Division of Surface Water
Response to Comments

Rules: Water Quality Standards Program Rules, OAC Chapter 3745-1:
OAC 3745-1-02: Definitions
OAC 3745-1-03: Analytical methods and availability of documents
OAC 3745-1-25: Mahoning river drainage basin
OAC 3745-1-31: Lake Erie standards

Agency Contact for this Package

Division Contact: Mariah Hood
Division of Surface Water
614-644-2865
Mariah.Hood@epa.ohio.gov

Ohio EPA held an Interested Party Review comment period from November 23, 2022 through January 6, 2023 regarding four Water Quality Standards Program rules. This document summarizes the comments and questions received during the comment period.

Ohio EPA reviewed and considered all comments received during the public comment period. By law, Ohio EPA has authority to consider specific issues related to protection of the environment and public health.

In an effort to help you review this document, the questions are grouped by topic and organized in a consistent format. The name of the commenter follows the comment in parentheses.

Comment 1: **OAC 3745-1-02(B)(3)**

(3) "Acute aquatic criterion" or "AAC" means the Ohio EPA ~~estimation~~estimate of the highest ~~instream~~ concentration of a ~~chemical~~material in the water column to which an aquatic ~~organisms~~community can be exposed ~~for a brief period of time~~briefly without ~~causing mortality~~resulting in an unacceptable effect.

MBI Comment:

It appears that Ohio EPA is adopting a facsimile of the EPA definition while changing, omitting, and/or modifying some important words. It would be more consistent to adopt the EPA definition verbatim. Acute has always been associated with various degrees of mortality so the elimination of this term seems a departure as well. While these are seemingly synonymous terms, we are unsure about their interpretation by a third party, especially if the intent is to dilute their meaning and/or enforceability. (Midwest Biodiversity Institute, MBI)

Response 1: Ohio EPA used "resulting in an unacceptable effect" to acknowledge that mortality is not the only effect of acute toxicity; physical, physiological, and behavioral changes in organisms can also result from acute effects, in addition to mortality. Ohio will use the following definition to incorporate these comments:

"Acute aquatic criterion" or "AAC" means the Ohio EPA estimate of the highest concentration of a material in the water column to which an aquatic community can be exposed briefly without resulting in an unacceptable effect including but not limited to mortality."

Comment 2: **OAC 3745-1-02(B)(5)**
(5) "Acute mixing zone" means the mixture of receiving water and effluent adjacent to a treated or untreated discharge within which the acute aquatic life criteria may be exceeded but the inside mixing zone maximum criteria may not be exceeded. The acute aquatic life criteria ~~shall~~is to be met on the downstream perimeter of the acute mixing zone.
MBI Comment:
We believe the proposed word "is" should be "are" unless the word "criteria" (plural) is changed to "criterion" (singular). We are also concerned that replacing of the word "shall" to meet the regulatory restriction reduction quota set by SB 9 with "is to" may diminish the enforceability of this definition and the IMZM criteria. (MBI)

Response 2: Ohio will use the following definition to incorporate these comments:
"Acute mixing zone" means the mixture of receiving water and effluent adjacent to a treated or untreated discharge within which the acute aquatic life criteria may be exceeded but the inside mixing zone maximum criteria are not to be exceeded. The acute aquatic life criteria are to be met on the downstream perimeter of the acute mixing zone.
Concerns about clarity and enforceability was considered and evaluated in our drafting of these changes and we are confident that the change will not adversely affect the enforceability of the rule. Defined terms do not need to have regulatory restrictive language in them. The rules that use the defined terms will house those regulatory restrictions.

Comment 3: **OAC 3745-1-02(B)(6)**
(6) "Acute toxicity" means ~~adverse effects~~concurrent and delayed adverse effects that result from an acute exposure and occur within any short observation period which begins when the exposure begins, may extend beyond the exposure period, and usually does not constitute a substantial portion of the life span of the organism.
MBI Comment:
There are numerous and varying scientific definitions of acute toxicity and most specify a time duration for acute effects to become measurable. The modification is to an already somewhat ambiguous definition, but does not seem to alter that former definition markedly. The phrase "*which begins when the exposure begins,"* has a repeated term that results in an awkward phrasing – this should be addressed. (MBI)

Response 3: Ohio disagrees that the phrase "*which begins when the exposure begins,"* is awkward; this is a literary technique which can emphasize a term or a relationship between terms; in this case, we are describing and emphasizing that the observation period begins when exposure begins.

Comment 4: **OAC 3745-1-02(B)(10)**
(10) "Average temperature" represents the arithmetic mean of multiple daily average temperatures ~~over a consecutive fifteen- or thirty-day period~~.
MBI Comment:

The deleted reference to consecutive 15 or thirty day periods are in deference to how the temperature criteria are structured with 15 day period in spring-early summer and late summer-fall to account for the rate of increase and decrease in ambient temperatures also known as acclimation periods. The criteria that occupy 15 day periods were intended to be calculated over that period comrade to the monthly criteria that are averages over a month. This eliminated needed specificity for how the temperature criteria are to be implemented. (MBI)

Response 4: We will use the following definition to incorporate these comments: *"Average temperature" represents the arithmetic mean of multiple daily average temperatures over a consecutive fifteen-day or thirty-day period or as otherwise specified in rule.*

Comment 5: **OAC 3745-1-02(B)(13)**
(13) "Beneficial uses" means potential uses of a water body by humans or other organisms, including uses for public water supply, propagation of aquatic life, recreation in and on the water, agricultural, industrial, or other purposes.
MBI Comment:
While the addition of this definition has merit, does it constitute the addition of a new regulation under SB 9? (MBI)

Response 5: This does not constitute a new restriction under SB 9. In accordance with Section 121.95 of the Revised Code, rules that include the words "shall," "must," "require," "shall not," "may not," and "prohibit" shall be considered to contain regulatory restrictions.

Comment 6: **OAC 3745-1-02(B)(22)**
(22) "Chronic aquatic criterion" or "CAC" means the Ohio EPA ~~estimation~~ estimate of the highest ~~instream~~ concentration of a ~~chemical~~material in the water column to which an aquatic ~~organisms~~community can be exposed indefinitely without ~~causing~~resulting in an unacceptable ~~effects~~effect (e.g., adverse ~~effects~~effect on growth or reproduction).
MBI Comment:
U.S. EPA's definition follows: *Criterion Continuous Concentration (CCC). An estimate of the highest concentration of a material in ambient water to which an aquatic community can be exposed indefinitely without resulting in an unacceptable adverse effect. This is the chronic criterion.*
https://www.epa.gov/wqs-tech/supplemental-module-aquatic-life-criteria#:~:text=An%20estimate%20of%20the%20highest,This%20is%20the%20acute%20criterion.
It appears that Ohio EPA is adopting portions of the EPA narrative while changing the term CCC to CAC and omitting and/or modifying some important words that are highlighted in yellow. It would be more consistent to adopt the EPA definition verbatim and especially to include the word adverse in lieu of unacceptable plus it would tie directly to the definition of adverse effect in definition (7). While these are seemingly synonymous terms, we are unsure about their interpretation by a third party, especially if the intent is to dilute their meaning and/or enforceability. (MBI)

