use and upstream flood control functions, but to a lesser degree than found in CAWS Aquatic Life Use A and Use B waters.

Qualitative Habitat Evaluation Index scores in Upper Dresden Island Pool range from 45 to 80, which according to the report prepared by the Center of Applied Bioassessment and Biocriteria correspond to fair to excellent biological potential. The habitat scores support that Upper Dresden Island Pool is capable of maintaining a biological condition that minimally meets the Clean Water Act's aquatic life goal. However, the Ohio Boatable Index and the Illinois EPA Fish

Index of Biological Integrity scores are generally 20, suggesting that the existing aquatic life is not achieving its expected biological potential.

As described in the recreational uses section of my testimony, a small portion of the CAWS is currently designated as General Use along with the presumption that full aquatic life support is an attainable use. Based on the findings of the CAWS UAA; Illinois EPA is proposing to remove these waterway segments from General Use designation and group them according to the characteristics they share with the other reaches of the CAWS and Lower Des Plaines River. The General Use designation was based on water quality conditions that existed at the time without consideration of habitat and aquatic life potential. As described in the CDM report, North Shore Channel and Chicago River flow conditions and resultant water quality have changed and degraded from the time these waterways were upgraded to General Use; an international treaty between Canada and the U.S. has further restricted the amount of water that may be diverted from Lake Michigan into CAWS and as a result, North Shore Channel is often stagnant and Chicago River is subject to density currents which bring in more saline, lower quality water from North Branch of Chicago River.

The CAWS UAA demonstrated through habitat and other aquatic life data that North Shore Channel, Chicago River and Calumet River possess conditions described in UAA factors 3, 4 and 5, which are not reversible in the foreseeable future and in combination with other factors, prevent them from maintaining a biological condition that meets the Clean Waters Act's aquatic life goal. The

CAWS UAA supports re-designating the now General Use reaches of North Shore Channel and Calumet River from Torrence Avenue to O'Brien Lock and Dam as Chicago Area Waterway System Aquatic Life Use A Waters. The CAWS UAA also supports re-designating the now General Use Chicago River and Calumet River from Torrence Avenue to Lake Michigan as Chicago Area Waterway System and Brandon Pool Aquatic Life Use B Waters defined and described below.

Chicago Area Waterway System Aquatic Life Use A Waters are artificially constructed, or channelized, earthen bank reaches with some fixed aquatic and overhanging riparian vegetation and other areas of refugia. They are generally less than 15 feet deep and a narrow, littoral zone flanks one or both sides of their steeper-sloped midstream channel. In addition to habitat constraints, the CAWS Aquatic Life Use A waters are routinely subject to moderate to severe navigation and other anthropogenic related conditions such as: wake disturbances of littoral zones; sediment scouring and re-suspension; and rapidly fluctuating water elevations and flow velocities that result from storm surges and pre-storm, human manipulations of the waterways necessary to accommodate such surges.

Qualitative Habitat Evaluation Index scores in the CAWS Aquatic Life Use A waters generally range from 40 to 55, which correspond to the Center of Applied Bioassessment and Biocriteria's ranking of poor to fair biological potential. IBI scores generally range from 22 to 30, which are expected in waterways with poor to fair habitat attributes. Such conditions are not reversible in the foreseeable future and in combination with other factors, prevent the

CAWS Aquatic Life Use A waters from maintaining a biological condition that meets the Clean Water Act's aquatic life goal.

The Chicago Area Waterway System and Brandon Pool Aquatic Life Use B Waters are capable of maintaining aquatic life populations predominated by individuals of tolerant types that are adaptive to the unique physical conditions, flow patterns, and operational controls designed to maintain navigational use, flood control, and drainage functions in deep-draft, steep-walled shipping channels.

The 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. The CAWS and Brandon Pool Aquatic Life Use B waters are also routinely subject to navigation and other anthropogenic conditions that are more sever than those in the CAWS Aquatic Life Use A Waters.

Qualitative Habitat Evaluation Index scores in the CAWS and Brandon Pool Aquatic Life Use B waters generally are below 40 and IBI scores generally are below 22, which are to be expected in waters with very poor to poor habitat attributes. Such conditions are irreversible, and in combination with other factors, prevent the CAWS and Brandon Pool Aquatic Life Use B waters from maintaining a biological condition that meets the Clean Water Act's Aquatic Life goal.

Effluent and Waterway Management Controls

The UAAs found that attainable uses were in some cases not achievable without overcoming dissolved oxygen, temperature and bacteria limitations. Waterway aeration, waterway flow augmentation, effluent cooling and effluent disinfection are the recommended options for overcoming the limitations.

Waterway aeration would be required to achieve compliance with the proposed dissolved oxygen standards in some reaches of the CAWS. Aeration may not in itself, however, sufficiently increase dissolved oxygen in the stagnant upper reach of the North Shore Channel or in the stagnant South Fork of South Branch Chicago River and may need to be supplemented by augmenting stream flow. Flow augmentation can be accomplished by diverting a portion of the MWRDGC North Side Plant effluent to the channel side of the North Shore Channel at the Wilmette Controlling Works and by diverting a portion of the South Branch Chicago River flow to the head end of the South Fork at the MWRDGC Racine Avenue Pumping Station.

Temperature constraints could be overcome through additional effluent cooling at the five Midwest Generation electrical generating stations located on South Branch Chicago River, Chicago Sanitary and Ship Canal and the Lower Des Plaines River.

In order to reduce bacteria levels, effluent disinfection would be required at all domestic wastewater treatment works discharging into water designated for Incidental Contact and Non-contact Recreation Use.

Technical Feasibility and Economic Reasonableness

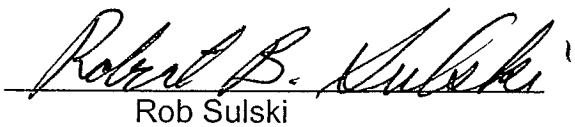
Each of the required waterway and effluent management controls are technically feasible. Supplemental aeration has been successfully used by MWRDGC for decades to increase the dissolved oxygen concentration in portions of CAWS, and flow augmentation is a relatively simple matter of installing and operating a pump station. The feasibility of supplemental aeration and flow augmentation was the subject of a study by MWRDGC.

Power plant effluent temperature can be lowered using cooling towers open- or closed-cycle cooling or a combination thereof. Such methods of cooling are widely used and accepted treatment technologies. Various factors will need to be taken into consideration by Midwest Generation to which technology will be more appropriate for each facility.

Technology-based effluent disinfection has been a long-standing requirement for and has been successfully used by domestic wastewater treatment facilities throughout the State, dating back to the original 1970s Board regulations. The most common and widely used technologies are chlorination, ozonation, and ultra violet (UV) radiation. The feasibility of effluent disinfection is the subject of several studies performed by MWRDGC. MWRDGC has indicated that if they were to undertake disinfection at their facilities they would likely use UV treatment, but would be free to select between any available technologies that would meet the 400 fecal coliforms per 100 ml requirement of 35 Illinois Administrative Code Section 304.224.

Under Section 27 of the Environmental Protection Act, the Board is also required to take into account the economic reasonableness of rulemaking proposals before it. To assist the Board with this mandate, the Agency encouraged stakeholders to present information quantifying the economic impacts upon their individual operations. That information was used by the Illinois EPA in formulating our petition and is intended to assist the Board as it considers the rulemaking proposal. Economic information submitted by MWRDGC is summarized in the Statement of Reasons and provided in Attachments NN, OO, PP and QQ. Only minimal information on economic impacts was provided by Midwest Generation, but the Agency included what was provided in the Statement of Reasons and Attachment SS to the Statement of Reasons. The Illinois EPA hopes the Record developed in this proceeding will contain sufficient information on economic reasonableness to allow the Board to meet its statutory burden.

Finally, I would like to thank the Board for the opportunity to provide this pre-filed testimony. I will be happy to answer questions from the Board and the public on the issues outlined in my Pre-filed testimony.

By: 
Rob Sulski

Date: December 20, 2007

Illinois Environmental Protection Agency
1021 North Grand Avenue East
P.O. Box 19276
Springfield, Illinois 62794-9276

BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

IN THE MATTER OF:	)	
	)	
WATER QUALITY STANDARDS AND	)	
EFFLUENT LIMITATIONS FOR THE	)	R08-09
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	)	

PRE-FILED TESTIMONY OF ROY SMOGOR

My name is Roy Smogor; I have been employed with the Illinois Environmental Protection Agency for seven and a half years. I am a stream biologist with a Master of Science degree in Fisheries and Wildlife Sciences from Virginia Polytechnic Institute and State University in Blacksburg, Virginia. I also have a Bachelor of Science degree in Biology from the University of Illinois at Urbana-Champaign. I have several years of experience, in the states of Virginia and Illinois, in developing ways to use information about fish and other aquatic life to determine the ecological health of streams. Currently, I am a Public Service Administrator in the Surface Water Section of the Bureau of Water. The Surface Water Section is responsible for monitoring the condition of Illinois streams and lakes. Specifically, we collect biological, chemical, and physical information from waters throughout the state and then interpret how this information represents the ecological health of Illinois surface waters. Our activities help guide the protection, management, and regulation of Illinois' aquatic natural resources. I have participated in one other rulemaking before the

Board. Specifically, I worked on the Amendments to the Dissolved Oxygen Water Quality Standard (R04-25).

My pre-filed testimony in this proposed rulemaking provides an overview of two topics: 1) the aquatic-life uses proposed for designation in the Chicago Area Waterway System and in the Lower Des Plaines River; and 2) the proposed dissolved oxygen standards to protect aquatic life in these waters.

Based on the two Use Attainability Analyses and associated information, Illinois EPA determined that three levels of biological potential apply in the Chicago Area Waterway System and in the Lower Des Plaines River. Each of the three attainable levels of biological potential applies in a specific group of waters.

First, Illinois EPA proposes that the highest applicable level of biological potential serve as the aquatic-life goal for the Upper Dresden Island Pool. This level represents the capability to maintain aquatic-life populations consisting of individuals of tolerant, intermediately tolerant, and intolerant types that are adaptive to the unique flow conditions necessary to maintain navigational use and upstream flood control functions of the Upper Dresden Island Pool. Illinois EPA proposes that the second and somewhat lower level of biological potential serve as the aquatic-life goal for specific parts of the Chicago Area Waterway System, called "Chicago Area Waterway System Aquatic Life Use A Waters." This second level represents the capability to maintain aquatic-life populations predominated by individuals of tolerant or intermediately tolerant types that are adaptive to the unique physical conditions, flow patterns, and operational controls

necessary to maintain navigational use, flood control, and drainage functions of the waterway system. Third, Illinois EPA proposes that the lowest applicable level of biological potential serve as the aquatic-life goal for the remaining part of the Chicago Area Waterway System and part of the Lower Des Plaines River; these waters are collectively called "Chicago Area Waterway System and Brandon Pool Aquatic Life Use B Waters." This final level of biological potential represents the capability to maintain aquatic-life populations predominated by individuals of tolerant types that are adaptive to the unique physical conditions, flow patterns, and operational controls designed to maintain navigational use, flood control, and drainage functions in deep-draft, steep-walled shipping channels.

Illinois EPA primarily bases these proposed aquatic-life uses and designations on direct measurements and observations of the chemical and physical conditions in these waters and on how foreseeable improvements in these conditions—or lack thereof—relate to the potential biological condition. Illinois EPA also considered direct observations, including measures of biological integrity, of the types, life stages, and relative numbers of aquatic organisms that have lived or currently live in the Lower Des Plaines River and the Chicago Area Waterway System. Although understanding the past and present biological conditions of these waters provides essential context, the primary responsibility in defining and designating aquatic-life uses is to consider what level of biological condition represents a reasonable and attainable goal from now into the foreseeable future.

Additional to helping define and designate aquatic-life uses for the Lower Des Plaines River and the Chicago Area Waterway System, I participated in determining the dissolved oxygen criteria that would sufficiently protect the aquatic life in these waters. The dissolved oxygen standards being proposed by Illinois EPA are based primarily on criteria and corresponding justification in U.S. EPA's national-criteria document published in 1986. Illinois EPA used this document as a foundation from which to interpret and incorporate more-recent information specifically applicable to the dissolved oxygen needs of aquatic life in Illinois waters. The dissolved oxygen standards being proposed for the Chicago Area Waterway System and the Lower Des Plaines River are consistent with the standards already recommended to the Board by Illinois EPA in the pending rulemaking, R04-25.

The proposed dissolved oxygen standards represent minimum concentration thresholds intended to protect aquatic organisms from acutely lethal effects and from chronic, sublethal effects of low dissolved oxygen. Protection against acutely lethal effects of low dissolved oxygen is provided by the standards that represent a daily minimum. These acute standards apply to organisms regardless of their life stage. Protection against chronic, sublethal effects—such as inhibited growth—is provided by two types of standards that are based mostly on studies of various life stages of fishes.

As a fish grows through life stages from embryo to hatchling to juvenile to reproductive adult, its sensitivity to low dissolved oxygen can decrease. To address these physiological changes, two types of chronic standards are

proposed. The first type of chronic standard is intended to apply to life stages older than 30 days; it is a seven-day average of daily minimum concentrations of dissolved oxygen. This type of chronic standard is designed to prevent continuous or regularly recurring exposures to dissolved oxygen concentrations at or near the acutely lethal threshold. The second type of chronic standard, which applies to all life stages, is a daily average concentration that is averaged across seven days—to protect early life stages; or averaged across thirty days—to protect older life stages. This second type of chronic standard is designed to ensure the long-term maintenance of aquatic life.

Illinois EPA proposes different dissolved oxygen standards for each of the three sets of waters designated for different aquatic-life uses. For the Upper Dresden Island Pool Aquatic Life Waters, the proposed standards are identical to standards recommended for the large majority of General Use waters throughout Illinois, as presented in the previous pending rulemaking (R04-25).

For the Chicago Area Waterway System Aquatic Life Use A Waters, Illinois EPA proposes dissolved oxygen standards similar to those for the Upper Dresden Island Pool, but designed to protect for less-optimal fish growth that is consistent with the proposed aquatic-life use designation. One manifestation of the limited biological potential of Chicago Area Waterway System Aquatic Life Use A Waters is suboptimal growth conditions for fish. For sufficient protection under such limited growth situations, U.S. EPA's 1986 national-criteria document provides a chronic criterion of 5.0 mg/l as a daily mean averaged across seven days, for early life stages. For other life stages, U.S. EPA provides an analogous

criterion of 4.0 mg/l. The 1986 national-criteria document states that these two criteria protect for "...the persistence of existing fish populations...", but allow "...considerable loss of production" (Attachment X of the Statement of Reasons). Illinois EPA judges that this level of protection is sufficient to attain the already limited growth potential of fish in these waters. However, Illinois EPA does not propose these two chronic standards because this level of protection is already provided by the other applicable standards. Specifically, for early life stages, if dissolved oxygen concentrations remain at all times above the proposed acute standard of 5.0 mg/l, it is mathematically impossible for a daily mean averaged over seven days to be less than 5.0 mg/l. Similarly, for other life stages, if seven-day averages of daily minima remain above the proposed 4.0 mg/l standard, it is unnecessarily redundant to require that daily means averaged over seven days remain above 4.0 mg/l. Therefore, because suboptimal growth of fishes is a characteristic of the lower biological potential of these waters, the proposed dissolved oxygen standards based on daily minima alone provide sufficient chronic protection for all life stages in Chicago Area Waterway System Aquatic Life Use A Waters.