Response 6: Ohio EPA has had CAC and CCC in the definitions rule since 1990 and 1997, respectively, but CCC was not used anywhere within OAC Chapter 1 outside of definitions. On further consideration, we will keep both CAC and CCC in the definitions rule, but using the following definition for both terms: *An estimate of the highest concentration of a material in the water column (ambient water) to which an aquatic* *community can be exposed indefinitely without resulting in an unacceptable adverse effect, including but not limited to effects on growth or reproduction. This is the chronic criterion.*

Ohio EPA has used CAC in 3745-1-40 (Methodologies for development of aquatic life criteria and values) since 1990, instead of CCC, though both terms had very similar definitions in the definitions rule. We recognize that US EPA, particularly their 1985 guidance, uses the term CCC, and will be amending Rule 3745-1-40 to mention both terms in an upcoming rulemaking.
Reference: Stephan, C.E., D.I. Mount, D.J. Hansen, J.R. Gentile, G.A. Chapman, and W.A. Brungs. 1985. Guidelines for Deriving Numerical Water Quality Criteria for Protection of Aquatic Organisms and Their Uses. U.S. Environmental Protection Agency. Office of Research and Development. Environmental Research Laboratories. PB85-227049

Comment 7: **OAC 3745-1-02(B)(25)**
(25) "Coldwater ~~fish~~fauna" means ~~those~~the species of ~~fish that thrive in relatively cold water. These species include, but are not limited to, salmon and trout (Salmonidae), and may include sculpins (Cottidae), and certain minnow (Cyprinidae) species~~aquatic animal life adapted to waters having temperatures moderated by contributions from deep or perched aquifers or springs. Water temperatures in such streams typically average less than twenty-one degrees Celsius and rarely exceed twenty-four degrees Celsius.
MBI Comment:
While the technical merits of the definition generally seem appropriate, we are concerned that this conflicts with the existing Cold Water Habitat narrative that requires fish AND macroinvertebrates AND plants to be present. We realize this is in development, but the apparent conflict between this proposed definition and the current use designation may make this premature until the use designation and its assessment is more firmly developed. Further, it is important to distinguish a mid-latitude "coldwater" fauna form a true coldwater fauna typical of northern latitudes. The expectations of a response to stress and adverse effects are fundamentally different. We would also suggest examining the concept of thermal guilds defined in Hokanson (1977) that includes the criteria for classifying aquatic organisms as stenothermic, mesothermic, and eurythermic be considered going forward. Some of Hokanson's temperature thresholds are higher than what are proposed here. It may be better to leave the quantitative specification of critical temperatures to a use designation narrative or a methods document. The agency also needs to continue a two assemblage approach with Cold Water Habitat the same as other uses with appropriate subcategories for situations where only macroinvertebrates may be present.
Reference: Hokanson, K.E.F. 1977. Temperature requirements of some percids and adaptations to the seasonal temperature cycle. J. Fish. Res. Bd. Can. 34: 1524-1550. (MBI)

Response 7: OAC 3745-1-07(B)(1)(f)(ii) specifically uses the term "Coldwater habitat, native fauna", so Ohio EPA chose to expand the definition from fish into fauna to acknowledge other assemblages used in the assessment and to mirror the language used in OAC 3745-1-07. We included the specification of critical temperatures based upon the thermal characteristics of Ohio's macroinvertebrate fauna to distinguish what Ohio considers coldwater taxa from more typical coldwater taxa found in northern latitudes.

Reference: Miltner, R., & McLaughlin, D. (2019). Management of headwaters based on macroinvertebrate assemblages and environmental attributes. *Science of the Total Environment*, *650*, 438-451.

Comment 8: **OAC 3745-1-02(B)(40)**
(40) "Existing uses" means uses that are actually attained in the water body, whether or not they are being included in the water quality standards.
MBI Comment:
U.S. EPA at 40 CFR 131.1(e) defines an existing uses as ‘‘those uses actually attained in the water body on or after November 28, 1975, whether or not they are included in the water quality standards. The proposed definition omits the November 28, 1975 date that is included in the current definition of existing use at 3745-1-05(8). We see this omission as being problematic as it could affect how the codified use designations that reflect less than CWA Section 101(a)(2) goal uses are assigned. While we acknowledge there is a long adherence to this date in the implementation of those uses, a literal reading could result in challenges to established practice.
We will also point out that both the proposed definition and the existing definition at 3745-1-05(8) are in apparent conflict with 3745-1-05(C)(1) that states *"Existing uses, which are determined using the use designations defined in rule 3745-1-07 of the Administrative Code, and the level of water quality necessary to protect existing uses, shall be maintained and protected.*" This seems to limit existing use to only waterbodies that have been already designated which directly contravenes the *"whether or not they are included in the water quality standards"* portion of the proposed and existing definitions in the WQS. (MBI)

Response 8: Ohio EPA will use the same definition listed in 3745-1-05(A)(8): "Existing uses" mean those uses actually attained in the water body on or after November 28, 1975.

Comment 9: **OAC 3745-1-02(B)(55)**
(55) "Lacustuary" means a river or stream reach where water from a direct lake Erie tributary mixes with lake Erie waters. A lacustuary is a slack water reach of a given tributary that ebbs and flows as lake seiches affect water levels, and is generally located between the farthest downstream riffle of the tributary and lake Erie proper. In addition to direct lake Erie tributaries, all inland streams and rivers that are tributary to a lake Erie lacustuary are considered a lacustuary in reaches affected by the lake Erie water level.
[Comment: Although "lacustuary" is the preferred terminology, the term "rheopalustrine" or "estuary" are occasionally used and should be considered interchangeable with "lacustuary".]
MBI Comment:
While this is a needed addition to the definitions there are aspects that require clarification and/or modification. The clause *"where water from a direct lake Erie tributary mixes with lake Erie waters."* is not necessarily true in every case and especially at the upper end of a lacustuary. It would be more accurate to say where the level of Lake Erie and the inflow of lake water affects the water level would be more accurate. The demarcation of the farthest downstream riffle seems sufficient, but we would also include run, i.e., riffle-run in that definition.
The synonymizing with the terms rheopalustrine or estuary may be technically accurate, but allowing this terminology to be mixed with the primary term lacustuary will potentially introduce confusion and misunderstanding as we have frequently experienced. The term estuary has an inherent affiliation with marine systems. (MBI)

Response 9: The new definition does specify the effect of water level relative to both Lake Erie and the receiving waterbody in the second and third sentences. Ohio will retain the comment at the end of the definition, since estuary has been removed from our definitions list and is still commonly used for freshwater estuaries by other organizations. With your input and further internal input, we have revised the lacustuary definition to the following:
"Lacustuary" is a reach of a given tributary where stream habitat and flow dynamics are affected by lake Erie water levels. In addition to direct lake Erie tributaries, all inland streams and rivers that are a tributary to a lake Erie lacustuary are considered a lacustuary in reaches affected by the lake Erie water level.
[Comment: Although "lacustuary" is the preferred terminology, the term "estuary" is occasionally used and should be considered interchangeable with "lacustuary" when used consistent with this definition.]

Comment 10: **OAC 3745-1-02(B)(81)**
(81) "Qualitative habitat evaluation index" or "QHEI" means an index of macro-habitat quality that is designed to provide a measure of habitat that generally corresponds to those physical factors that affect fish communities and that are generally important to other aquatic life (e.g., invertebrates). Description and derivation of the QHEI are contained in "The Qualitative Habitat Evaluation Index [QHEI]: Rationale, Methods, and Application" and "Methods for Assessing Habitat in Flowing Waters using the Qualitative Habitat Evaluation Index (QHEI)."
MBI Comment:
We advise checking the original QHEI documents including Rankin (1995) to make sure this definition matches the original technical derivation of this index. The clause *"and that are generally important to other aquatic life (e.g., invertebrates)"* should be revised to remove the term generally. The QHEI shows a strong relationship with macroinvertebrates in other states where it has been applied thus the relationship is better than general. The QHEI also is a measure that has a strong influence on water quality conditions, particularly nutrients and sediments, and provides a fundamental measure of the physical integrity of streams. Therefore we suggest adding: *" . . . that are generally important to other aquatic life (e.g., invertebrates) and which has a strong influence on water quality conditions, particularly nutrients and sediments, and provides a fundamental measure of the physical integrity of streams." (Yellow highlighted language should be added to the proposed definition.)* (MBI)

Response 10: Ohio will use the following definition to incorporate these comments and to remain consistent with the definition found in OAC 3745-4-02:
"Qualitative habitat evaluation index" or "QHEI" means an assessment methodology of the principal physical and riparian stream habitat features that affect fish communities and other aquatic life.

Comment 11: **OAC 3745-1-02(B)(102)**
(102) "Warmwater fish" means those species of fish that ~~inhabit relatively warm water. These species include, but are not limited to, bass; crappies and sunfish (Centrarchidae), and catfish (Ictaluridae), and may include certain suckers (Catostomidae), minnows (Cyprinidae), and perch and darter (Percidae) species~~ are adapted to waters where the temperature is influenced primarily by ambient air temperature.
MBI Comment:

The proposed definition is technically inadequate and unnecessarily vague. It could be especially vulnerable to the shifting baseline anticipated with climate change and potentially increasing ambient temperatures. This could result in conflicts with the application of existing use for example. In addition, the agency seems to be moving away from specifying such concepts based on a single assemblage (i.e., fish in this case) hence we suggest the following as replacement language:
Warm water aquatic organisms occur where water temperature, habitat and other characteristics are suitable for their support and propagation. These are also referred to as eurtyhtermic in terms of their tolerance of a wide range of temperatures.
See the previously cited Hokanson (1977) definitions for additional detail and clarity. (MBI)

Response 11: Ohio will use the following definition to incorporate these comments:
"Warmwater fauna" means the species of aquatic animal life that occur where water temperature is primarily influenced by ambient air temperature; habitat and other characteristics also influence their range and propagation."

Comment 12: **OAC 3745-1-03**
Ohio Coal Association submitted a fourteen-page comment with five appendices of supplemental information, focusing on removing "Field Methods for Evaluating Primary Headwater (PWH) Streams in Ohio 2020, Version 4.1" from the references listed in rule. (Ohio Coal Association)

Response 12: Most of the comments in OCA are not pertinent to this rulemaking because inserting the definition into Rule 01-03 does not describe its programmatic use, which is what OCA argues in their comments. Ohio EPA is inserting the PWH manual because primary headwaters will be surveyed in 2023 as a probabilistic survey, which was outlined in our Monitoring Strategy (Section A.1.1.4 of https://epa.ohio.gov/static/Portals/35/tmdl/Compiled_Monitoring_Strategy_2022.pdf); this was introduced to the public July 10, 2019. The strategy was submitted and approved by U.S. EPA between 2020 and 2021.
This survey will be used to establish baseline conditions for Ohio headwaters and better understand expectations for biotic assemblages in headwater streams in relation to biocriteria scoring and metrics. A Quality Assurance Project Plan (QAPP) for the probabilistic headwater survey can be found at https://epa.ohio.gov/static/Portals/35/tmdl/PRBHW-QAPP.pdf.

Comment 13: **OAC 3745-1-03(B)(3)(d)**
(d) "Development of a Multimetric Index for Assessing the Biological Condition of the Ohio River, Emery et. al., Transactions of the American Fisheries Society 132:791-808, 2003." This document is available on the internet at http://orsanco.org/wp-content/uploads/2016/11/Development-of-a-Multimetric-Index-for-Assessing-the-Biological-Conditon-of-the-Ohio-River.pdf.
MBI Comment:
We are unsure why a technical journal publication applicable to the development of the ORFIn index for the Ohio River is needed in the Ohio WQS. ORSANCO already lists these methods documents on their website and is what should be consulted to execute this type of work on the Ohio River in conformance with ORSANCO practices. If this is somehow seen as being essential then it would seem to make sense for Ohio EPA to list the numerous publications that have been done since the adoption of the biological

criteria and affiliated tools and methods since 1990. Some of these documents have clarified and updated the application of the biocriteria and the QHEI. Somehow it seems to be consistent to add these alongside the Emery et al. 2003 publication. Ohio EPA TSDs listed these as supporting documents alongside the codified biocriteria and QHEI manuals for many years. (MBI)

Response 13: This document was added because Ohio EPA plans to use ORSANCO's ORFIn index results to assess the aquatic life use attainment status of Ohio's Ohio River segments in the upcoming 2024 Integrated Report. A 2021 ORSANCO pool assessment report is also included as a reference for the macroinvertebrate index assessment. These references to ORSANCO indices will be updated as necessary in future rulemakings to reflect the most current application.

Comment 14: **OAC 3745-1-31(B)**
(B) ~~Temperature.~~Water temperature in lake Erie shall not:
MBI Comment:
This proposed revisions add a regulatory restriction while eliminating three such restrictions. Is this a new rule or is it a net reduction being done to meet the SB 9 reduction targets?
We do not have any substantive comments on this rule because the technical aspects appear to remain intact, but we remain concerned about substitution for imperative terms and how that may impact the implementation of the WQS. (MBI)

Response 14: Yes, it is a net reduction being done to meet SB 9 requirements. This is one requirement on the water temperature and not three, however, since the rule stated the word shall three times, Ohio EPA had to list these as separate restrictions in our inventory.

Comment 15: **3745-1-25**
MBI has no comments on this rule revision, but supports the adoption of the naming convention of the Geographic Names Information System. (MBI)

Response 15: Thank you for your comment, we plan to continue updating names as necessary to agree with those in the GNIS.