For the third set of waters, called Chicago Area Waterway System and Brandon Pool Aquatic Life Use B Waters, the proposed dissolved oxygen standards are consistent with the incrementally lower biological potential of these waters compared to Chicago Area Waterway System Aquatic Life Use A Waters. For the Chicago Area Waterway System and Brandon Pool Aquatic Life Use B Waters, Illinois EPA is not proposing standards to protect early life stages of fish

because these waters do not have the potential to consistently support such early life stages. Similar to the Chicago Area Waterway System Aquatic Life Use A Waters, these lower-potential group "B" waters can attain only suboptimal growth conditions for fish; therefore, only one of the two types of chronic standards is needed to provide sufficient protection against unacceptable effects of low dissolved oxygen.

I would like to thank the Board for the opportunity to provide this pre-filed testimony. I am available to answer questions from the Board and the public on the issues outlined in my pre-filed testimony.

By: Roy Smogor
Roy Smogor

Date: December 19, 2007

BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

IN THE MATTER OF:	)	
	)	
WATER QUALITY STANDARDS AND	)	
EFFLUENT LIMITATIONS FOR THE	)	R08-09
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	)	
	)	

PREFILED TESTIMONY OF SCOTT TWAIT

My name is Scott Twait and I am an Environmental Protection Engineer in the Water Quality Standards Section in the Illinois EPA's Bureau of Water. I have held that position since October 1996. I received a Bachelor's degree in Civil Engineering from the University of Illinois in 1992. As a member of the Water Quality Standards staff, I have participated in the internal development of rulemaking proposals and Agency responses to site-specific rulemaking proposals and petitions for adjusted standards and variances. These include serving as the lead technical reviewer for the Effingham and Exxon-Mobil site-specific rulemakings, the Belleville Combined Sewer Overflow and Borden Chemical Adjusted Standards, and the CITGO and Ameren CIPS - Grand Tower Variances.

My involvement in the use attainability analysis process that has led to this rulemaking began with serving as lead technical staff on the Lower Des Plaines River Use Attainability Analysis. I have been involved in a technical review of each of the numeric water quality standards applicable to the Secondary Contact and Indigenous Aquatic Life waters and the recommendations to update and upgrade them as contained in the Agency's proposal. In particular, I was involved in interpreting the

information and recommendations provided to the Agency with regard to the thermal water quality standards by U.S. EPA's contractor, Chris Yoder of the Center of Applied Bioassessment and Biocriteria at the Midwest Biodiversity Institute, and translating those recommendations into the numeric temperature water quality standard proposal before the Board.

The focus of my testimony is the decisions Illinois EPA made in formulating its proposal to the Board for the set of comprehensive numeric water quality standards necessary to protect the designated aquatic life and recreational uses being established for the Lower Des Plaines River and Chicago Area Waterway System. After selection of recommended aquatic life and recreational uses, which is described in Rob Sulski's Pre-filed Testimony, the Agency reviewed the latest available criteria documents and literature to get the most current science on numerical standards necessary for individual parameters to protect the proposed uses. In most cases that proved to be U.S. EPA's national criteria document or information supporting a recent upgrade to an Illinois General Use standard. This type of information was significantly lacking for two very important parameters — temperature and bacteria. My testimony will address the efforts the Agency undertook to address these informational gaps.

In most cases, identical numeric water quality standards are necessary to protect all of the proposed aquatic life use designations. The exceptions to this are temperature, dissolved oxygen and ammonia. I will be discussing two of these exceptions – temperature and ammonia – in my testimony. In general, the Agency attempted to use the most current criteria available when proposing water quality standards for the various toxic parameters. This was accomplished with all parameters

except cadmium, copper and chloride which will be explained in further detail in my testimony. The Agency is also proposing water quality standards for sulfate and chloride that are based on the proposal currently before the Board in R07-09. Like the Agency's proposal in R07-09, the proposal in this rulemaking also includes the elimination of a numeric water quality standard for Total Dissolved Solids. My testimony will provide details regarding the basis for the Agency's current proposal to the Board for an updated temperature water quality standard for the three aquatic life use designations being recommended for these waters. Finally, I will also discuss the recommendations being made by the Agency with regard to numeric bacteria standards for the protection of the recreational use designations of these waters.

Numeric Water Quality Standards for Toxic Parameters and Metals

There are a number of water quality standards where the most recent U.S. EPA National Criteria Document was found to be the same as or consistent with the current water quality standard on the books for the General Use designation. The proposal before the Board in this rulemaking contains water quality standards for the following contaminants in order to protect aquatic life use designations in the CAWS and Lower Des Plaines River that are based on both the U.S. EPA National Criteria Document and the General Use Standard: pH, Chromium (total hexavalent), Cyanide and Total Residual Chlorine. Ammonia is also based on both of these documents with two variations which I will explain in more detail.

With regard to pH, the Agency has proposed updating the current standard of 6.0 to 9.0 to conform to the current General Use standard of 6.5 to 9.0 which is also consistent with the most recent federal criteria document. It is expected that this

standard will be attained at most times and in most areas of the CAWS and Lower Des Plaines River, though data from the Metropolitan Water Reclamation District of Greater Chicago (or MWRDGC) indicates there may be occasional pH violations below 6.5. The federal criterion states that a pH range of 6.0 to 6.5 will be unlikely to be harmful to fish unless the free carbon dioxide present is in excess of 100 parts per million. At the Agency's request, MWRDGC derived the free carbon dioxide concentrations. In cases where pH was between 6.0 and 6.5, the free carbon dioxide level was greater than 100 parts per million approximately 64 percent of the time. Therefore, the Agency concluded a pH standard below 6.5 could not be supported for these waters at this time.

With regard to ammonia, the water quality standard contained in the Agency's proposal to the Board is based on the most recent national criteria document. The ammonia proposal is also the same as the General Use water quality standards with two exceptions. The first exception is that the seasonal ammonia standard protecting the early life stage period is not applicable to those waters not being designated for the protection of early life stages. The waters that do not protect for early life stages are the Chicago Area Waterway System and Brandon Pool Aquatic Life Use B waters. The second exception is that the following sentence from 35 Illinois Administrative Code Section 302.212(e) is not proposed for inclusion in the CAWS and Lower Des Plaines River standards "In addition, during any other period when early life stages are present, and where the water quality standard does not provide adequate protection for these organisms, the water body must meet the Early Life Stage Present water quality standard." This sentence was inserted in the General Use water quality standards to provide a heightened level of conservatism or an additional safety factor to the General

Use water quality standards to address any unknown organisms that may be found to spawn extremely early or extremely late in the year. Illinois EPA is confident this language is not necessary to protect the aquatic life uses designated for these waters. Chicago Area Waterway Aquatic Life Use A Waters, Chicago Area Waterway and Brandon Pool Aquatic Life Use B Waters and the Upper Dresden Island Pool Aquatic Life Use Waters will be fully protected by the adoption of the ammonia water quality standards proposed by the Agency.

When reviewing the available water quality criteria information, the Agency found that the existing General Use standards for several parameters where either more up-to-date than the current National Criteria Document or there was no available National Criteria Document. In those situations the Agency chose to propose that the Board adopt the General Use water quality standard for the CAWS and Lower Des Plaines River aquatic life uses. These parameters are lead, benzene, ethylbenzene, toluene, xylene, nickel, zinc, mercury (human health standard), benzene (human health standard) and iron. On page 70 of the Statement of Reasons, the Agency indicated that U.S. EPA approval for benzene, ethylbenzene, toluene, xylene, nickel (dissolved) and Zinc (dissolved) was pending. U.S. EPA formally approved the General Use water quality standards for these six parameters in a letter dated July 25, 2007. This approval letter is included as Attachment 1 to my pre-filed testimony.

In several cases, the Illinois EPA found that a U.S. EPA National Criteria Document was available that was more current from what is currently adopted for General Use waters. Where possible, the Agency attempted to use this updated criteria for the Lower Des Plaines River and CAWS waters. These parameters are arsenic,

chromium (trivalent), silver and the aquatic life standard for mercury. The Agency has proposed to adopt the National Criteria Document recommendations for these numeric water quality standards, because they represent the most up-to-date information available on the impacts of these metals on aquatic life.

Cadmium

The proposed Cadmium water quality standard is the same as the General Use water quality standard. U.S. EPA's most recent National Criteria Document for cadmium was finalized in 2001. The Agency considered basing the acute and chronic cadmium water quality standards on the recalculation procedure from the 2001 National Criteria Document by removing cold water species and species not native to Illinois. Based on stream data provided by MWRDGC, it appeared to the Agency that the chronic criteria would be periodically exceeded in these waters. This discovery led the Agency to investigate the potential cause of these exceedances.

MWRDGC collects cadmium data once per month at twenty-six stream locations. The Agency reviewed the data and noted that periodic exceedances of the national criteria would occur mostly in the summer months and that cadmium was usually not detectable in the winter months when barge traffic was minimal. Contaminated sediment is scoured and resuspended by barge traffic. Photos showing the plume from sediment scoured and resuspended in the waterway are attached to the Statement of Reasons as Attachment CC. The Agency reviewed the stream data where there was not a known point source of cadmium and concluded that the exceedances of the chronic criteria were most likely the result of contaminated sediment, but could not rule out point sources that were not quantified, such as CSOs. Based on an analysis of the

data, the Agency believes that a legacy of contaminated sediment prevents full attainment of the Clean Water Act aquatic life use in these waters and is the primary reason that the chronic national criterion cannot be met in the segments of the CAWS. The Agency concluded that the General Use dissolved cadmium water quality standards would fully protect the aquatic life uses that have been defined for the Lower Des Plaines River and the Chicago Area Waterway System.

Copper

The acute and chronic copper water quality standards in this proposal are based on the recalculation procedure established in the 1995 National Criteria Document removing cold water species and species not native to Illinois. The northern squawfish and chiselmouth are only found in the western states and viable populations of Coho salmon, sockeye salmon, cutthroat trout, Chinook salmon, rainbow trout, Atlantic salmon and brook trout are not found in Illinois outside of Lake Michigan. The proposed water quality standards for these waters are also being updated to include a translator from total copper to dissolved copper.

On February 22, 2007, U.S. EPA finalized a national criterion update for copper. Illinois EPA has not chosen to incorporate the 2007 criterion because it is based on a Biotic Ligand Model. This new methodology is quite complex and requires the ability to measure the presence of additional parameters that would impact copper's toxicity such as dissolved organics. This new methodology would be a significant departure from the way copper water quality standards have been used in the past. Illinois EPA will continue to evaluate whether this model is useful for General Use waters and the waters

impacted by this proposal and will consider updating or supplementing the copper standards as appropriate.

On page 72 of the Statement of Reasons we state that: "Based on the compliance of the Agency samples and the closeness to compliance of the MWRDGC data, the Agency recommends that the water quality standard be set at the existing General Use standard." This statement is erroneous since the Agency is proposing to use a recalculation based on the National Criteria Document, which is more up-to-date than the General Use water quality standard.

Chloride, Sulfate and Total Dissolved Solids

Currently, there are no sulfate or chloride ambient water quality standards applicable to the CAWS and Lower Des Plaines River. The Agency proposed changes to the General Use water quality standards for sulfate and total dissolved solids (or TDS) in docket R07-09 which was filed with the Board on October 23, 2006. The proposal in this rulemaking to address sulfate, chloride and TDS in the CAWS and the Lower Des Plaines River is patterned after the proposal currently before the Board in R07-09. It was also developed prior to a First Notice Opinion by the Board in that proceeding. There are currently no applicable national criteria for sulfate.

While the proposed sulfate water quality standard in this rulemaking is based primarily on the proposal in R07-09, it does not include the limit of 2,000 mg/L for protection of livestock watering since this is not a designated use of the CAWS or Lower Des Plaines River. In addition, the Agency's proposal does not include provisions for instances when hardness is less than 100 mg/L or chloride is less than 5 mg/L since

these conditions do not exist in the CAWS or Lower Des Plaines River. Monitoring data collected by MWRDGC was used to support this conclusion.

There is currently no chloride standard applicable to the Secondary Contact and Indigenous Aquatic Life Uses segments of the CAWS and Lower Des Plaines River. The proposed chloride water quality standard is exactly the same as the current General Use water quality standard of 500 mg/L. The General Use chloride standard has not been updated since the original adoption. U.S. EPA's National Criteria Document recommends a Criterion Maximum Concentration of 860 mg/L and a Criterion Chronic Concentration of 230 mg/L. Illinois EPA is proposing to maintain the General Use water quality standard in these waters as a single value of 500 mg/L. This is the value that has been used by scientists in evaluating the toxicity of sulfate. It would be inconsistent with the results of that research to convert to the federal methodology which contains an acute value that is less restrictive than the Illinois EPA's General Use standard and a chronic value that may be more restrictive than the Agency's General Use standard. The Illinois EPA expects that there will be violations of the chloride standard during the winter months when road salting takes place to address winter weather events and the safety of Illinois motorists. This problem is not unique to the CAWS and Lower Des Plaines River and the Illinois EPA plans to continue to work with state and local government entities to mitigate the potential harm to aquatic life from these practices.

Sulfate and chloride are the key toxic components of dissolved solids. As a result of the improvements to the sulfate water quality standard the Agency also proposed elimination of the total dissolved solids standard in R07-09. Illinois EPA is

proposing elimination of a TDS standard for the Lower Des Plaines River and CAWS as well. In addition to TDS, the Agency is proposing elimination of the barium, fluoride, manganese, oil/fats/grease, and phenols water quality standards as unnecessary, inappropriate or outdated. These are explained in more detail in the Agency's Statement of Reasons.

Temperature

Due to extreme difference of opinion in the temperature discussions and the lack of an updated national criteria document, Illinois EPA decided to take advantage of an undertaking by the Ohio River Valley Water Sanitary Commission (or ORSANCO) to update their methodology and data for derivation of temperature criteria. Through funding from U.S. EPA, an independent national temperature expert was retained to develop temperature criteria options to protect the aquatic life uses for the Lower Des Plaines River. The proposed temperature water quality standards utilized methods contained in the report by Midwest Biodiversity Institute and Center for Applied Bioassessment and Biocriteria titled *Temperature Criteria Options for the Lower Des Plaines River*. The authors are Chris O. Yoder and Edward T. Rankin. A version of that report dated October 11, 2005 is included as Attachment GG to the Agency's Statement of Reasons. A final version with non-substantive corrections dated November 23, 2005 is being submitted as Attachment 2 to the pre-filed testimony of Chris Yoder. A transcription error effecting Table 3 of the November 2005 report is corrected in Attachment HH to the Agency's Statement of Reasons. The Agency used the conclusions and options presented in this report to develop temperature standards for the CAWS and Lower Des Plaines River.