End of Response to Comments

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

Rule Coordinator
Ohio EPA, Division of Surface Water
P.O. Box 1049
Columbus, OH 43216-1019
dsw_rulecomments@epa.ohio.gov

January 6, 2023

Subject: Proposed Rules -- Water Quality Standards – Definitions, Methods, and Lake Erie Standards (OAC 3745-1-02, 3745-1-03, 3745-1-25, 3745-1-31)

To Whom It May Concern:

The Midwest Biodiversity Institute (MBI) is submitting comments on the Ohio Environmental Protection Agency's ("Ohio EPA" or "Agency") Interested Party Review for Water Quality Standards – Definitions, Methods, and Lake Erie Standards (OAC 3745-1-02, 3745-1-03, 3745-1-25, 3745-1-31) that were noticed on November 23, 2022. MBI is a not-for-profit corporation specializing in applied research with aquatic bioassessments, water quality standards, monitoring and assessment, and state bioassessment program development. As part of our mission MBI has conducted in depth reviews of 28 state, three federal, and two tribal programs since 2002. These reviews have included the development and implementation of biological assessments and biological criteria in state and federal programs. In addition, MBI has also conducted a number of comprehensive watershed bioassessments in Ohio and other states that emulate the essential concepts and attributes of the Ohio EPA program that includes the proposed rule modifications. It is from this base of experience that we offer the attached comments and suggestions which we believe will positively enhance and improve the proposed rule language and its application.

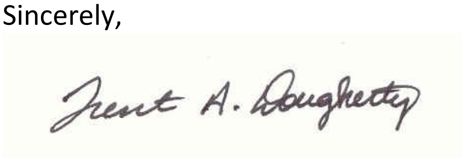
The bulk of our comments focus on the changes made to OAC 3745-1-02 (Definitions). A general comment, however, is that some of the proposed changes remove scientific specificity and meaning that is replaced by seemingly ambiguous terms that could be subject to broad interpretation and therefore disagreements about their actual meaning. We are unsure about why these changes are necessary, with the exception that some seem to copy recent U.S. EPA definitions. Even if this is a forced requirement to adopt federal definitions it does not mitigate the concerns we express in our attached specific comments.

Nevertheless, as it pertains to the amendments to OAC 3745-1-02, we noticed one glaring omission. In 2015, the US EPA amended paragraph (g) at 40 C.F.R. § 131.10 to provide that where a state or tribe adopts new or revised water quality standards based on a use attainability analysis, it must adopt the highest attainable use (HAU). The regulations further defined "highest attainable use" in 40 C.F.R. § 131.10(m) as "the modified aquatic life, wildlife, or recreation use that is both closest to the uses specified in section 101(a)(2) of the Act and attainable, based on the evaluation of the factor(s) in 131.10(g) that preclude(s) attainment of the use and any other information or analyses that were used to evaluate attainability." The definition and use of HAU provides clearer expectations for when an analysis of attainability of designated uses is or is not required. Such clarity allows for better and more transparent communication among EPA, states, regulated community and the public about the designated use revision process, and the appropriate level of protection necessary to meet the purposes of the Clean Water Act. We believe this would be useful throughout the state, but most significantly in urban streams (especially those subject to consent decrees) suffer chronic non-attainment. Thus, MBI recommends that the Agency adopt the § 131.13 (m) definition of "Highest Attainable Use" in these proposed regulations, and consider HAUs during the current Triennial Review process.

Furthermore, a major part of this, and future, rule revisions, concerns addressing the regulatory restriction reductions pursuant to SB9 of the 134th General Assembly. What one may call a regulatory restriction is in our eyes environmental protection. We are very concerned about how the Agency, the JCARR and/or the Common Sense Initiative will implement this legislation when it impacts the state's protection of water quality. We urge the Agency to be mindful of the direct and indirect implications of removing certain regulatory restrictions, including the enforceability of certain provisions and how removal of one restriction may complicate other provisions required under federal law.

We appreciate the opportunity to offer comments and we look forward to working with the agency to develop a better set of rules. If you or others in the Agency have questions or would like to discuss these issues further, please do not hesitate to contact me at tdougherty@mwbinst.com, or MBI's Research Director, Chris Yoder, at cyoder@mwbinst.com.

Sincerely,



Trent A. Dougherty
Executive Director

Enclosure: **Midwest Biodiversity Institute's Specific Comments on Draft Rules – Definitions, Methods, and Lake Erie Standards OAC 3745-1-02, -03, -25, and -31**

Midwest Biodiversity Institute
Specific Comments on Draft Rules – Definitions, Methods, and Lake Erie Standards OAC 3745-1-02, -03, -25, and -31

OAC 3745-1-02 Definitions

The following are specific comments by MBI on selected proposed changes to existing definitions in OAC 3745-1-02:

OAC 3745-1-02(3)

(3) "Acute aquatic criterion" or "AAC" means the Ohio EPA ~~estimation~~estimate of the highest ~~instream~~ concentration of a ~~chemical~~material in the water column to which an aquatic ~~organisms~~community can be exposed ~~for a brief period of time~~briefly without ~~causing mortality~~resulting in an unacceptable effect.

MBI Comment:
It appears that Ohio EPA is adopting a facsimile of the EPA definition while changing, omitting, and/or modifying some important words. It would be more consistent to adopt the EPA definition verbatim. Acute has always been associated with various degrees of mortality so the elimination of this term seems a departure as well. While these are seemingly synonymous terms, we are unsure about their interpretation by a third party, especially if the intent is to dilute their meaning and/or enforceability.

OAC 3745-1-02(5)

(5) "Acute mixing zone" means the mixture of receiving water and effluent adjacent to a treated or untreated discharge within which the acute aquatic life criteria may be exceeded but the inside mixing zone maximum criteria may not be exceeded. The acute aquatic life criteria ~~shall~~is to be met on the downstream perimeter of the acute mixing zone.

MBI Comment:
We believe the proposed word "is" should be "are" unless the word "criteria" (plural) is changed to "criterion" (singular). We are also concerned that replacing of the word "shall" to meet the regulatory restriction reduction quota set by SB 9 with "is to" may diminish the enforceability of this definition and the IMZM criteria.

OAC 3745-1-02(6)

(6) "Acute toxicity" means ~~adverse effects~~concurrent and delayed adverse effects that result from an acute exposure and occur within any short observation period which begins when the exposure begins, may extend beyond the exposure period, and usually does not constitute a substantial portion of the life span of the organism.

MBI Comment:
There are numerous and varying scientific definitions of acute toxicity and most specify a time duration for acute effects to become measurable. The modification is to an already somewhat ambiguous definition, but does not seem to alter that former definition markedly. The phrase "*which begins when the exposure begins,*" has a repeated term that results in an awkward phrasing – this should be addressed.

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The deleted reference to consecutive 15 or thirty day periods are in deference to how the temperature criteria are structured with 15 day period in spring-early summer and late summer-fall to account for the rate of increase and decrease in ambient temperatures also known as acclimation periods. The criteria that occupy 15 day periods were intended to be calculated over that period comrade to the monthly criteria that are averages over a month. This eliminated needed specificity for how the temperature criteria are to be implemented.

OAC 3745-1-02(13)
(13) "Beneficial uses" means potential uses of a water body by humans or other organisms, including uses for public water supply, propagation of aquatic life, recreation in and on the water, agricultural, industrial, or other purposes.

MBI Comment:
While the addition of this definition has merit, does it constitute the addition of a new regulation under SB 9?

OAC 3745-1-02(22)
(22) "Chronic aquatic criterion" or "CAC" means the Ohio EPA ~~estimation~~estimate of the highest ~~instream~~ concentration of a ~~chemical~~material in the water column to which an aquatic ~~organisms~~community can be exposed indefinitely without ~~causing~~resulting in an unacceptable ~~effects~~effect (e.g., adverse ~~effects~~effect on growth or reproduction).

MBI Comment:
U.S. EPA's definition follows: *Criterion Continuous Concentration (CCC). An estimate of the highest concentration of a material in ambient water to which an aquatic community can be exposed indefinitely without resulting in an unacceptable adverse effect. This is the chronic criterion. https://www.epa.gov/wqs-tech/supplemental-module-aquatic-life-criteria#:~:text=An%20estimate%20of%20the%20highest,This%20is%20the%20acute%20criterion.*

It appears that Ohio EPA is adopting portions of the EPA narrative while changing the term CCC to CAC and omitting and/or modifying some important words that are highlighted in yellow. It would be more consistent to adopt the EPA definition verbatim and especially to include the word adverse in lieu of unacceptable plus it would tie directly to the definition of adverse effect in definition (7). While these are seemingly synonymous terms, we are unsure about their interpretation by a third party, especially if the intent is to dilute their meaning and/or enforceability.

OAC 3745-1-02(25)

(25) "Coldwater ~~fish~~fauna" means ~~those~~the species of ~~fish that thrive in relatively cold water. These species include, but are not limited to, salmon and trout (Salmonidae), and may include sculpins (Cottidae), and certain minnow (Cyprinidae) species~~aquatic animal life adapted to waters having temperatures moderated by contributions from deep or perched aquifers or springs. Water temperatures in such streams typically average less than 21 degrees Celsius and rarely exceed 24 degrees Celsius.

MBI Comment:

While the technical merits of the definition generally seem appropriate, we are concerned that this conflicts with the existing Cold Water Habitat narrative that requires fish AND macroinvertebrates AND plants to be present. We realize this is in development, but the apparent conflict between this proposed definition and the current use designation may make this premature until the use designation and its assessment is more firmly developed. Further, it is important to distinguish a mid-latitude “coldwater” fauna form a true coldwater fauna typical of northern latitudes. The expectations of a response to stress and adverse effects are fundamentally different. We would also suggest examining the concept of thermal guilds defined in Hokanson (1977) that includes the criteria for classifying aquatic organisms as stenothermic, mesothermic, and eurythermnc be considered going forward. Some of Hokanson’s temperature thresholds are higher than what are proposed here. It may be better to leave the quantitative specification of critical temperatures to a use designation narrative or a methods document. The agency also needs to continue a two assemblage approach with Cold Water Habitat the same as other uses with appropriate subcategories for situations where only macroinvertebrates may be present.

Reference:

Hokanson, K.E.F. 1977. Temperature requirements of some percids and adaptations to the seasonal temperature cycle. J. Fish. Res. Bd. Can. 34: 1524-1550.

OAC 3745-1-02(40)

(40) "Existing uses" means uses that are actually attained in the water body, whether or not they are being included in the water quality standards.

MBI Comment:

U.S. EPA at 40 CFR 131.1(e) defines an existing uses as ‘‘those uses actually attained in the water body on or after November 28, 1975, whether or not they are included in the water quality standards. The proposed definition omits the November 28, 1975 date that is included in the current definition of existing use at 3745-1-05(8). We see this omission as being problematic as it could affect how the codified use designations that reflect less than CWA

Section 101(a)(2) goal uses are assigned. While we acknowledge there is a long adherence to this date in the implementation of those uses, a literal reading could result in challenges to established practice.

We will also point out that both the proposed definition and the existing definition at 3745-1-05(8) are in apparent conflict with 3745-1-05(C)(1) that states *"Existing uses, which are determined using the use designations defined in rule 3745-1-07 of the Administrative Code, and the level of water quality necessary to protect existing uses, shall be maintained and protected."* This seems to limit existing use to only waterbodies that have been already designated which directly contravenes the *"whether or not they are included in the water quality standards"* portion of the proposed and existing definitions in the WQS.

OAC 3745-1-02(55)

(55) "Lacustuary" means a river or stream reach where water from a direct lake Erie tributary mixes with lake Erie waters. A lacustuary is a slack water reach of a given tributary that ebbs and flows as lake seiches affect water levels, and is generally located between the farthest downstream riffle of the tributary and lake Erie proper. In addition to direct lake Erie tributaries, all inland streams and rivers that are tributary to a lake Erie lacustuary are considered a lacustuary in reaches affected by the lake Erie water level.

[Comment: Although "lacustuary" is the preferred terminology, the term "rheopalustrine" or "estuary" are occasionally used and should be considered interchangeable with "lacustuary".]

MBI Comment:
While this is a needed addition to the definitions there are aspects that require clarification and/or modification. The clause *"where water from a direct lake Erie tributary mixes with lake Erie waters."* is not necessarily true in every case and especially at the upper end of a lacustuary. It would be more accurate to say where the level of Lake Erie and the inflow of lake water affects the water level would be more accurate. The demarcation of the farthest downstream riffle seems sufficient, but we would also include run, i.e., riffle-run in that definition.

The synonymizing with the terms rheopalustrine or estuary may be technically accurate, but allowing this terminology to be mixed with the primary term lacustuary will potentially introduce confusion and misunderstanding as we have frequently experienced. The term estuary has an inherent affiliation with marine systems.

OAC 3745-1-02(81)

(81) "Qualitative habitat evaluation index" or "QHEI" means an index of macro-habitat quality that is designed to provide a measure of habitat that generally corresponds to those physical factors that affect fish communities and that are generally important to other aquatic life (e.g., invertebrates). Description and derivation of the QHEI are contained in "The Qualitative Habitat

Evaluation Index [QHEI]: Rationale, Methods, and Application" and "Methods for Assessing Habitat in Flowing Waters using the Qualitative Habitat Evaluation Index (QHEI)."

MBI Comment:
We advise checking the original QHEI documents including Rankin (1995) to make sure this definition matches the original technical derivation of this index. The clause *"and that are generally important to other aquatic life (e.g., invertebrates)"* should be revised to remove the term generally. The QHEI shows a strong relationship with macroinvertebrates in other states where it has been applied thus the relationship is better than general. The QHEI also is a measure that has a strong influence on water quality conditions, particularly nutrients and sediments, and provides a fundamental measure of the physical integrity of streams. Therefore we suggest adding: *" . . . that are generally important to other aquatic life (e.g., invertebrates) and which has a strong influence on water quality conditions, particularly nutrients and sediments, and provides a fundamental measure of the physical integrity of streams." (Yellow highlighted language should be added to the proposed definition.)*

(102) "Warmwater fish" means those species of fish that inhabit relatively warm water. These species include, but are not limited to, bass; crappies and sunfish (Centrarchidae), and catfish (Ictaluridae), and may include certain suckers (Catostomidae), minnows (Cyprinidae), and perch and darter (Percidae) species are adapted to waters where the temperature is influenced primarily by ambient air temperature.