The methodology contained in Chris Yoder's report relies on use of a Representative Aquatic Species list, referred to as an RAS list. The methodology uses the RAS list to develop summer daily maximum and period average thermal criteria. The MBI report had three main categories of RAS lists with some subcategories: General Use, Modified Use, and Secondary Contact/Indigenous Aquatic Life Use with 49, 27, and 8 species RAS lists respectively. The categories are modeled after existing aquatic life uses in Illinois and Ohio's modified use, but should not be interpreted as being equivalent to existing Illinois and Ohio designated use labels. The Agency applied the RAS lists developed by Chris Yoder for the Lower Des Plaines River to the aquatic life use designations developed by the Agency for the CAWS and Lower Des Plaines River.

The Agency determined that the Chicago Area Waterway System and Brandon Pool Aquatic Life Use B waters listed in 35 Illinois Administrative Code 303.235 of the proposal should use the option of the 8 species RAS list (Secondary Contact/ Indigenous Aquatic Life) to determine the summer daily maximum and period average. This decision was made based on the aquatic life and habitat in the affected stream reaches. It is believed that those eight species are representative of the species that would be found in water capable of maintaining aquatic life populations predominated by individuals of tolerant types that are adaptive to the unique physical conditions, flow patterns and operational controls designed to maintain navigational use, flood control and drainage functions in deep-draft, steep-walled shipping channels.

Based on the fact that white sucker was present in certain waters, the Agency determined the Chicago Area Waterway System Aquatic Life Use A waters listed in 35

Illinois Administrative Code 303.230 of the rulemaking proposal should use the option of the 8 species RAS list plus white sucker to determine the summer daily maximum and period average. This decision was made based on the aquatic life and habitat in the affected stream reaches. It is believed that those nine species are representative of the species that would be found in water capable of maintaining aquatic life populations predominated by individuals of tolerant or intermediately tolerant types that are adaptive to the unique physical conditions, flow patterns, and operational controls necessary to maintain navigational use, flood control, and drainage functions of this waterway system.

The Des Plaines River between the Brandon Road Lock and Dam and the I-55 bridge has incrementally more diverse aquatic life and higher quality habitat than the rest of the CAWS and Lower Des Plaines River. For this reason, the Agency determined it was appropriate to use the option of the 27 species RAS list (Modified Use) to determine the summer daily maximum and period average for the Upper Dresden Island Pool waters. The Agency was asked to look at the feasibility of including the stonecat madtom to the 27 species RAS list by staff of U.S. EPA Region V. However, Illinois EPA biologists concluded that typical habitat for stonecat madtoms is higher-gradient creeks and rivers with moderate to swift currents and gravelly to rocky substrates. It is reasonable to not expect stonecats in Lower Des Plaines River, which does not have much of their typical habitat. Based on these recommendations from the Agency biologists, I determined not to rely on the stonecat madtom when working with the Fish Temperature Model to develop the proposed temperature water quality standards.

Criteria for non-summer periods are derived to maintain seasonal norms and cycles of increasing and decreasing temperatures. Seasonal ambient temperature data were analyzed from eight locations in the CAWS and Lower Des Plaines River for the period 1998 through 2004. The data from these stations can by found in Appendix B of Chris Yoder's report which is included as Attachment 2 to his pre-filed testimony. The monitoring location at Route 83 on the Chicago Sanitary and Ship Canal was used as the "background" location because it was not directly influenced by cooling water or Lake Michigan and was believed to be representative of "background" temperatures. Because the source water of the CAWS is composed of the MWRDGC wastewater treatment plant effluents, the temperatures of these waters can be expected to exceed other measures of background or ambient temperature at certain times of the year. Consequently, the Agency decided to use the effluent temperature from MWRDGC's North Side, Calumet and Stickney facilities as the background temperature instead of using temperatures at the Route 83 Chicago Sanitary and Ship Canal station during periods of the non-summer months when the effluent temperature was higher than the background temperature. These periods were January, February, October 1-15, November and December. For the non-summer periods of September 16-30, October 16-31, March, April, May and June 1-15, the Agency used temperature values from the Route 83 Chicago Sanitary and Ship Canal station in setting the period averages because the ambient values were higher than the effluent data values. The effluent data used was submitted to the Agency by MWRDGC on May 22, 2007 and is included as Attachment W to the Agency's Statement of Reasons. Had the Agency not made this alteration to the recommendations Chris Yoder's temperature report in developing

our water quality standards, the water quality standards for the three aquatic life use designations proposed for the CAWS and Lower Des Plaines River would have been lower than the MWRDGC effluents and would have required installation of cooling towers or other treatment technology to reduce the temperature of these effluents.

The Agency used the 75th percentile of the temperatures from the MWRDGC effluent and Route 83 Chicago Sanitary and Ship Canal station data as the period average to ensure that the seasonal norms are preserved in the system. The daily maximum of the summer months was preserved for the entire year to ensure that no acute lethal temperatures are present, rather than using the 98th percentile of ambient temperature values for the non-summer months or some other statistical method as suggested by Chris Yoder. This decision was made because the daily maximum is designed to protect acute (or lethal) impacts, while the chronic (or sub-lethal) impacts are protected through the period average. The Illinois EPA believes that seasonal norms are preserved with the period average as opposed to the daily maximum.

The proposed thermal water quality standards are more stringent than the current Secondary Contact and Indigenous Aquatic Life water quality standards for all months. The proposed thermal water quality standards are also more stringent than the current General Use standards for the months April through November, especially when considering the period average. During the remaining months, the proposed standards are approximately equivalent to the existing General Use standards. The proposed thermal water quality standards are more stringent than the current Adjusted Standard for temperature applicable at Interstate-55 for all of the months, especially when considering the period average.

Because fish can tolerate short-term elevations in temperature, the current water quality standards in Illinois allow for a certain amount of excursions before there is an exceedance of the standard. The excursions under the current General Use and Secondary Contact and Indigenous Aquatic Life Standards are limited both in their degree and frequency. The Agency is proposing to allow excursions from the daily maximum criteria to occur two percent of the time. This is between the one percent for General Use and five percent for the existing Secondary Contact and Indigenous Aquatic Life Standards. Currently, the excursion hours allowed under Midwest Generation's thermal adjusted standard at the Interstate-55 bridge also allow two percent excursion hours. The Agency is also proposing to limit the allowable excursions of the daily maximum up to 2° Celsius (or 3.6° Fahrenheit). This is between the 1.7° C (or 3° F) excursion allowance for the General Use standard and 3.8° C (or 7° F) for the existing Secondary Contact and Indigenous Aquatic Life Standards.

Developing the Agency's proposal to the Board for thermal water quality standards was one of the most challenging aspects of the rule development process and there will likely be additional information developed in the Record of this proceeding that the Board will have to consider in making a final decision.

Bacteria

In the case of bacteria, the Agency concluded there were no reliable criteria available on which to base water quality standards to protect the types of recreational uses designated in the CAWS and Lower Des Plaines River. Older federal criteria documents are viewed with skepticism among the scientific community. U.S. EPA has undertaken a multi-year initiative centered on an epidemiological survey to develop new

criteria. They have publicly stated their desire to have new criteria available for states to use within five years. The federal effort is focused exclusively on primary contact recreation areas such as public beaches. MWRDGC has commissioned the University of Illinois School of Public Health to perform an epidemiologic study in the Chicago area to look at a spectrum of recreational activity generally characterized as secondary contact. The Agency agrees with MWRDGC that such an approach is more closely representative of actual exposure conditions likely associated with recreational activity within the various segments of the CAWS. While the Agency is proposing that the Board adopt specific recreational use designations applicable within the CAWS and Lower Des Plaines River; we are recommending deferral of adopting any numeric bacterial water quality standard until sound information is available to support such a standard. As a precautionary measure to protect our recreating public, however, we are proposing to require wastewater treatment facilities discharging into any segments listed as Incidental Contract Recreation and Non-Contact Recreation to employ disinfection practices after a reasonable compliance period.

I will be happy to answer any questions from the Board and the public on the development of the temperature water quality standard, the other toxic and metals numeric water quality standards and the bacteria water quality standard recommendation.

By: Scott Twait
Scott Twait

Date: 20 Dec. 2007

Illinois Environmental Protection Agency
1021 North Grand Avenue East
P.O. Box 19276
Springfield, Illinois 62794-9276

ATTACHMENT 1

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

JUL 25 2007

REPLY TO THE ATTENTION OF:
WQ-16J

Marcia T. Willhite, Chief
Bureau of Water
Illinois Environmental Protection Agency
PO Box 19276
Springfield, Illinois 62794-9276

Dear Ms. Willhite:

On February 13, 2004, the Illinois Environmental Protection Agency (Illinois EPA) submitted amendments for revised water quality standards to the United States Environmental Protection Agency (U.S. EPA) for review and approval under Section 303(c) of the Clean Water Act (CWA). The proposed amendments are at 35 Ill. Adm. Code 302.105, Antidegradation; 302.208, Numeric Standards for Chemical Constituents; 302.504, Chemical Constituents (Lake Michigan Basin Water Quality Standards); and 302.575 (Procedures for Deriving Tier 1 Water Quality Criteria and Values in the Lake Michigan Basin to Protect Wildlife). U.S. EPA also reviewed proposed amendments at 35 Ill. Adm. Code 301.267, 301.313, 301.413, 309.141, and 309.157 that were pertinent to water quality standards.

Consistent with Section 303(c) of the CWA and Federal regulations at 40 CFR 131.21, U.S. EPA is required to review and approve, or disapprove, new or revised State water quality standards. U.S. EPA has reviewed the new and revised water quality standards identified above and the information submitted by Illinois EPA in support of these amendments and hereby approves all of the new and revised standards identified above pursuant to Section 303(c) of the CWA and Federal regulations at 40 CFR 131.21.

Illinois EPA's submittal includes proposed aquatic life criteria for BETX chemicals (benzene, ethylbenzene, toluene, and xylenes). Illinois EPA's criteria were derived using a significant amount of data from static, unmeasured toxicity tests that apparently were not reviewed to confirm that the reported concentrations of the toxicants were actually the concentrations to which the test organisms were exposed. Because BETX chemicals are highly volatile, data from static, unmeasured toxicity tests are likely to overestimate the exposure and consequently, the LC50 for the species being tested because of volatilization of the toxicant during the test. Incorporation of this data into the criterion can lead to a value that is not protective of aquatic life because the LC50 for the species represented by static, unmeasured data might be significantly lower, possibly even among the four, most-sensitive species LC50s that determine the magnitude of the criterion. For this reason, U.S. EPA's, "Guidelines for Deriving National Aquatic Life Criteria for the Protection of Aquatic Life and their Uses" (U.S. EPA, 1985), cautions against accepting static, unmeasured tests unless the individual studies are thoroughly reviewed to ensure the reported toxicant concentration is an accurate estimate of the exposure of the test

organisms. In the absence of other data demonstrating that the proposed criteria protect aquatic life uses, U.S. EPA would have disapproved Illinois EPA's proposed criteria for the BETX chemicals. However, after consulting extensively with U.S. EPA Headquarters and the Office of Research and Development, we determined that, in the case of BETX chemicals, published predictive models exist (Di Toro *et al.*, "Technical Basis for Narcotic Chemicals and Polycyclic Aromatic Hydrocarbon Criteria," 2000; ASTER (Assessment Tools for the Evaluation of Risk), U.S. EPA) that provide an additional line of evidence to confirm that Illinois' proposed BETX criteria are adequately protective of aquatic life uses in Illinois surface waters. By approving these criteria, U.S. EPA is not endorsing Illinois EPA's use of unreviewed static, unmeasured data in deriving BETX criteria. The use of static, unmeasured data is not appropriate for chemicals that may volatilize substantially during the course of the toxicity test, without careful review of each study to ensure an accurate estimate of the LC50.

Consistent with Section 7 of the Endangered Species Act (ESA) and Federal Regulations at 50 CFR Part 402, U.S. EPA is required to consult with the United States Fish and Wildlife Service (U.S. FWS) on any action that may affect Federally-listed threatened and endangered species. Pursuant to the "Memorandum of Agreement Between the Environmental Protection Agency, Fish and Wildlife Service and National Marine Fisheries Service Regarding Enhanced Coordination Under the Clean Water Act and Endangered Species Act" (the MOA) governing consultation with U.S. FWS, the approval of new and revised State water quality criteria under Section 303 of the CWA is an action requiring consultation. To date, U.S. EPA has initiated, but not completed, consultation with U.S. FWS on the revised rules approved above. U.S. EPA has determined that this approval action does not violate Section 7(d) of the ESA, which prohibits irreversible or irretrievable commitments of resources that have the effect of foreclosing the formulation or implementation of reasonable and prudent alternatives, and has included in the record the basis for the conclusion that there are not impacts of concern during the interim period until the consultation is completed.

If you or your staff has any questions regarding this approval, please have them contact Brian Thompson of my staff. Mr. Thompson may be reached at (312) 353-6066.

Very truly yours,

Linda Holst

Linda Holst, Acting Director
Water Division

cc: Robert Mosher, Illinois EPA
Michael Coffee, U.S. FWS, Rock Island ES Field Office

BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

IN THE MATTER OF:	)	
	)	
WATER QUALITY STANDARDS AND	)	
EFFLUENT LIMITATIONS FOR THE	)	R08-09
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	)	

PRE-FILED TESTIMONY OF CHRIS O. YODER

My name is Chris O. Yoder and I am the Research Director for the Center of Applied Bioassessment and Biocriteria (or CABB) at the Midwest Biodiversity Institute (or MBI). I hold a Bachelor of Science degree from the Ohio State University and a Masters in Zoology from DePauw University.

MBI is a non-profit 501[c][3] corporation governed by a Board of Trustees and administered by an Executive Director. As research director of MBI, I am responsible for project direction, management, administration and coordination and reporting to the Executive Director and the Board of Trustees. A cooperative agreement between MBI and U.S. EPA was the primary vehicle for establishing CABB as a national center of expertise for biological assessments and biocriteria within MBI. MBI performs applied research for U.S. EPA, the states and other clients on biological assessment and biological criteria development and implementation in support of multiple water quality and natural resource management objectives. This research is focused on improving the science and technology used to classify, assess and diagnose problems in watersheds, and making it more widely available to a variety of potential users. To accomplish this mission, MBI provides logistics and expertise in all aspects of

bioassessment and biocriteria including field sampling and laboratory procedures, spatial sampling design, data management, data analysis, index development and calibration, interpretation of results, establishing indicator linkages, development of new and refined tools, reporting, and training professionals, administrators, and non-technical individuals and institutions.