MBI Comment:
The proposed definition is technically inadequate and unnecessarily vague. It could be especially vulnerable to the shifting baseline anticipated with climate change and potentially increasing ambient temperatures. This could result in conflicts with the application of existing use for example. In addition, the agency seems to be moving away from specifying such concepts based on a single assemblage (i.e., fish in this case) hence we suggest the following as replacement language:

Warm water aquatic organisms occur where water temperature, habitat and other characteristics are suitable for their support and propagation. These are also referred to as eurtyhtermic in terms of their tolerance of a wide range of temperatures.

See the previously cited Hokanson (1977) definitions for additional detail and clarity.

OAC 3745-1-03 Analytical methods and availability of documents

OAC 3745-1-03(3)(d)
(d) "Development of a Multimetric Index for Assessing the Biological Condition of the Ohio River, Emery et. al., Transactions of the American Fisheries Society 132:791-808, 2003." This document is available on the internet at http://orsanco.org/wp-content/uploads/2016/11/Development-of-a-Multimetric-Index-for-Assessing- the-Biological-Conditon-of-the-Ohio-River.pdf.

MBI Comment:
We are unsure why a technical journal publication applicable to the development of the ORFIn index for the Ohio River is needed in the Ohio WQS. ORSANCO already lists these methods documents on their website and is what should be consulted to execute this type of work on the Ohio River in conformance with ORSANCO practices. If this is somehow seen as being essential then it would seem to make sense for Ohio EPA to list the numerous publications that have been done since the adoption of the biological criteria and affiliated tools and methods since 1990. Some of these documents have clarified and updated the application of the biocriteria and the QHEI. Somehow it seems to be consistent to add these alongside the Emery et al. 2003 publication. Ohio EPA TSDs listed these as supporting documents alongside the codified biocriteria and QHEI manuals for many years.

3745-1-25 Mahoning River Basin

MBI has no comments on this rule revision, but supports the adoption of the naming convention of the Geographic Names Information System.

3745-1-31 Lake Erie standards

OAC 3745-1-31(B)
(B) ~~Temperature.~~Water temperature in lake Erie shall not:

MBI Comment:
This proposed revisions add a regulatory restriction while eliminating three such restrictions. Is this a new rule or is it a net reduction being done to meet the SB 9 reduction targets?

We do not have any substantive comments on this rule because the technical aspects appear to remain intact, but we remain concerned about substitution for imperative terms and how that may impact the implementation of the WQS.

January 5, 2023

Ms. Tiffani Kavalec
Ohio EPA, Division of Surface Water
50 W. Town Street, PO Box 1049
Columbus, Ohio 43216-1049

Re: The Ohio Coal Association Interested Party Review Comments concerning WQS Definitions, Methods, and Other Rules (OAC 3745-1)

Dear Ms. Kavalec:

The Ohio Coal Association (OCA) appreciates the opportunity to submit this letter in response to WQS Definitions, Methods, and Other Rules (OAC 3745-1). Specifically, the OCA is commenting on OAC 3745-1-03: Analytical Methods and Availability of Documents regarding our concerns with the "*Field Methods for Evaluating Primary Headwater (PHW) Streams in Ohio 2020*", Version 4.1, document, which is proposed as a reference document within this proposed rule. The OCA recommends that this document not be listed as reference document for the numerous reasons discussed in our attached comments.

The Ohio Coal Association is a trade organization that adheres to the best interests of the coal mining companies who operate in the State of Ohio. Our coal companies all utilize the 401 Program, where applicable, to obtain permission for fills and activities that impact aquatic life, habitat, and waters of the State. It is through the years of application of these rules and working with Ohio EPA personnel, both directly or through our respective coal operators and their consultants, that we are submitting these concerns. In efforts to create a focused value we have provided you with a straightforward reaction to areas in need of improvement with these draft rules, moving forward. It is with this persevered experience that we share our perspective and honest recommendations.

Again, thank you for the opportunity and your sincere consideration of OCA's comments. Feel free to contact me with any questions you may have.

Sincerely,

Paul Leist

OCA Environmental Committee Chair
Encl. (1)

OCA Interested Party Review (IPR) Public Comments for
OEPA Division of Surface Water (DSW)
WQS Definitions, Methods, and Other Rules (OAC 3745-1)
January 6, 2023

1.0 Introduction

The Ohio Coal Association (OCA) requests that that OEPA remove the "*Field Methods for Evaluating Primary Headwater (PHW) Streams in Ohio 2020*, Version 4.1" (hereinafter referred to as the PHW Manual) listed in proposed draft OAC 3745-1-03(B)(3) – Other References – found in Item (vii). This reference is unnecessary since the document is never cited in OAC 3745-1. The only location that this reference is cited is within OAC 3745-4, which refers to the *voluntary* credible data program. Additionally, the Environmental Review Appeals Commission (ERAC) ruled in Case No. ERAC 12-256581 that the Primary Headwater classification system expands the scope of regulatory definitions of the existing use classifications and that because this manual does not function as a mere guidance (reference) document, it should be subject to formal rulemaking.

At its inception in 2002, the PHW Manual was comprised of 86 pages and was designed to categorize the flow regime of primary headwater streams. Now more than two decades later, without any review, evaluation, or comment, the PWH Manual has grown to 130 pages and is now the foundation of permitting for more than an estimated 87% of the stream footage in Ohio (PWH Manual, Version 4.1, pg. 10).

Furthermore, the current iteration of the PWH manual (Version 4.1) has incorporated most, if not all, of the rule changes proposed by the agency in 2012. At that time, the agency was working toward adopting Primary Headwater Habitat as an aquatic life use in rule. Version 3.0 (January 2012) of the PWH Manual focused on further differentiating Class III streams into Class IIIA and Class IIIB. This separation of Class III streams was also intended to be made a rule as a "coldwater" designation within the proposed Primary Headwater Habitat Aquatic Life Use. After several early stakeholder work group discussions, the proposed rule changes were tabled, and no proposed rule package was submitted to the legislature. However, the revised PWH Manual was adopted as Version 3.0 (January 2012), further refined in Version 4.0 (October 2018), and now again in Version 4.1 (May 2020) without the benefit of formal rulemaking.

In addition to these above concerns, this Primary Headwater (PHW) Manual and the included Headwater Habitat Evaluation Index (HHEI), as employed by the OEPA, are being used beyond its purpose and limitations regarding evaluation, permitting, and mitigation. This is leading to significant unnecessary expenses and uncertainty to business, industry, individuals and governments. Moreover, the OEPA's misguided interpretations based on this manual lead to the agency misunderstanding and undervaluing physical integrity as a co-equal component to stream health, thus resulting in unrecognized stream degradation and continued stream instability throughout Ohio. These concerns are further discussed within the following sections.