Prior to coming to MBI, I worked for over 25 years for the State of Ohio's Environmental Protection Agency in various capacities. Just to highlight of few my duties for Ohio EPA, I worked on ecological assessments, surface water issues, biomonitoring, evaluation of water quality standards, review of thermal discharges and development of guidelines for 316 demonstrations. I was also a research assistant at DePauw University where I collected and analyzed data on the effect of thermal discharges on the seasonal distribution and abundance of Ohio River fishes and evaluated effects of thermal and other impacts on the fish community of the Great Miami River. Throughout my career I have participated in numerous research projects. I have 37 years of experience with the taxonomy, distribution, ecology and habitat of stream, river and estuarine fishes. I have provided expert witness testimony in proceedings before U.S. EPA, Ohio EPA and other State of Ohio Environmental Review Board, which is now the Environmental Review Appeals Commission. I have previously presented testimony on thermal issues before U.S. EPA as an employee of the Indiana Department of Health (now Indiana Department of Environmental Management) for the Wabash River 316(a) hearings in 1976 and as an employee of Ohio EPA regarding the development of their temperature criteria in 1978.

My complete curriculum vita is provided as Attachment 1 to this pre-filed testimony.

I was retained by U.S. EPA Region V via a cooperative agreement initiated in 2002 to provide technical assistance with several matters related to the use attainability analysis of the Lower Des Plaines River. These included participation in the biological subcommittee of the Lower Des Plaines River use attainability analysis stakeholder workgroup and biological data collection in the Lower Des Plaines River and some portions of the Chicago Area Waterway System. Specific to this project, MBI was tasked to evaluate temperature criteria options for the Lower Des Plaines River in 2005 and 2006.

The focus of my testimony in this matter is the report titled "Temperature Criteria Options for the Lower Des Plaines River" that was prepared for U.S. EPA and Illinois EPA and was included as Exhibit GG to the Illinois EPA's Statement of Reasons. In this document, I applied a methodologogy developed in a prior thermal project to the portions of the Lower Des Plaines River being studied in the UAA to develop options which the State could rely on in formulating its thermal criteria proposal to the Pollution Control Board. The document provided to the Board and the Lower Des Plaines River UAA stakeholder group was dated October 11, 2005. Non-substantive edits were made to that document for a final report dated November 23, 2005. That final version of my report is included as Attachment 2 to this pre-filed testimony. In July 2007, a transcription error was found in Table 3 of my final report and Attachment HH to the Illinois EPA's Statement of Reasons is my letter correcting that error.

The report I prepared for the Lower Des Plaines River UAA was developed prior to and independent of use designation determinations for the Lower Des Plaines River and Chicago Area Waterway System by the Illinois EPA. It was intended to provide a guideline to be used to link potential use designation decisions with possible criteria. I did not participate in the use designation process or make recommendations regarding the final criteria appropriate for the uses ultimately selected by Illinois EPA. I was not asked to propose specific thermal criteria for either the Lower Des Plaines River or the Chicago Area Waterway System or make recommendations regarding allocation of heat loads among specific sources.

My testimony will summarize the report I prepared for U.S. EPA and the Illinois EPA and the methodology it relies upon. It is necessary first to briefly summarize the history of the development of the Fish Temperature Model relied on in my report.

U.S. EPA's criteria document on temperature dates back to 1970's and has not been updated. My thermal work at MBI has focused on updating the thermal methodology that was developed by Ohio EPA in 1978. The methodology that has been relied upon in this prior work uses data from the thermal effects literature to create a thermal effects database for freshwater fish. This data is then used within a procedure that calculates four behavioral and physiological thresholds for a list of representative fish species termed RAS (or Representative Aquatic Species) that is designed to represent the entire fish assemblage of a particular river or river segment. During my tenure at Ohio EPA, we used this approach in setting temperature criteria for inland waters and Lake Erie in 1978 and ORSANCO (the Ohio River Valley Water Sanitation Commission) used it to adopt the current Ohio River temperature criteria in

1984. I played a lead role in developing the methodology used to derive seasonal temperature criteria adopted by Ohio EPA in 1978.

Based on this prior work in Ohio, MBI was retained by ORSANCO in 2003 to update the 1978 science and methodology on which the existing Ohio River standard relies. A project to review the temperature criteria for the Ohio River was the impetus for these revisions and included an examination of existing temperature criteria models and techniques, a review of state temperature criteria and methods and an extensive update to the thermal tolerance database for freshwater fishes common to rivers and streams of the Great Lakes and Ohio River drainages. The final report for that project is titled "Re-evaluation of the Technical Justification for Existing Ohio River Mainstem Temperature Criteria" and dated January 27, 2006. This report is included as Attachment 3 to this pre-filed testimony. While this work for ORSANCO was ongoing, I was tasked by the U.S. EPA to use this same information to develop temperature criteria options applicable to the Lower Des Plaines River pilot UAA study area. A draft report for the Lower Des Plaines River study area was prepared in June 2004 before completion of my work updating the Fish Temperature Model for ORSANCO. Upon completion of that work, my report on the Lower Des Plaines River was updated and finalized. (*See* Attachment 2 to this pre-filed testimony).

The remainder of my testimony will briefly summarize the updates made for ORSANCO to the Fish Temperature Model and then I will summarize two major assumptions underlying this methodology for customizing temperature criteria which include the thermal endpoints utilized in the Fish Temperature Model and representative

aquatic species selections made by the user. Finally, I will briefly summarize the criteria options that were included in my report.

Literature review used to update Fish Temperature Model database

The update of the Fish Temperature Model that MBI conducted for ORSANCO and applied to the Lower Des Plaines River involved an extensive update to the thermal tolerance database for freshwater fishes common to rivers and streams of the Great Lakes and Ohio River drainages. The original Ohio EPA methodology used thermal effects data from over 370 literature sources that dated prior to 1978. This information was updated by MBI for ORSANCO and included over 200 new and suitable thermal effects studies mostly produced after 1978. Where specific thermal tolerance endpoints used in the Fish Temperature Model (which I will discuss in more detail next) were available, the results of these additional studies were incorporated into a master thermal effects database and classified as one of the seven thermal endpoints. These studies primarily focused on freshwater fishes, but also included some macroinvertebrate data. An attempt was also made to include thermal tolerance data on the temperature tolerance of bivalve mollusks; however, I was not able to make this update because so few relevant studies were found at that time.

Thermal Endpoints

The first important principle underlying use of the Fish Temperature Model in developing thermal water quality standards is the thermal endpoints that are used. I will now explain what these are and how they were used in developing my conclusions. The seven endpoints are the Upper Incipient Lethal Temperature (or UILT); Chronic Thermal Maximum (ChTM); Critical Thermal Maximum (CTM); Optimum temperature;

Final Preferendum; Upper Avoidance Temperature and Growth. An additional endpoint referred to as Mean Weekly Average Temperature for growth (or MWAT) can be calculated if three of these seven endpoints are available.

The original seven endpoints are condensed into four thermal input parameters for the Fish Temperature Model. The first three of these seven endpoints (UILT, ChTM and CTM) measure lethality and have been combined into a single input parameter which I refer to in my report as an upper lethal temperature at acclimation temperatures of 25-30° C. The lethal endpoints are distinguished by the type of study utilized to measure lethality to fish and how realistically the testing methodology approximates conditions in the field. ChTM is a slow heating method that is the best available laboratory method for simulating natural conditions, but this methodology is new and there are very few studies available. UILT is still the primary method relied on because it is viewed as being more realistic than the CTM and numerous studies exist. CTM is a rapid heating method that does not approximate natural conditions and produces unrealistically high lethality endpoints. Therefore, a safety factor of 2° C was used when relying on tests conducted according to this method to address the inherent weakness of this rapid heating method in mimicking nature. Surprisingly, much of the new data that we found were based on CTM studies. The combined lethality input parameter (relying on ChTM, UILT and CTM with a safety factor) was used in calculating the short-term and long-term survival outputs of the Fish Temperature Model.

The remaining four endpoints (Optimum temperature, Final Preferendum, Upper Avoidance Temperature and MWAT for Growth) are considered to be sub-lethal or chronic effects endpoints. These were condensed into three input parameters for the

Fish Temperature Model by combining Optimum temperature and Final Preferendum into a single input parameter. Together these thermal input parameters are used in the Fish Temperature Model to determine period average and daily maximum temperature values in the summer season.

Representative Aquatic Species List

Once data on different fish species was entered in the Fish Temperature Model database by species and appropriate thermal endpoints are selected, the user of the Fish Temperature Model must determine the representative aquatic species for the subject water body. An important input variable of the Fish Temperature Model is the Representative Aquatic Species list (the methodology for developing this list is provided in Exhibit GG). This methodology does not include all of the species that may be present due to available data limitations, but instead relies on having an adequate representation of the spectrum of thermal tolerances in order achieve the objective of protecting all other species including those that lack direct thermal endpoints. One finding of our research is that intolerant species are under-represented in the thermal database, which is dominated by tolerant and intermediately tolerant species. As a result, we need to rely on the available data which frequently includes single studies (as opposed to multiple studies for the tolerant species) that do not always produce all of the thermal endpoints in the Fish Temperature Model. To address this issue, we developed an extrapolation procedure to fill in these holes in the database. This procedure is described in detail in the ORSANCO report included as Attachment 3 to this testimony.

Using existing field and historical data, I developed potential RAS lists for three designated use options that were considered by the contractors during the Lower Des Plaines UAA process. In the absence of an existing tiered aquatic life use designation system in Illinois and prior to the development of the use designations for the CAWS and Lower Des Plaines River, I chose to split the options into three categories that I termed General Use, Modified Use and Secondary Contact, which range in order from least to most impacted by chemical, physical and hydrologic modifications. These lists were developed based on expectations of which species we would expect to see in waters of these types. It was left to the local and policy experts at Illinois EPA to designate uses for the study area waters and make appropriate decisions about the Representative Aquatic Species lists. Of the total of 97 fish species with temperature tolerance values contained in MBI's database, the warmwater habitat assemblage that corresponds to the general use designation included 49 species. The modified use designation in my report is designed to represent impounded portions of rivers similar to the Des Plaines River and included 27 species, while the RAS list termed secondary contact consisted of 8 representative aquatic species. Only the General and Modified RAS lists relied on sampled data from the Lower Des Plaines; the Secondary Contact RAS is a general collection of typically tolerant species that are usually found in highly degraded and modified waters.

After developing these potential RAS lists, the Fish Temperature Model was used to calculate period average and daily maximum summer temperature criteria. Summer is defined as the period between June 15 and September 15. The tables I provided on pages 13 and 14 of my report illustrate temperatures that should not be exceeded in

order to protect a given percentage of the species in each RAS grouping for the four primary thermal endpoints.

Temperature Criteria Options

My report on the Lower Des Plaines River included some different options regarding the eventual development of thermal water quality standards. The Fish Temperature Model also specifies some criteria for developing water body specific temperature criteria. First, period averages should ensure the following: 100% long term survival of all representative species including Illinois threatened or endangered fish species, growth of commercially or recreationally important species, growth of at least 50% of non-game species and consistency with the observed historical ambient temperature record. Second, daily maxima should ensure 100% short term survival of all representative species and also be consistent with the observed historical ambient temperature record. The long-term survival endpoint is derived by subtracting a 2° C safety factor from the short-term survival value which is based on the lethal endpoints in the Fish Temperature Model database.

Table 2 on page 13 of Attachment 2 to my pre-filed testimony summarizes the values obtained from the Fish Temperature Model for different RAS options in the General Use category, while Table 3 on page 14 shows similar outputs for two options for a Modified Use RAS and one for a Secondary Contact RAS. These lists and outputs were provided to Illinois EPA as potential thermal criteria options for the Lower Des Plaines River study area.

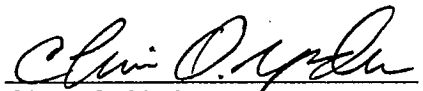
For the most tolerant Representative Species list provided (called Secondary Contact/Indigenous Aquatic Life, which represents the most physically and

hydrologically modified water bodies) eight thermally tolerant species were included. The Fish Temperature Model indicates that a summer daily maximum of 32.4° C (or 90.3° F) and a period average of 30.4° C (or 86.7° F) is needed to protect 100% of my Secondary Contact RAS list. The water quality standards currently in place in the waters subject to the Lower Des Plaines River and Chicago Area Waterway System are a daily maximum value of 34° C or 93° F that can be exceeded for 5 percent of the hours in a 12 month period up to a value of 37.8° C or 100° F at any time. The long-term survival values of only 50 percent of the representative aquatic species on my Secondary Contact RAS list would be protected by a standard of 93° F while 100°F exceeds the short-term and long-term survival values of more than 50 percent of the species on all the RAS lists developed for the Lower Des Plaines River.

I also provided options for calculating daily maximums and period averages for the non-summer months based on background temperatures. My suggestion was to use the geometric mean for the period average and the 98th percentile for the daily maximum, but other statistical thresholds could also be used in setting non-summer criteria. To establish background temperatures, I suggested using either a set of representative ambient sampling stations designed to represent background or a temperature modeling study. The concept applied here is that maintaining the normal seasonal cycles will protect essential functions such as growth, gametogeneisis and spawning. Selecting a temperature representative of background temperatures in this system is complicated by the physically and thermally altered characteristics of the Upper Illinois and the Chicago Area Waterway Systems.

In conclusion, I would like to stress that as with other naturally occurring physical and chemical constituents, occasional exceedences of well developed thermal criteria are inevitable and may not necessarily result in a biologically impaired use. A conclusion that I have reached is that temperature excursions should be evaluated with direct biological measures in a receiving water body that is representative of reference or least impacted conditions. Conversely, setting criteria to avoid the potential regulatory inconveniences of such exceedences can have potentially adverse biological consequences.

I will be available at the January 2008 hearings to address any questions for the Board or public on the use of the Fish Temperature Model as a methodology for setting temperature criteria.

By: 

Chris O. Yoder,
Midwest Biodiversity Institute

Date: December 12, 2007

Midwest Biodiversity Institute
P.O. Box 21561
Columbus, Oh 43221-0561

ATTACHMENT 1

Curriculum Vitae

Chris O. Yoder
7845 Darby Rd.
Circleville, OH
(740) 474-9537
yoder@rrohio.com

Personal: Birth date: October 11, 1950
Married, 2 children

Education: Ohio State University - B.Sc. Natural Resources, 1973
Major: Fisheries Management
DePauw University - M.A. Zoology, 1976
Major: Zoology
Thesis: Spatial and Temporal Distribution and Abundance of Fishes in the Middle Ohio River (May 1976)

Positions Held:

January 2007 – present: Research Director, Center for Applied Bioassessment & Biocriteria, Midwest Biodiversity Institute. Responsible for the following:

- As Research Director of MBI I am responsible for project direction, management, administration, and coordination and reporting to the Executive Director and the Board of Trustees; this includes managing 30+ major projects totaling $6.0 million since 2001.
- Fulfilling management and technical tasks in support of grants and contracts between the Midwest Biodiversity Institute (MBI), Center for Applied Bioassessment and Biocriteria (CABB) and various clients including U.S. EPA, State and Local governments, non-governmental organizations, academic institutions, and private corporations.
- Seek applied research grant opportunities to support research related to aquatic biological assessments and furthering the development and demonstration of adequate bioassessment and biocriteria approaches and programs.
- Provide direct technical assistance to State and Local government and non-government organizations with monitoring and assessment design and bioassessment and biocriteria implementation issues and topics via grants and contracts with U.S. EPA.
- Conduct and facilitate training sessions and certification classes for various clients.
- Perform administrative management duties including budgeting, office and facilities management, equipment management, health & safety, and personnel management and supervision.

February 2002 – December 2006: Senior Research Associate, Institute for Local Government Administration and Rural Development (ILGARD), Ohio University; Senior Research Associate and Principal Investigator, Cooperative Agreements with U.S. EPA, Office of Water; Research Director, Center for Applied Bioassessment & Biocriteria, Midwest Biodiversity Institute. Responsible for:

Positions Held: (continued)

- As Senior Research Associate, I was responsible for the execution of research projects, interactions with lead scientists, reporting to the manager of the Appalachian Watershed
- Research group member, preparing project proposals, conducting project management, representing OU at conferences and symposia.
- Served as part time Research Director of MBI where I was responsible for project management and coordination and reporting to the Director and the Board of Trustees.
- Fulfilling U.S. EPA tasks in support of cooperative agreements with the Midwest Biodiversity Institute (MBI) and the Center for Applied Bioassessment and Biocriteria (CABB).
- Seek applied research grant opportunities to support research related to cooperative agreement tasks and activities and further the development and demonstration of adequate bioassessment and biocriteria approaches and programs.
- Provide direct technical assistance to State and local government and non-government organizations with monitoring and assessment design and bioassessment and biocriteria implementation issues and topics.
- Instructed in Ohio University class (BIOS 492/692) offered one semester per year.
- Conduct and facilitate training and certification classes.
- Support environmental projects development and management at ILGARD.

February 2001 – January 2002: Midwest Biodiversity Institute (MBI) and Institute for Local Government Administration and Rural Development (ILGARD), Ohio University - Principal Investigator, Cooperative Agreement with U.S. EPA, Office of Water (Leave-of-absence from Ohio EPA). Responsible for the following:

- Conducting activities as tasked by U.S. EPA in support of EPA-OW initiatives for biological criteria and biological assessments.
- Provide direct assistance to EPA, states, and other non-governmental organizations with biological criteria including the rationale and development of methods,
- techniques, protocols, and criteria.
- Initiated the Center for Bioassessment and Biocriteria (CABB) to provide expertise to federal, state, local, and non-government organizations for biological assessments and the application of biological criteria in all aspects of water quality management.
- Conducted training classes.

January 1990 - February 2001: State of Ohio Environmental Protection Agency - Manager, Ecological Assessment Section. Responsible for the following:

- Administrative responsibilities for the Ecological Assessment Section – statewide scope.
- Biological Criteria - development of rationale, methods, techniques, manuals, and criteria.
- Research and development into methods and procedures for incorporating ecoregions, biological, chemical, and physical data in water quality management policy and programs.
- Development of different levels of bioassessment methods.
- Represent Ohio EPA as a spokesman for ecological issues at state, regional, and national

Positions Held: (continued)

meetings, symposia, and conferences.
- Provide expert witness testimony on behalf of the State of Ohio in litigation proceedings.
- Conducted training classes.

January 1997 - March 31, 1999: State of Ohio Environmental Protection Agency, Manager, Ecological Assessment Section - Principal Investigator, Cooperative Agreement with U.S. EPA, Office of Water. Responsible for the following:

- Supervise and manage the biological and water quality survey program including project selection, resource allocation, study planning, and report production.
- Supervise ecological assessments of unregulated hazardous waste sites, Natural Resource Damage Assessments, and biomarkers indicator development.
- Development of ecological and other environmental indicators and establishment of linkages between these and administrative indicators.
- Provide technical assistance to other Ohio EPA programs, and other local, state, and federal agencies and organizations.
- Conducting activities as tasked by U.S. EPA project officer in support of EPA-OW initiatives for biological criteria and biological assessments.
- Provide direct assistance to States and EPA with biological criteria including the rationale and development of methods, techniques, protocols, and criteria.
- Assign duties under cooperative agreement to other Ohio EPA staff as listed in the agreement.

January 1986 - December 1990: State of Ohio Environmental Protection Agency - Assistant Manager, Surface Water Section - Responsible for the following:

- Biological Criteria - development of rationale, techniques, manuals, and criteria.
- Research and development into methods and procedures for incorporating biological data into surface water quality management policy and programs.
- Represent Ohio EPA as a spokesman for biological issues at state and national meetings, symposia, and conferences.
- Provide expert witness testimony on behalf of Ohio EPA in litigation proceedings.
- Coordinate the biological and water quality survey program including project selection, resource allocation, study planning, and report production.
- Provide technical assistance to other Ohio EPA programs.

August 1985 - January 1986: State of Ohio Environmental Protection Agency, Supervisor, Reporting and Evaluation Unit, Biomonitoring Section - Responsible for the following:

- Development of biological evaluation methods and analytical procedures.
- Design field studies to evaluate point/nonpoint pollution using integrated bioassessments.
- Development and application of field sampling methods for assessing fish communities.
- Produce river and basin-specific reports on biological conditions and water quality.

Positions Held: (continued)

January 1979 - August 1985: State of Ohio Environmental Protection Agency, Manager, Evaluation & Standards Section - Responsible for the following:

- Development of Water Quality Standards.
- Fish community evaluations.
- Biennial 305b report.
- Surface water monitoring strategy.
- 401/404 dredge and fill program.
- Biological & water quality survey program.

November 1976 - January 1979: State of Ohio Environmental Protection Agency, Industrial Wastewater Section - Duties of my position included the following:

- Reviewed and evaluated thermal discharge and cooling water intake studies (Section 316 demonstrations)
- Developed state guidelines for 316 demonstrations.
- Developed temperature and thermal mixing zone criteria for the state water quality standards.

August 1976 - November 1976: Indiana State Board of Health, Stream Pollution Control Board Permits Section - Duties of my position included:

- Reviewed and evaluated section 316(a) thermal discharge studies.
- Provided expert witness testimony on the behalf U.S. EPA and the Indiana SPCB.

June 1974 - August 1976: DePauw University, Zoology Department, Research Assistant to Dr. James R. Gammon - My research duties included the following:

- Data collection and analysis of the effects of thermal discharges on the seasonal distribution and abundance of Ohio River fishes.
- Data collection and analysis of the effects of all pollution sources and habitat on the longitudinal distribution and abundance of Ohio River fish.
- Evaluated effects of thermal and other impacts on the fish community of the Gr. Miami River.
- Assisted other researchers with similar efforts on the Wabash River and its tributaries.

January 1974 - June 1974: Ohio State Univ., Museum of Zoology, Dr. Ted M. Cavender - duties included:

- Cataloguing ichthyologic collections from Maine and Ohio into the OSUMZ collections.
- Collected data on the distribution and abundance of fish in Big Walnut Creek (Ohio) to evaluate the effects of a municipal water supply reservoir.

September 1973 - January 1974: Wittenberg Univ., Biology Dept., Dr. Louis Laux - work duties included:

Positions Held: (continued)

- Data collection, analysis, and reporting for an environmental impact statement to evaluate the effect of a reservoir on Buck Creek (Ohio).

1969, 1971, 1972, 1973 (June - September): Chewonki Foundation, Inc., Wiscasset, Maine - job duties included:

- Summer camp counselor - conducted a marine and estuarine studies program along the coast of Maine (two reports were produced).
- Led canoeing and backpacking trips throughout the state of Maine.

General Experience:

- Thirty-seven (37) years of experience with the taxonomy, distribution, ecology, and habitat of stream, river, and estuarine fishes.
- Thirty-six (36) years of experience with fish sampling gear including seines, trawls, fyke nets, gill nets, hoop nets, A.C. and pulsed D.C. electrofishing gear, boats, and outboard motors.
- Thirty-five (35) years experience with water quality sampling gear and data analysis.
- Thirty-three (33) years experience with government procedures, budgeting, supervision, grant proposals, and office procedures.
- Expert witness testimony for the States of Ohio and Indiana, and U.S. EPA.
- Experience with state and federal water quality and water pollution control laws and regulations.
- Design of field studies to evaluate site-specific, basin-specific, and regional fish and aquatic assemblage status, trends, and characteristics and associated chemical and physical parameters.

Professional Societies:

American Fisheries Society (1975 - present)
Ohio Chapter American Fisheries Society (1977 - present)
Ohio Academy of Science (1977 - present)
North American Benthological Society (1993 - present)

Professional Awards/Certifications:

The Nature Conservancy, Outstanding Public Service Award (May 2002)
Water Management Assoc. of Ohio, Wayne S. Nichols Outstanding Public Servant Award (Nov. 1997)
Certified Fisheries Scientist (Tier II) - by American Fisheries Society (February 1986).
Sigma Xi Science Honorary (November 1974).

Other Professional Achievements/Skills:

Served as a manuscript reviewer for the following:

- Northeast Naturalist – Guest Editor
- Archives of Environmental Contamination and Toxicology

- N. American Journal of Fisheries Management
- Hydrobiologia
- Ohio Journal of Science
- Transactions of the American Fisheries Society
- Environmental Toxicology and Chemistry
- Environmental Science and Policy
- Journal of the N. American Benthological Society
- Journal of Environmental Monitoring and Assessment
- Ecological Engineering
- Ecological Applications
- N. American Journal of Fisheries Management
- Electric Power Research Institute
- U.S. EPA Ecological Report Series
- U.S. EPA Technical Guidance Documents
- U.S. EPA Environmental Research Laboratory, Corvallis
- Ohio DNR Strategic Plan - Endangered Fish section.

Recent Service on Committees/Workgroups:

- U.S. EPA, Tiered Aquatic Life Uses technical document writing team (Sept. 2004 – present)
- U.S. EPA, Region V State Bioassessment Working Group (December 2001-present)
- U.S. EPA, ORD – Mid-Continent Ecology Division peer review panel (February 2002).
- National Research Council, Science in TMDLs Committee (Jan. - June 2001).
- U.S. EPA Science Advisory Board review of Applied Regional Analysis (April 1990).
- U.S. EPA - Biocriteria Policy Guidance Writing Committee, (February 1989 - present).
- Ohio DNR, Div. of Reclamation - Re-mining & Pond Management task forces (April 1988 - May 1989).
- Ohio DNR, Interagency ad hoc workgroup on endangered fish and fish population data (1986 - 1989).
- Ohio DNR, Scenic Rivers Program - ongoing technical assistance (1987 - present).
- Ohio DNR, Non-game Technical Advisory Committee (January 1989 - June 1997).
- U.S. EPA, Monitoring and Data Support - ongoing technical assistance with rapid bioassessment protocol, monitoring strategy, and program indicators (1987 - present).
- Ohio DNR/Ohio EPA Agricultural Drainage Committee (June 1990).
- Invited to participate in Water Quality 2000, an inter-disciplinary task force including over 70 organizations to review national water quality goals and policies for the 21st century (sponsored by the Water Environment Federation).
- U.S. Forest Service BMP Effectiveness Task Force, participant (Sept. 1991 - August 1994).
- USGS - NAWQA Program advisory panel for fish ecology issues (September 1991 - present).
- Intergovernmental Task Force on Monitoring Water Quality (March 1993 - September 1996).
- Clermont County Project XL Science Advisory Committee (May 1997 - present)
- Intergovernmental Task Force on Monitoring Water Quality - Indicators Task Group (March 1992 - September 1996).
- Intergovernmental Task Force on Monitoring Water Quality - Methods Comparability Task Group (April 1993 - present).
- State-U.S. EPA Workgroup, Environmental Monitoring & Assessment Program (EMAP; March 1992 - September 1995).

Recent Service on Committees/Workgroups (continued):

- U.S. EPA Wet Weather Flows Expert Panel (February - August 1993).
- Review of Environment Canada's Interpretive Review of the Adult Fish Survey Used for Aquatic Environmental Effects Monitoring (May - December 1993).
- Ohio River Basin Consortium for Research & Education, Environmental Visions '94 (Speakers Bureau; August 1994 - present).
- U.S. EPA, National Advisory Council on Policy & Technology, Environmental Statistics Subcommittee (August 1994 - September 1998).
- State Environmental Goals & Indicators Project Advisory Board (September 1994 - September 1997).
- U.S. EPA, Pilot Environmental Indicators Project (May 1994 - September 1997).
- Advisory Panel to ORSANCO for Development of Ohio River IBI (March 1995 – present).
- Cooperative Agreement w/U.S.EPA on biol. assessments & criteria (Jan. 1997 - March 1999).
- DuPage River – Salt Creek Watershed Group stormwater strategy committee (December 2007).

Recent Projects:

- Ohio Credible Data Law Qualified Data Collector Bioassessment Training, Ohio EPA (June 2006-7).
- Development of biological assessment tools for Midwestern non-wadeable rivers (June 2004-present).
- Monitoring and bioassessment plan development of the DuPage-Salt Creek watershed group, Illinois (September 2005 – present).
- Review and update of temperature criteria for the Ohio River mainstem (Feb. 2003 – Feb. 2006)
- Monitoring strategy development for the State of Rhode Island DEM (June 2002 – October 2004).
- Bioassessment program development for the Miami Conservancy District, Ohio (June 2002 – Dec. 2004).
- Critical elements of state bioassessment programs – process development for U.S. EPA; 15 states and multiple tribes evaluated (October 2003 – present).
- Maine and New England Rivers fish assemblage assessment (June 2002 – present).
- Evaluation of six Region V state biological assessment programs and methods (Jan. 2002 – present).
- Initiated the Center for Applied Bioassessments and Biocriteria (CABB) as a regional center of expertise for facilitating the development of bioassessment and biocriteria tools and methods and assisting other organizations with bioassessment and biocriteria issues (October 2002).
- Review of applicability of the U.S. EPA refined aquatic life uses and biological condition axis to CWA Section 304(a) chemical criteria derivation (October 2001 – present).
- Review of Michigan DEQ biological monitoring program with emphasis on statewide design issues (subcontractor to the Great Lakes Environmental Center [GLEC]; October 2002 – March 2003).
- Review of Tennessee's biocriteria development document (consulting agreement with GLEC).
- Development of new approaches to deriving 304(a) water quality criteria for U.S. EPA.
- Member of technical expert panel for reviewing storm water monitoring and assessment in Southern California (Southern California Coastal Watershed Research Project).
- Constructed an electrofishing boat for use in Maine and New England lakes and rivers by Kleinschmidt Assoc., Pittsfield, ME.
- Review of Missouri's biocriteria development (consulting agreement with GLEC).
- Development of a comprehensive surface water monitoring strategy for Rhode Island DEM and in conjunction with the development of an estuarine strategy.
- Development of a biological assessment [program for the Miami Conservancy District and the production of visual watershed assessment layouts.