2.0 PHW Manual & HHEI – Purpose and Limitations

The PHW manual and the associated HHEI stream assessment methodology, in general, were developed to determine whether a geomorphically stable reach of stream has an ephemeral, intermittent or perennial flow regime for streams with a drainage area (DA) of less than 1.0 square mile. However, the PHW Manual refers to these three flow regimes more specifically as Class 1, Class 2 and Class 3. The HHEI scoring system is categorical, that is, the HHEI scores do not have any specific independent meaning other than to determine a reach of stream's flow regime or Class. For example, an HHEI score of less than 30 indicates that a reach of streams has an ephemeral or Class 1 flow regime. In other words, an HHEI score of 12 or 27 for a stream reach only tells you that the flow regime for the reach of stream assessed is ephemeral or a Class 1 flow regime and nothing else. Further, based on discussions with the HHEI author, Paul Anderson, the HHEI scoring system is statistically-based and was designed to be conservative, that is, there is more of a likelihood that an ephemeral stream reach is identified as having an intermittent flow regime and an intermittent stream reach is identified as having a perennial flow regime than vice versa.

The HHEI scoring system has a limitation that it is to be used only for flow regime assessment on geomorphically *stable* streams. This limitation is continually overlooked by the OEPA when requiring that HHEI to be used to assess geomorphically *unstable* streams regardless of the degree of instability of stream. The OCA has mentioned this limitation concern to the OEPA in prior public comments regarding the HHEI. Additionally, the author of the HHEI has affirmed this concern. Specifically, the HHEI has no ability to assess stream instability, or more specifically, the degree of stream instability; thus, the HHEI is beyond its design limitation when it is used to assess flow regime on geomorphically unstable stream reaches.

This HHEI author also discussed at a stream mitigation meeting held at the OEPA Columbus HQ on February 25, 2019 that back in 1999 and 2000 when headwater stream data was collected to develop the HHEI scoring system that only three (3) of the headwater streams (i.e., streams with DA's less than 1.0 square mile) assessed were determined to be geomorphically unstable, and all of the other streams assessed and used in the database to develop the HHEI scoring system were considered to be geomorphically stable stream reaches (i.e., not incised). In reviewing the OEPA *Primary Headwater Habitat Initiative Data Compendium, 1999-2000 Habitat, Chemistry and Stream Morphology Data*, September 2002, there were 214 headwater streams assessed for usage in the database to develop the HHEI scoring system. In Appendix III of this document, only 10 out of the 214 streams were successfully assessed geomorphically to obtain a Rosgen geomorphic stream classification, which describes generally whether a stream is in a stable or unstable stream form, and only 3 of these 10 streams were classified as geomorphically unstable as described at the meeting. But more importantly, a Rosgen stream classification assessment does not assess for the degree of incision, which is the required stream assessment parameter to determine the degree of incision ratio or degree of channel instability (refer to Appendix A, Figure 1 for degree of incision ratio definition and description). In other words, <u>none</u> of the 214 streams assessed for the database used to develop the HHEI scoring system were assessed to determine the degree of incision ratio, which makes it impossible for the OEPA to establish any correlation between an HHEI score and the degree of channel instability (i.e., a geomorphically unstable incised stream).

Rosgen (2001) does however provide criteria to determine the relative severity for the degree of incision ratio, which is commonly referred to as the bank-height-ratio (BHR), in the following Table 1.

TABLE 1	
Adjective Stability Rating	**Bank Height Ratio (BHR) or Degree of Incision Ratio**
Stable (low risk of degradation)	1.0 to 1.05
Moderately Unstable	1.06 to 1.30
Unstable (high risk of degradation)	1.31 to 1.50
Highly Unstable	Greater than 1.50
Rosgen, D., *A Stream Channel Stability Assessment Methodology, Wildland Hydrology, 2001.*	

Based on Table 1, geomorphically stable streams have a bank height ratio (BHR) of 1.0 to 1.05, which would be typical of the streams assessed for the database used to develop the HHEI scoring system. Yet, OCA members and others have had to regularly use the HHEI scoring system to assess *highly unstable* streams with a BHR much greater than 2.0 (e.g., a BHR of 3, 4 or 5) even though the OEPA has not developed any correlation whatsoever between the BHR (degree of incision ratio) and the HHEI scoring system. In other words, any HHEI assessment on a stream with a BHR greater than 1.05 would be an invalid assessment and should be considered null and void for any purposes, which includes establishing a flow regime. That is, the HHEI scoring system should only be used to assess geomorphically stable streams.

3.0 The PHW Manual and HHEI excludes Natural High-Functioning Stream Types

The PHW Manual and the associated HHEI scoring system was developed to only assess single-thread headwater stream types, and it is not calibrated to consider other natural stream types, such as, wetland streams, braided streams or natural beaver impounded streams. The limitations or bias of the HHEI scoring system does not consider the value of these *other* natural, high-functioning stream types, which leads to the OEPA's assumption that these other natural stream types have little to no value or purpose. Historically, in pre-settlement times, natural beaver impounded streams, braided streams and wetland streams were common stream types in Ohio's headwater streams and further downstream.

In the time of Daniel Boone and Simon Kenton, and the centuries before, Ohio's landscape was covered with dense forests and prairie grasslands, and streams were filled with beaver ponds. This combination of features provided tremendous storage of stormwater within Ohio's watersheds. First, the dense land cover, deep porous soils and close-knit tree and grass root systems provided significant resistance to stormwater runoff. These features slowed runoff providing the time for it to infiltrate and be stored in deep porous soils. Second, an extensive in-stream network of beaver ponds captured and stored much of the remaining stormwater runoff (refer to Appendix B, Figure 2). These beaver ponds recharged groundwater systems and released water slowly through their leaky dams. Thus, in these earlier days, ephemeral streams rarely occurred in Ohio's densely vegetated landscape, and most of Ohio's streams were perennial with considerably fewer intermittent streams due to the continual slow release of water from leaky beaver dams located far into the headwaters and from water draining out of fully recharged groundwater systems. These beaver ponds slowly and eventually filled with sediment to first form low-gradient braided streams, which evolve into wetlands & meadows (refer to Appendix B, Figures 3 and 4) and then wetland streams (refer to Appendix B, Figure 5) as fine sediment was continually captured and aggregated within these features.

Moving forward from these earlier days, beavers were trapped-out of Ohio in the early 1800's, which resulted in the loss of in-stream beaver dams, and Ohio's landscape has been changed significantly over the past 200 years by a vast array of land development activities. These changes to the landscape have resulted in the loss of soil and groundwater storage that has increased stormwater runoff and simultaneously decreased runoff resistance and increased the velocity of runoff, which has resulted in the formation of single-thread streams in more recent times that are more typically found within Ohio's watersheds. Further, these single-thread streams have advanced headward in a dendritic pattern via erosional processes to the remote upper reaches of watersheds across Ohio. This more recent formation of single-thread streams and their expansion far into the headwaters has been to the detriment of downstream channels, because they create the pathways or 'pipes' that convey stormwater runoff rapidly from the watershed (i.e., increased peak flow frequency and duration) to downstream channels causing channel degradation (incision), increased flooding and many other adverse impacts (refer to Appendix B, Figure 6 and 7). Even though these single-thread streams are more typical in present times, that does not mean they are appropriate stream type nor should other, higher-functioning stream types be ignored or not valued.