Recent Projects (continued):

- U.S. EPA Methods for Tiered Aquatic Life Uses (2002-2007)
- Ohio University Watershed-based classification and prediction method development, U.S. EPA STAR grant, Ohio University (2004-2006).
- Determining transition between wadeable and non-wadeable lotic habitats using a combined probabilistic and targeted monitoring design, U.S. EPA (March 2007 – present).

Publications and Technical Reports:

Barbour, M.T. and C.O. Yoder. 2007. Critical technical elements of a bioassessment program. U.S. EPA, Office of Water, Washington, DC. 71 pp.

Tewes, R., E. Emery, J. Thomas, L.E. Hersha and E.T. Rankin. 2006. Evaluation and development of biological assessment methods and standardized protocols for Region V: Boat electrofishing methods comparison study. C.O. Yoder (editor). Report to U.S. EPA. Region V (grant CP-96510501). 110 pp. + appendices.

Yoder, C.O., B.H. Kulik, and J.M. Audet. 2006. 2005 Maine Rivers Fish Assemblage Assessment: I. Northern Maine Rivers Results Allagash River. II. Maine Rivers Fish Species Distribution Atlas III. Toward the Development of a Fish Assemblage Index for Maine Rivers. MBI Technical Report MBI/12-06-1. Report to U.S. EPA, Region I, Boston, MA.. 71 pp. + appendices.

Yoder, C.O., B.H. Kulik, and J.M. Audet. 2006. The spatial and relative abundance characteristics of the fish assemblages in three Maine Rivers. MBI Technical Report MBI/12-05-1. Grant X-98128601 report to U.S. EPA, Region I, Boston, MA.. 136 pp. + appendices.

Yoder, C.O., B.J. Armitage, and E.T. Rankin. 2005. Re-evaluation of the technical justification for the existing Ohio River mainstem temperature criteria. Report to the Ohio River Valley Water Sanitation Commission (ORSANCO) ad hoc Committee on Temperature Criteria Re-evaluation. MBI Technical Report MBI/05-05-2. 55 pp. + Appendices.

U.S. EPA. 2005. Use of biological information to better define designated aquatic life uses in state and tribal water quality standards. Office of Water, Washington, DC. EPA 822-R-05-001. 188 pp.

Yoder, C.O. and 9 others. 2005. Changes in fish assemblage status in Ohio's non-wadeable rivers and streams over two decades, pp. 399-429. *in* R. Hughes and J. Rinne (eds.). Historical changes in fish assemblages of large rivers in the America's. American Fisheries Society Symposium Series.

Yoder, C.O. and E.B. Emery. 2004. Updating a temperature criteria methodology for the Ohio River mainstem, pp. 4-1 to 4-13. *in Proceedings from the EPRI Workshop on 316(a) Issues: Technical and Regulatory Considerations:* October 16-17, 2003, EPRI, Palo Alto CA, and American Electric Power Company, Columbus, OH: 2004. 1008476.

Karr, J.R. and C.O. Yoder. 2004. Biological assessment and criteria improve TMDL planning and decision-making. Journal of Environmental Engineering 130(6): 594-604.

Publications and Technical Reports:

Yoder, C.O. and B.H. Kulik. 2003. The development and application of multimetric biological assessment tools for the assessment of impacts to aquatic assemblages in large, non-wadeable rivers: a review of current science and applications. Canadian Journal of Water Resources, 28 (2): 1 - 28.

Miltner, R.J., D. White, and C.O. Yoder. 2003. The biotic integrity of streams in urban and suburbanizing landscapes. Landscape and Urban Planning 69 (2004): 87-100.

Emery, E. B., T. P. Simon, F. H. McCormick, P. A. Angermier, J. E. DeShon, C. O. Yoder, R. E. Sanders, W. D. Pearson, G. D. Hickman, R. J. Reash, J. A. Thomas. 2003. Development of a Multimetric Index for Assessing the Biological Condition of the Ohio River. Transactions of the American Fisheries Society 132:791-808.

Yoder, C.O. and J.E. DeShon. 2002. Using Biological Response Signatures Within a Framework of Multiple Indicators to Assess and Diagnose Causes and Sources of Impairments to Aquatic Assemblages in Selected Ohio Rivers and Streams. In T.P. Simon and P.M. Stewart (eds.). Biological Response Signatures: multimetric index patterns for assessment of freshwater aquatic assemblages, Lewis Publishers, Boca Raton (in press).

Yoder, C.O., M.J. Knapp, E.T. Rankin, and C.E. Boucher. 2001. Using biological assessments and criteria within a framework of environmental indicators to assess impairments from mine drainage. *in* B. Stuart (ed.), National Association of Abandoned Mine Lands Conference, Ohio University, Athens, OH.

National Research Council. 2001. Assessing the TMDL approach to water quality management. National Academy Press, Washington, DC. 109 pp.

Yoder, C.O., R.J. Miltner, and D. White. 2000. Using biological criteria to assess and classify urban streams and develop improved landscape indicators, pp. 32-44. *in* S. Minamyer, J. Dye, and S. Wilson (eds.), National Conference on Tools for Urban Water Resource Management and Protection. U.S. EPA, Cincinnati, OH. EPA/625/R-00/001.

Barbour, M.T and C.O. Yoder. 2000. The multimetric approach to bioassessment, as used in the United States of America, pp. 281-292. *in* J.F. Wright et al. (eds.), Assessing the biological quality of fresh waters. RIVPACS and similar techniques. Freshwater Biological Association, Ambleside, UK.

Barbour, M.T., W.F. Swietlik, S.K. Jackson, D.L. Courtemanch, S.P. Davies, and C.O. Yoder. 2000. Measuring the attainment of biological integrity in the USA: A critical element of ecological integrity. Hydrobiologia 00:1-12.

Yoder, C.O., R.J. Miltner, and D. White. 1999. Assessing the status of aquatic life designated uses in urban and suburban watersheds, pp. 16-28. *in* Everson, A. *et al.* (eds.), National Conference on Retrofit Opportunities for Water Resource Protection in Urban Environments. U.S. EPA, Offc. Res. Dev., Washington, DC. EPA/625/R-99/002.

Publications and Technical Reports:

Yoder, C.O. and E.T. Rankin. 1999. Biological criteria for water resource management, pp. 227-259. *in* P.C. Schulze and R.A. Frosch (eds.). Measures of Environmental Performance and Ecosystem Condition. National Academy of Engineering, National Academy Press, Washington, DC.

Yoder, C.O., R.J. Miltner, and D. White. 1999. Assessing biological quality and limitations to biological potential in urban and suburban watersheds in Ohio, pp. 139-148. *in* M. Malone (ed.), Comprehensive Stormwater & Aquatic Ecosystem Management, First South Pacific Conference, Volume I. ISBN 1-877134-18-X. Auckland Regional Council, Auckland, NZ.

Yoder, C.O. and M.A Smith. 1999. Using fish assemblages in a state biological assessment and criteria program: essential concepts and considerations, pp. 17-56. *in* T.P. Simon (ed.). Assessing the Sustainability and Ecological Integrity of Fish Assemblages. Lewis Publishers, Boca Raton, FL.

Rankin, E.T., R.J. Miltner, C.O. Yoder, and D. Mishne. 1999. Associations between nutrients, habitat, and aquatic biota. Ohio EPA Tech. Bull. MAS/1999-1-1. Div. Surface Water, Columbus, OH. 65 pp. + app.

Sanders, R.E., R.J. Miltner, C.O. Yoder, and E.T. Rankin. 1999. The use of external deformities, erosion, lesions, and tumors (DELT anomalies) in fish assemblages for characterizing aquatic resources: a case study of seven Ohio streams, pp. 225-248. *in* T.P. Simon (ed.). Assessing the Sustainability and Ecological Integrity of Fish Assemblages. Lewis Pub., Boca Raton, FL.

Rankin, E.T. and C.O. Yoder. 1999. Methods for deriving maximum species richness lines and other threshold relationships in biological field data, pp. 611-624. *in* T.P. Simon (ed.). Assessing the Sustainability and Ecological Integrity of Fish Assemblages. Lewis Publishers, Boca Raton, FL.

Rankin, E.T. and C.O. Yoder. 1999. Adjustments to the index of biotic integrity: a summary of Ohio experiences and some suggested modifications, pp. 625-638. *in* T.P. Simon (ed.). Assessing the Sustainability and Ecological Integrity of Fish Assemblages. Lewis Publishers, Boca Raton, FL.

Yoder, C.O. 1998. Important concepts and elements of an adequate state watershed monitoring and assessment program, pp. 615-628. *in* Proceedings of the NWQMC National Conference Monitoring: Critical Foundations to Protecting Our Waters. U.S. Environmental Protection Agency, Washington, DC.

Thoma, R.F. and C.O. Yoder. 1998. The Ohio environmental protection agency's biological monitoring program, IBI measures and their possible application to estuarine environments, pp. 14-42. *in* I. Hartwell (ed.), Biological and Habitat Quality Indicators for Essential Fish Habitat Workshop Proceedings, NOAA Technical Memorandum NMFS-F/SPO-32. U.S. Dept. Commerce, NOAA/NMFS, Silver Spring, MD.

Yoder, C.O. and E.T. Rankin. 1998. The role of biological indicators in a state water quality management process. J. Env. Mon. Assess. 51(1-2): 61-88.

Yoder, C.O. and E.T. Rankin. 1996. Assessing the condition and status of aquatic life designated Uses in urban and suburban watersheds, pp. 201-226. *in* L.A. Roesner (ed.). Effects of Watershed Development and Management on Aquatic Ecosystems, American Society of Civil Engineers, New York, NY.

Publications and Technical Reports:

Barbour, M.T., J.M. Diamond, and C.O. Yoder. 1996. Biological assessment strategies: applications and limitations, pp. 245-270. Whole Effluent Toxicity Testing: An evaluation of Methods and Prediction of Receiving Stream Impacts. SETAC Press.

Yoder, C.O. 1995. Incorporating ecological concepts and biological criteria in the assessment and management of urban nonpoint source pollution, pp. 183-197. *in* H. Schultz (ed.). Seminar Publication: National Conference on Urban Runoff Management: Enhancing Urban Watershed Management at the Local, County, and State Levels. U.S. EPA, Cen. Env. Res. Inf., Cincinnati, OH. EPA/625/R-95/003.

Yoder, C.O. 1995. Justification and rationale for revisions to the dissolved oxygen criteria in the Ohio water quality standards. Ohio EPA Tech. Bull. MAS/1995-8-5.

Yoder, C.O. and E.T. Rankin. 1995. The role of biological criteria in water quality monitoring, assessment, and regulation. Environmental Regulation in Ohio: How to Cope With the Regulatory Jungle. Inst. of Business Law, Santa Monica, CA. 54 pp.

Yoder, C.O. and E.T. Rankin. 1995. Biological criteria program development and implementation in Ohio, pp. 109-144. in W. Davis and T. Simon (eds.). Biological Assessment and Criteria: Tools for Water Resource Planning and Decision Making. Lewis Publishers, Boca Raton, FL.

Yoder, C.O. and E.T. Rankin. 1995. Biological response signatures and the area of degradation value: new tools for interpreting multimetric data, pp. 263-286. in W. Davis and T. Simon (eds.). Biological Assessment and Criteria: Tools for Water Resource Planning and Decision Making. Lewis Publishers, Boca Raton, FL.

Yoder, C.O. 1995. Policy issues and management applications for biological criteria, pp. 327-344. in W. Davis and T. Simon (eds.). Biological Assessment and Criteria: Tools for Water Resource Planning and Decision Making. Lewis Publishers, Boca Raton, FL.

Yoder, C.O. 1994. Toward improved collaboration among local, state, and federal monitoring and assessment efforts. J. N. Am. Benth. Soc. 13(3): 391-398.

Hughes, R.M., S.A. Heiskary, W.J. Matthews, and C.O. Yoder. 1993. Use of ecoregions in biological monitoring, pp. 125-151. in S.L. Loeb and A. Spacie (eds.), Biological Monitoring of Aquatic Systems. Lewis Publishers, CRC Press, Boca Raton, FL.

Yoder, C.O. 1991. The integrated biosurvey as an approach for the evaluation of aquatic life use attainment and diagnosis of impairment for Ohio surface waters. Biocriteria Symposium on Research and Regulation, U.S. EPA, Offc. Water, Criteria and Stds. Div., Washington, D.C. EPA-440/5-91-005. pp. 110-122.

Yoder, C.O. 1991. Answering some concerns about biological criteria based on experiences in Ohio. U.S. EPA, Criteria and Standards Div., Water Quality Stds. 21st Century, Wash., D.C., 1991. pp. 95 - 103.

Publications and Technical Reports:

Rankin, E.T. and C.O. Yoder. 1990. The nature of sampling variability in the index of biotic integrity (IBI) in Ohio streams, pp. 9-18. in Davis, W.S. (ed.). Proc. 1990 Midwest Poll. Biol. Mtg., Chicago, Ill. EPA-905-9-90/005.

Sanders. R.E. and C.O. Yoder. 1989. Recent collections and food items of river darters, *Percina shumardi* (Percidae) in the Markland Dam pool of the Ohio River. Ohio J. Sci. 89(1): 31-35.

Yoder, C.O. 1989. The development and use of biological criteria for Ohio surface waters. U.S. EPA, Criteria and Standards Div., Water Qual. Stds. 21st Cent., Dallas, Texas, 1989: 139-146.

Yoder, C.O. and R.A. Beaumier. 1986. The occurrence and distribution of the river redhorse *(Moxostoma carinatum)* and greater redhorse *(Moxostoma valenciennesi)* in the middle Sandusky River, Ohio. Ohio J. Sci. 86(1): 18-21.

Yoder, C.O. and J.R. Gammon. 1976. Seasonal distributions and abundance of Ohio River fishes at the J.M. Stuart electric generating station, pp. 284-295. in G.W. Esch and R.F. McFarlane (eds.) Thermal Ecology II (ERDA Symposium Series) "CONF-750425".

Yoder, C.O. 1976. Spatial and temporal distribution and abundance of fishes in the middle Ohio River. M.A. Thesis, DePauw University, Greencastle, Indiana. 113 pp.

Cavender, T.M. and C.O. Yoder. 1973. The fishes of Cedar Run - past and present. Ohio Biol. Inf. Circ. No. 4: 24-28.

Dudley, D.R., J.E. Luey, and C.O. Yoder. 1983. The integration of biological and chemical data in water quality management - the Ohio experience. ASTM Symposium on the Rationale for Sampling and Interpretation of Ecological Data in the Assess. of Freshwater Ecosystems. 35 pp.

Yoder, C.O., D.R. Dudley, J.E. Luey and J.P. Abrams. 1984. Evaluation and explanation of the biological and water quality survey program. Ohio EPA, Div. of Water Qual. Mon. & Assess., Columbus. 39 pp.

Yoder, C.O., T. Hadden, R. Bournique, P. Albeit, and J. Freda. 1984. Comprehensive water quality report for the central Scioto River mainstem. Ohio EPA, Division of Water Quality Monitoring & Assessment, Columbus. 303 pp.

Yoder, C.O., M. Smith, J. DeShon, and G. Mitchell. 1982. Biological and water quality study of the lower Great Miami River mainstem. Ohio EPA, Surveillance Section, Columbus. 303 pp.

Yoder, C.O., J. Hren, J. Freda, D. McIntyre, C.D. Webster and J.P. Abrams. 1980. Biological and water quality study of Mill Creek. Ohio EPA, Surv. Sect., Tech. Rept. OEPA 80/1.

Ohio Environmental Protection Agency. 1995. Ohio water resource inventory. Summary, Conclusions, and Recommendations & Vol. I. E.T. Rankin, C.O. Yoder, D. Mishne (eds.) Division of Surface Water, Monitoring & Assessment Section, Columbus, Ohio.

Publications and Technical Reports:

Ohio Environmental Protection Agency. 1992. Ohio water resource inventory. Executive Summary & Vol. I. E.T. Rankin, C.O. Yoder, D. Mishne (eds.) Division of Water Quality Planning and Assessment, Ecological Assessment Section, Columbus, Ohio.

Ohio Environmental Protection Agency. 1990. Ohio water resource inventory. Executive Summary & Vol. I. E.T. Rankin, C.O. Yoder, D. Mishne (eds.) Division of Water Quality Planning and Assessment, Ecological Assessment Section, Columbus, Ohio.

Ohio Environmental Protection Agency. 1990. Uses of biocriteria in the Ohio EPA surface water monitoring and assessment program. Division of Water Quality Planning and Assessment, Ecological Assessment Section, Columbus, Ohio. 52 pp.

Ohio Environmental Protection Agency. 1990. The cost of biological monitoring. Division of Water Quality Planning and Assessment, Ecol. Assess. Section, Columbus, Ohio. 16 pp.

Ohio Environmental Protection Agency. 1990. Compendium of biological results from Ohio rivers, streams, and lakes: 1989 edition. Div. of Water Qual. Plan. Assess., Ecol. Assess. Sec., Columbus, Ohio.

Ohio EPA. 1987. Biological criteria for the protection of aquatic life: Volume I. The role of biological data in water quality management. Division of Water Quality Monitoring and Assessment, Surface Water Section, Columbus, Ohio.

Ohio EPA (Multiple Contributors). 1987. Biological criteria for the protection of aquatic life: Volume II. Users manual for biological field assessment of Ohio surface waters. Division of Water Quality Monitoring and Assessment, Surface Water Section, Columbus, Ohio.

Ohio EPA (Multiple Contributors). 1989. Addendum to biological criteria for the protection of aquatic life: Volume II. Users manual for biological field assessment of Ohio surface waters. Div. of Water Qual. Mon. and Assess., Surface Water Section, Columbus, Ohio.

Ohio EPA (Multiple Contributors). 1989. Biological criteria for the protection of aquatic life: Volume III. Standardized field and laboratory methods for assessing fish and macroinvertebrate communities. Division of Water Quality Monitoring and Assessment, Surface Water Section, Columbus, Ohio.

Technical Presentations on Biological Criteria Development and Policies:

- Ohio Chapter, Soc. of Environ. Toxicologists & Chemists, Oxford, OH (June 1987).
- Ohio Chapter, Soil and Water Conservation Society, Columbus, OH (Oct. 1987).
- U.S. EPA National Workshop on Biocriteria, Chicago, IL (December 1987).
- ORSANCO Stream Criteria Subcommittee, Cincinnati, OH (December 1987).
- Ohio Fish and Wildlife Conference, Columbus, OH (February 1988).
- U.S. EPA, Region III Biologists Workshop, Cacapon, WV (April 1988).
- U.S. EPA National Symp. on Water Quality Assessment, Annapolis, MD (June 1988).
- Operators Training and Certification of Ohio annual meeting, Columbus, OH (July 1988).

Technical Presentations on Biological Criteria Development and Policies (continued):

- Ohio DNR, National Scenic Rivers Symposium, Columbus, OH (September 1988).
- Water Management Association of Ohio, Columbus, OH (November 1988).
- Ohio EPA Nonpoint Source Project Review Group, Columbus, OH (November 1988).
- Midwest Fish and Wildlife Conf. 50th annual meeting, Columbus, OH (December 1988).
- U.S. EPA, Region VII Nonpoint Source Seminar, Kansas City, KS (December 1988).
- Ohio DNR Mine Reclamation Division, Columbus, OH (January 1989).
- U.S. EPA, Midwest Pollution Control Biologists, Chicago, IL (February 1989).
- U.S. EPA, Water Quality Standards for the 21st Century, Dallas, TX (March 1989).
- Cuyahoga River Remedial Action Plan Steering Committee, Cleveland, OH (April 1989).
- National Council on Air and Stream Improvement, Dayton, OH (September 1989).
- U.S. EPA National Water Quality Monitoring Symp., Ft. Collins, CO (October 1989).
- Northeast Ohio Areawide Coordinating Agency, Cleveland, OH (November 1989).
- City of Columbus, Surveillance division in-house training (November 1989).
- Shawnee Nature Club, Portsmouth, OH (November 1989).
- Soil and Water Conservation Society Great Lakes Symp., Detroit, MI (November 1989).
- Soil and Water Conservation Society All-Ohio Chapter, Columbus, OH (January 1990).
- Soil Conservation Service Water Quality Action Plan, Chillicothe, OH (January 1990).
- Ohio DNR, Game Protectors Stream Ecology Workshop, Columbus, OH (January 1990).
- Indiana Wildlife Conference - Rivers and Streams Symposium, Muncie, IN (March 1990).
- U.S. EPA Science Advisory Board Review of Applied Regional Analysis, Corvallis, OR (April 1990).
- BBN, Inc. (Cambridge, MA) Environmental Seminar Series (May 1990).
- U.S. EPA Water Quality Standards Workshop, Sarasota, FL (June 1990).
- Ohio EPA-DE&RR Training Academy, Columbus, OH (June 1990).
- Biological Monitoring of Freshwater Ecosystems, SIL, W. Lafayette, IN (Nov. 1990).
- U.S. EPA, Water Quality Standards for the 21st Century, Wash., D.C. (Dec. 1990).
- U.S. EPA, Biocriteria Workshop: Research and Regulation, Wash., D.C. (Dec. 1990).
- Ohio River Basin Consortium for Research & Education, Morgantown, WV (Dec. 1990).
- U.S. EPA, Biosurveys and Biocriteria (seminar), Cincinnati, OH (January 1991).
- Ohio EPA WQS/Permit Training (5 locations, January - February 1991).
- Ohio DNR, Division of Reclamation Water Quality Training, Zanesville, OH (May 1991).
- Bioindicators of Rural Nonpoint Source Poll., Heidelberg Coll., Tiffin, OH (May 1991).
- Water Quality and Treatment Seminar, Ohio DNR, Div. of Reclamation, Zanesville, OH (May 1991).
- IKO Chapter of SETAC Meeting, Cincinnati, OH (June 1991).
- Ohio Water Pollution Control Association annual meeting, Cincinnati, OH (June 1991).
- Farmers and the Darby - a tri-county tour, Ohio Coop. Extension Service, Columbus, OH (July 1991).
- Ohio SWCD Technicians training in Nonpoint Source Management and Water Quality, Springfield, OH (October 1991).
- Northwest Ohio Water Management Conference, Leipsic, OH (December 1991).
- Ohio EPA, Construction Sites and Stormwater Training, Ohio EPA District Offices (February 1992).
- U.S. EPA, Environmental Monitoring & Assessment Program (EMAP), Stream Indicators Workshop, Cincinnati, OH (February 26-28, 1992).
- U.S. Geological Survey, National Water Quality Assessment (NAWQA), Biological Task Group, Reston, VA (March 10, 1992).

Technical Presentations on Biological Criteria Development and Policies (continued):

- U.S. EPA National Monitoring and Nonpoint Source Eval. Conf., Chicago. Illinois (March 11, 1992).
- Ohio SWCD Technicians training in Nonpoint Source Mgmt. & Water Quality, Wooster, OH (March 1992).
- Cuyahoga River Remedial Action Plan advisory group, Cleveland, OH (July 21, 1992).
- Environmental Citizens Action Committee, Lima, OH (September 22, 1992.
- Water Management Assoc. of Ohio, Annual Meeting, Columbus, Ohio (October 1992).
- Partnerships for Clean Water, Soil & Water Conservation Soc., Angola, IN (Nov. 1992).
- Ecosystem Objectives Workshop (Environment Canada), Sidney, B.C., Can. (Dec. 1992).
- U.S. EPA Workshop on Wet Weather Flows, Fairfax, VA (February 1993).
- National Workshop on Urban Runoff Management, Chicago, IL (April 1993).
- Minnesota PCA Biocriteria Workshop, St. Paul, MN (April 1993).
- National Governors Assoc. EMAP Workshop, Annapolis, MD (April 1993).
- Midwest Environmental Indicators & Biocriteria Workshop, Chicago, IL (May 1993).
- N. American Benthological Society Annual Meeting, Calgary, Alberta (May 1993).
- ORSANCO Monitoring CSO Impacts Workshop, Ft. Mitchell, Kentucky (June 1993).
- Interagency Biological Methods Workshop, U.S. Geological Surv., Reston, VA (June 1993).
- ITFM Data Collection Methods Task Group, U.S. Geol. Surv., Denver, CO (July 1993).
- TMACOG Urban Stormwater Symposium, Toledo, Ohio (November 1993).
- Research Approaches to Wetland Ecological Criteria, U.S. EPA/FWS, Duluth, MN (December 1993).
- Midwest Fish & Wildlife Conference - Special Symposium, St. Louis, MO (December 1993).
- U.S. Fish & Wildlife Service, Columbia National Fisheries Contaminants Research Center, Columbia, MO (December 1993).
- Ohio Chapter Soil & Water Conservation Society, Columbus, Ohio (January 1994).
- Bioassessment & Biocriteria: Briefing for U.S. EPA Office of Water management & staff, Washington, D.C. (February 1994).
- Aquatic Ecology Seminar Series, Ohio State Univ. Research Center, Columbus, Ohio (May 1994).
- Clean Water, Clean Rivers, Ohio Chapt. Sierra Club, Columbus, Ohio (May 1994).
- N. American Benthological Society Annual Meeting, Orlando, FL (May 1994).
- Natl. Acad. of Engineering, 3rd Industrial Ecology Workshop, Woods Hole, MA (June 1994).
- Ohio Natural Resource Coordinating Agencies, Columbus, Ohio (July 1994).
- 49th Soil & Water Conservation Society annual meeting, Norfolk, VA (August 1994).
- U.S. Forest Service BMP Effectiveness Workshop, Blacksburg, VA (August 1994).
- U.S. EPA WQS 21st Century, 4th National Meeting, Pentagon City, VA (September 1994).
- Darke and Miami Co. Soil & Water Conservation Districts, Stillwater Watershed Project, Brukner Nature Center, Troy, OH (October 1994).
- U.S. EPA Multi-regional WQS Workshop, Chicago, IL (December 1994).
- Ohio Fish & Wildlife Conference, OSU Fawcett Center, Columbus, OH (February 1995).
- Environmental Regulation in Ohio, Inst. of Business Law, Cleveland, OH (February 1995).
- ORSANCO Panel for Development of Ohio R. IBI, ORSANCO, Cincinnati, OH (Feb. 1995).
- Upper Scioto River Conservancy Board, Kenton, OH (March 1995).
- Regional EMAP Workshop, Pokagon State Park, IN (March 1995).
- U.S. EPA National Advisory Council on Environmental Policy & Technology, Environmental Statistics Subcommittee, Washington, D.C. (April 1995).

Technical Presentations on Biological Criteria Development and Policies (continued):

- Top of Ohio Resource Conservation & Development Board, Urbana, OH (April 1995).
- F.O. Butler Speaker, Ecological Seminars (April 20-22), South Dakota State University, Brookings, SD (April 1995).
- U.S. EPA National Environmental Indicators Workshop, Alexandria, VA (June 1995).
- Connecting Watersheds, Columbus, OH (June 1995).
- Biocriteria briefing for the U.S. EPA, Office of Water, Washington, D.C. (August 1995).
- Mid Ohio Regional Planning Comm., Franklin Co. Greenways Project, Columbus, OH (Oct. 1995).
- State Water Director's Meeting, U.S. EPA, Region V, Chicago, IL (November 1995).
- Ohio State University, School of Natural Resources, Terraqua Club, Columbus, OH (Feb. 1996).
- U.S. EPA, Region V Compliance Task Force, Bowling Green, OH (April 1995).
- SE Ohio Chapt. Water Environment Federation, Dresden, OH (May 1995).
- ITFM Monitoring & Design Workshop, Watersheds 96, Baltimore, MD (June 1996).
- Ad Hoc Committee on Combined Sewers & Stormwater, Columbus, OH (June 1996).
- Great Lakes Initiative External Advisory Group, Columbus, OH (July 1996).
- Effects of Watershed Development on Aquatic Ecosystems, Salt Lake City, UT (Aug. 1996).
- IBI Symposium, American Fisheries Society National Meeting, Dearborn, MI (Aug. 1996).
- Biological Criteria Development for Wetlands, U.S. EPA, Boulder, CO (Sept. 1996).
- Pennsylvania Fish Community Assessment Workshop, State College, PA (Nov. 1996).
- Stormwater Indicators Workshop, Madison, WS (Feb. 1997).
- USGS NAWQA National Meeting, San Antonio, TX (Feb. 1997).
- Stormwater Indicators Workshop, San Francisco, CA (March 1997).
- U.S. EPA Federal Advisory Committee on Wet Weather Flows, Washington, DC (April 1997).
- U.S. EPA Third EMAP Research Symposium, Albany, NY (April 1997).
- Pennsylvania Biocriteria Workshop, State College, PA (June 1997).
- EPA National WQ Permitting Conference, Providence, RI (June 1997).
- West Virginia Biocriteria Workshop, Morgantown, WV (July 1997).
- Virginia Biocriteria Workshop, Blacksburg, VA (July 1997).
- Maryland and Delaware Biocriteria Workshop, Annapolis, MD (August 1997).
- ASIWPCA National Conference, 1997, Reno, NV (August 1997).
- Midwest Environmental Enforcement Assoc. Conf., Nebraska City, NE (October 1997).
- U.S. EPA Regional Monitoring Coordinators Conf., Bandera, TX (October 1997).
- Watershed Partnerships Training Seminar (Instructor), Lancaster, PA (October 1997).
- U.S. EPA, Regional Offices (nine locations; November 1997 - February 1998).
- Ohio DNR, Soil & Water, Nonpoint Source Management seminar (November 1997).
- U.S. EPA Regions VIII & IX Biocriteria Symposium, Boise, ID (January 1998).
- Urban Retrofit Conference, Chicago, IL (February 1998).
- New England Interstate Water Pollution Control Comm., Lexington, MA (March 1998).
- U.S. EPA, Region VI Water Quality Monitoring Seminar, Bandera, TX (March 1998).
- Association of State Wetlands Managers, Washington, DC (April 1998).
- State of Connecticut DEP, Hartford, CT (April 1998).
- N. American Benthological Society, Charlottetown, PEI, Canada (June 1998).
- Watershed Partnerships Training Seminar (Instructor), Denver, CO (June 1998).

Technical Presentations on Biological Criteria Development and Policies (continued):

- WEF Specialty Conf., Urban Wet Weather Impacts, Cleveland, OH (2) (June 1998).
- National Water Quality Monitoring Conf., Reno, NV (July 1998).
- AMSA Annual Conf., Colorado Springs, CO (July 1998).
- ASIWPCA National Conference, 1998, Perdido Beach, AL (August 1998).
- U.S. EPA, ORD-NHREEL, Corvallis, OR (September 1998).
- Ohio EPA TMDL Educational Forum, Ohio State Univ., Columbus, OH (October 1998).
- Watershed Partnerships Training Seminar (Instructor), Denver, CO (October 1998).
- U.S. EPA, Office of Inspector General Water Quality Seminar, Kansas City, MO (Nov. 1998).
- Society of Environmental and Toxicologists Annual Meeting, Charlotte, NC (Nov. 1998).
- U.S. EPA, Region V Biocriteria/Bioassessments Working Group, Chicago, IL (Dec. 1998).
- U.S. EPA/New England State/Interstate Water Pollution Control Administrators Wetlands Symposium (January 1999).
- Western Governor's Association TMDL Forum, Las Vegas, NV (January 1999).
- Blacklick Creek Watershed Association, Reynoldsburg, OH (January 1999).
- Comprehensive Stormwater and Aquatic Ecosystem Management, First South Pacific Conference, Auckland, New Zealand (February 1999).
- Licking River Watershed Conditions, Newark City Government, Newark, OH (May 1999).
- Ohio Chapter SWCS Summer Meeting, Maumee Bay State Park, OH (June 1999).
- Connecting Ohio Watersheds Conference, Oberlin College, Oberlin, OH (June 1999).
- Minnesota PCA, Technical Seminar, St. Paul, MN (December 1999).
- Conference on Ecological Indicators, Minneapolis Metropolitan Council, St. Paul, MN (December 1999).
- Electric Power Research Institute (EPRI) conference on 316(b), Indianapolis, IN (May 2000).
- U.S. EPA Aquatic Life Use Support work group, Alexandria, VA (June 2000).
- Ohio DNR Reclamation Effectiveness Conf., Ohio University, Athens, OH (Aug. 2000).
- Massachusetts Bay Program, Using Biology to Signal Health, Boston, MA (Nov. 2000).
- ASA/SSSA/CSSA TMDL Seminar, Minneapolis, MN (Nov. 2000).
- Electric Power Research Institute, Large Rivers Biocriteria Symposium, Columbus, OH (Dec. 2000).
- Ohio Federation of Soil & Water Conservation Districts, Columbus, OH (Jan. 2001).
- Sustainable Watershed Planning in Ohio, Columbus, OH (Jan. 2001).
- National Research Council Science in TMDLs Committee, Washington, DC (Jan. 2001).
- Ohio Environmental Council, Clean Water Act Conference, Columbus, OH (Jan. 2001).
- U.S. EPA, Aquatic Life Use Support Workshop, Baltimore, MD (Feb. 2001).
- Water Environment Federation, Science in TMDLs Conf., St. Louis, MO (Feb. 2001).
- Sustainable Watershed Planning in Ohio, Fairborn, OH (Feb. 2001).
- Central Plains Center for Bioassessment/Biocriteria, Lawrence, KS (Mar. 2001).
- National Stormwater Permitting Conference, Orlando, FL (Apr. 2001).
- State of Nevada Surface Water Monitoring and Assessment Conference, Reno, NV (May 2001).
- Sustainable Watershed Planning in Ohio, Athens, OH (May 2001).
- N. American Benthological Society Annual Meeting, LaCrosse, WS (June 2001).
- Watershed Partnerships Seminar, WMDC – Denver, CO (June 2001).
- Rhode Island, Surface Water Monitoring & Assessment Workshop, Narragansett, RI (June 2001).
- National Assoc. of Abandoned Mine Land Managers Annual Conference, Athens, OH (August 2001).

Technical Presentations on Biological Criteria Development and Policies (continued):

- WEFTECH Workshops, TMDLs & Monitoring, Atlanta, GA (October 2001).
- U.S. EPA, Use Attainability Analysis workgroup, San Francisco, CA (November 2001).
- Central Valley Regional Water Quality Control Board, Effluent Dominated Waterbodies group, Sacramento, CA (November 2001).
- California Aquatic Bioassessment Workgroup 8th Annual Meeting, Sacramento, CA (November 2001).
- U.S. EPA ORD Water Quality Criteria workshop, Seattle, WA (December 2001).
- Midwest Surface Water Monit. & Stds Conference - keynote, Chicago, IL (Feb 2002).
- WEFTECH Workshops, TMDLs & Monitoring, Ft. Lauderdale, FL (February 2002).
- Ohio State University, Terra Aqua Seminar, Columbus, Ohio (March 2002).
- U.S. EPA, ALUS Working Group annual meeting, Annapolis, MD (March 2002).
- Ohio Department of Health, State Sanitarian Annual Meeting, Columbus, OH (March 2002).
- Columbus Natural History Society, OSU Museum of Biodiversity, Columbus, Ohio (March 2002).
- Darby Partners Meeting on Urban Development Issues, Hilliard, OH (April 2002).
- Maine State Agencies, Kennebec River Biological Assessment, Sidney, Maine (April 2002).
- U.S. EPA ALUS - 304a Criteria Conference, Potomac, MD (April 2002).
- U.S. EPA, Central Basin EMAP Conference (3 presentations), Kansas City, Missouri (May 2002).
- The Nature Conservancy, Freshwater Initiative Workshop, Birmingham, AL (May 2002).
- N. Am. Benth. Society Annual Meeting, Diagnosis Workshop, Pittsburgh, PA (May 2002).
- U.S. EPA Symposium on Designated Uses, Washington, DC (June 2002).
- Greater Milwaukee Area Clean Water Conference (Luncheon Keynote), Milwaukee, WI (October 2002).
- World Watershed Conference, Washington, DC (October 2002).
- Connections 2002, Illinois Water Conference, Champaign, Illinois (November 2002).
- Rhode Island Monitoring Conference, Providence, RI (November 2002).
- California Water Conference, Sacramento, CA (December 2002).
- Midwest SWiMS Conference, Chicago, IL (February 2003).
- U.S. EPA Fourth TALU Workshop, Baltimore, MD (February 2003).
- Quebec Instream Flows Conference, Quebec, P.O. (March 2003).
- Central Valley Wastewater Management Association, Sacramento, CA (March 2003)
- U.S. EPA National Biocriteria Workshop (instructor), Coeur de Aileen, ID (April 2003).
- Nat. Conference of Regional Environmental Enforcement Assoc., San Antonio, TX (April 2003).
- Proposal to assess Ohio R. and Upper Mississippi R. basin large river fish assemblages, Springfield, IL (May 2003).
- Kennebec River fish assemblage assessment advisory group, Sidney, ME (May 2003).
- U.S. EPA, Region I Water Quality Standards group meeting, Boston, MA (May 2003).
- Annual meeting of the American Fisheries Society, large rivers symposium (August 2003).
- The Nature Conservancy, Freshwater Agricultural Workshop, W. Lafayette, IN (Oct. 2003).
- U.S. EPA, Region V Midwest SWiMS, Chicago, IL (Feb. 2004).
- Chicago Waterway System UAA stakeholder group, Chicago, IL (Feb. 2004).
- Indiana Chapter AFS, W. Lafayette, IN (March 2004)
- New England Association of Environmental Biologists annual conference, Hancock, MA (March 2004).

Technical Presentations on Biological Criteria Development and Policies (continued):

- Northeast Fish & Wildlife Conference, Ocean City, MD (April 2004).
- USGS Ecological Relations & Water Quality, Denver, CO (May 2004).
- Ohio Valley Chapter SETAC Workshop, Columbus, OH (May 2004).
- OPM-WMDC Healthy Watersheds Partnerships Seminar, Denver, CO (November 2004).
- U.S. EPA, Region V Midwest SWiMS, Chicago, IL (Feb. 2005) - 1 monitoring workshop & 2 technical presentations.
- Ohio Natural History Conference, Columbus, OH (February 26, 2005).
- New England Association of Environmental Biologists, Lake George, NY (March 2005).
- Use attainability analysis principles, Illinois EPA, Springfield, IL (April 2005).
- WEFTECH Special Workshop for Watershed Groups, Philadelphia, PA (June 2005).
- The Nature Conservancy Hydrological Modifications workshop, Amherst, MA (Oct. 2005).
- Red River Bioassessment Conference, Moorhead, MN (Nov. 2005).
- Ohio DNR, Mineral Resources Applied Research Conference, Athens, OH (Dec. 2005).
- Maine State Agencies, Maine Rivers project, Sidney, ME (Jan. 2006).
- Maine Atlantic Salmon Technical Research Conference, Orono, ME (Jan. 2006).
- Midwest SWiMS, 2 workshops, 1 tech. session, Chicago, IL (Feb. 2006).
- Ohio Natural History Conference, Columbus, OH (Feb. 2006).
- DuPage-Salt Creek watershed group, Chicago, IL (March 2006).
- Univ. of Maine, Mitchell Center Seminar, Orono, ME (March 2006).
- New England Association of Environmental Biologists, Bethel, ME (March 2006).
- EPA, Region V Tribal Bioassessment Workshop, Cloquet, MN (April 2006)
- National Water Quality Monitoring Council National Conference, San Jose, CA (May 2006).
- California Association of Stormwater Quality Agencies, San Jose, CA (May 2006).
- Water Environment Federation Watershed Partnerships workshop, Pittsburgh, PA (May 2006).
- Arizona DEQ Bioassessment Program Evaluation, Phoenix, AZ (August 2006).
- Connecticut DEP Bioassessment Program Evaluation, Hartford, CT (November 2006).
- Colorado DPHE Bioassessment Program Evaluation, Denver, CO (December 2006).
- Region V Best Practices in Bioassessment Workshop II, Chicago, IL (December 2006).
- Region V Surface Water Monitoring and Standards Conference, Chicago, IL (January 2007).
- U.S. EPA, Region VIII, State Water Quality Standards Coordinators meeting (May 2007).
- North Atlantic Chapter SETAC Conference, Narragansett, RI (June 2007).
- American Fisheries Society annual conference (3 presentations), San Francisco, CA (September 2007).
- Electric Power Research Institute Research & Regulation conference, Denver, CO (October 2007).

Other Technical Presentations:

- Thermal Ecology Symposium (April 1974).
- Indiana Chapter, American Fisheries Society (February 1976).
- Ohio Fish and Wildlife Conference (February 1978).
- Ohio River Biology Symposium (November 1978).
- Ohio Academy of Science (1977, 1978, 1979, 1981, 1982).
- American Fisheries Society, National Meeting, Louisville, KY (September 1980).
- Symposia on Big Darby Creek (November 1985, October 1986).

General Interests:

- Hunting, fishing, boating, swimming, canoeing, farming, gardening, golf, ice hockey, softball, sports and outdoor activities in general.

References:

Mr. Gary Martin, Asst. Chief (Retired)
Ohio EPA, Division of Surface Water
(614) 403-5046

Dr. James R. Gammon, Professor (Emeritus)
DePauw University
Zoology Department
Greencastle, Indiana 46135
(317) 653-9721

Dr. Ted M. Cavender, Professor (Emeritus)
Ohio State University Museum of Biodiversity
Columbus, Ohio 43210
(614) 292-7873

Dr. James R. Karr, Professor (Emeritus)
Dept. Biological Sciences
University of Washington
Seattle, WA 98195
(206) 685-4784

Dr. Brian J. Armitage, Director (Emeritus)
Midwest Biodiversity Institute
P.O. Box 21561
Columbus, OH 43221-0561
(614) 442-7576

Mr. Scott Miller, Environmental Projects Manager
Ohio University
Institute for Local Government Administration and Rural Development
The Ridges, Bldg. 22
Athens, OH 45701
(740) 593-0827

Mr. Peter A. Precario, Executive Director
Midwest Biodiversity Institute
P.O. Box 21561
Columbus, OH 43221-0561
(614) 457-6000

ATTACHMENT 2

STATE OF ILLINOIS)
) SS
COUNTY OF SANGAMON)
)

PROOF OF SERVICE

I, the undersigned, on oath state that I have served the attached Pre-filed testimony of Rob Sulski, Pre-filed testimony of Roy Smoger, Pre-filed testimony of Scott Twait and Prefiled Testimony of Chris O. Yoder upon the person to whom it is directed, by placing it in an envelope and mailing it by Federal Express to:

John Therriault, Clerk
Illinois Pollution Control Board
James R. Thompson Center
100 West Randolph Street, Suite 11-500
Chicago, Illinois 60601

Marie Tipsord, Hearing Officer
Illinois Pollution Control Board
James R. Thompson Center
100 West Randolph Street, Suite 11-500
Chicago, Illinois 60601

and by placing it an envelope addressed to:

See Attached Service List

and mailing it First Class Mail from Springfield, Illinois on December 20, 2007, with sufficient postage affixed.

Vera B Nerst

SUBSCRIBED AND SWORN TO BEFORE ME

This 20th day of December, 2007

Brenda Boehner
Notary Public

OFFICIAL SEAL
BRENDA BOEHNER
NOTARY PUBLIC, STATE OF ILLINOIS
MY COMMISSION EXPIRES 11-3-2009

Service List for R08-9

Elizabeth Schenkier
Keith Harley
Chicago Legal Clinic, Inc.
205 W. Monroe, 4th Floor
Chicago, IL 60606

Ann Alexander
Senior Attorney, Midwest Program
Natural Resources Defense Council
101 North Wacker Dr., Ste. 609
Chicago, IL 60606

Susan M. Franzetti
Franzetti Law Firm P.C.
10 South LaSalle St.
Ste. 3600
Chicago, IL 60603

Fredrick M. Feldman
Ronald M. Hill
Margaret T. Conway
Metropolitan Water Reclamation District
of Greater Chicago
111 East Erie Street
Chicago, IL 60611

Katherine D. Hodge
Monica Rios
Hodge Dwyer Zeman
3150 Roland Ave.
P.O. Box 5776
Springfield, IL 62705-5776

John Therriault, Clerk
Illinois Pollution Control Board
James R. Thompson Center
100 West Randolph, Ste 11-500
Chicago, IL 60601

Marie Tipsord, Hearing Officer
Illinois Pollution Control Board
James R. Thompson Center
100 West Randolph, Ste 11-500
Chicago, IL 60601

Matthew J. Dunn, Chief
Office of the Attorney General
Environmental Bureau North
69 West Washington Street, Suite 1800
Chicago, IL 60602

William Richardson, Chief Legal Counsel
Illinois Department of Natural Resources
One Natural Resources Way
Springfield, IL 62702