3.1 Brief Overview of the HHEI Scoring System

The HHE scoring system only evaluates three stream attributes of single-thread streams to develop an assessment score. These three attributes are *substrate*, *maximum pool depth* and *bankfull width*. These three attributes as measured by the HHEI are insufficient to evaluate a stream's geomorphic condition. The *degree of incision ratio* is required to determine whether a stream is geomorphically stable, unstable or in some degree of instability. The attributes collected for the HHEI are merely physical characteristics of the channel as opposed to evaluative techniques. While the HHEI does include information regarding the riparian area and sinuosity, these data are not incorporated into the final score. Furthermore, these three single-thread attributes are insufficient to assess wetland streams that may have no defined channel due to dense, resistive vegetation that prevents a single-thread channel from forming, braided streams that have multi-thread channels, or natural beaver impounded streams.

Based on the HHEI single-thread stream scoring system, it is observed that these three attributes are not representative or appropriate attributes to describe these other natural, high-functioning stream types (i.e., natural beaver impounded streams, braided streams or wetland streams). Thus, this further indicates that the PHW Manual and HHEI scoring system do not value or are biased against these other high-functioning stream types.

3.2 HMFEI Supplemental Assessment for Flow Regime

The Headwater Macroinvertebrate Field Evaluation Index (HMFEI) is presented in the PHW Manual, Version 4.1, as a rapid bio-assessment field sampling method. Designed by a former OEPA biologist, Mike Bolton, the index has been documented to be a good predictor of the three classes (flow regimes) of PHW streams in Ohio. The HMFEI method is stated to be used if there is a reason to question the HHEI results.

The final HMFEI calculated score as described in the manual is the output of the aquatic bug assessment and the scoring ranges described as follows, resulting in the following headwater stream classes:

> If the Final HMFEI score is greater than 19, then a Class 3 stream,
> If the Final HMFEI score is 7 to 19, then a Class 2 stream; and,
> If the Final HMFEI score is less than 7, then a Class 1 stream.

Again, the PHW Manual was developed to assess only single-thread streams. Benthic macroinvertebrate assemblages are typically more diverse when channel substrate is a diverse mixture (e.g., silts, sands, gravels, cobbles, leaf pack/woody debris). However, this HMFEI assessment does not consider the effect of the geomorphic condition of the stream in its evaluation of stream Class. Thus, unstable streams with a high degree of incision (i.e., high velocities and shear stresses) will most often have the finer substrates (e.g., silts, sands and gravels) eroded from the unstable reach leaving only bedrock, hardpans, cobbles and boulders in the channel, yet HMFEI scores are often times unchanged or only slightly changed in these highly unstable reaches. This is by design. As with the HHEI, the HMFEI was designed to determine flow regime, nothing else. In the same way that the HHEI score is not correlated to stream stability, neither is the HMFEI. The stability of HMFEI scores in these highly unstable reaches is likely due to the nocturnal drift of aquatic insects from upstream that occur on a daily basis (Allan, D., 1995). That is, aquatic insects from upstream will release each night and drift downstream to a reach downstream regardless of the stability of the reach. This daily pattern of drifting and relocating means that aquatic macroinvertebrates (insects in particular) are, in a sense, transitory by nature. Also, aquatic insects, particularly those that score the highest on the HMFEI, are known to fly upstream as adults to deposit eggs. This repopulates both stable and unstable reaches and allows for the continuation of the drift cycle. As a result, an HMFEI assessment is not able to capture the geomorphic condition of a stream as there is no documented correlation between the rate of a streams physical degradation and the rate of biological decline.

Another significant concern with the HMFEI assessment procedures is that the standard assessment length for headwater benthic macroinvertebrates assessment is 200 feet regardless of drainage area. That is, the requirement to use a fixed 200-foot assessment length regardless of drainage area results in improper scaling of streambed sampling area for aquatic insects. Thus, the streambed area sampled for aquatic insects is disproportional, that is, the streambed sampling area increases as the drainage area increases because the streambed width increases as the drainage area increases (refer to Table 2 below).

TABLE 2				
Headwater Stream Drainage Area (square miles)	**HMFEI Assessment Length (feet)**	**Typical Streambed Width (feet)**	**Typical Streambed Area to be sample for Aquatic Insects (square feet)**	**Increased sampling area ratio relative to 0.10 acre DA streambed width**
0.10	200	6	1200	1.0
0.50	200	12	2400	2.0
0.90	200	16	3200	2.67

Therefore, when sampling for aquatic insects using the HMFEI procedure, the streambed sampling area increases as the stream width or drainage area increases. This results in sampling area increase of upwards of 2 to 2.67 times for larger headwater streams versus smaller headwater streams. This disproportionate aquatic bug streambed sampling area requirement for aquatic insects directly biases the probability that as streams become larger they will be more quickly determined to be in a higher stream class (e.g., Class 1 to a Class 2 or a Class 2 to a Class 3A or Class 3B), which arbitrarily and directly leads to increased stream mitigation costs for business, industry, individuals and governments under the current mitigation requirements (e.g., impacts to Class 2 (intermittent) streams are at a ratio of 2:1 and a ratio of 3:1 for Class 3 (perennial) streams per the Ohio IRT mitigation guidelines, Version 1.1, 2016).

Lastly, aquatic insects found in single-thread streams would be expected to be much different than aquatic insects found natural impounded streams, in-stream wetlands or braided (multi-thread) streams. Thus, the HMFEI scoring would be expected to be structured differently, and thus, the relative value of these features would be perceived or considered to much less than single-thread streams. Additionally, it is most likely that the HMFEI assessment criteria is not even applicable to these other aquatic resource types. Further, given that the OEPA typically requires that HMFEI scores be achieved after restoration/mitigation in WQC permits, then these other higher-functioning features (in-stream natural beaver ponds or analogs, wetland streams or braided streams) would score relatively poorly when assessed (improperly) with a single-thread stream scoring system. Thus, use of this improper stream assessment procedure leads to outcomes that are detrimental to stream health both locally and downstream while, at the same time, imposing excessive mitigation costs on permittees.

4.0 The PHW Manual and HHEI do not assess Geomorphic Condition or Water Quality

Neither the PHW Manual nor the HHEI scoring system evaluates the geomorphic condition of the reach of stream being assessed or the water quality processes that are occurring in this reach of stream's watershed or the stream reach itself.

4.1 Geomorphic Condition

As previously mentioned, the critical geomorphic parameter necessary to assess a stream's geomorphic condition, that is, is the stream geomorphically stable, unstable or in some degree of instability is the *degree of incision ratio*. Given that the database used to develop the HHEI scoring system did not evaluate the degree of incision ratio for any of the streams in the database, it is impossible for the HHEI to assess the geomorphic condition of a stream.

The OEPA has stated that the PHW Manual purpose is to categorize the stream based on aquatic fauna. Obviously, aquatic fauna and water quality are both impacted by the geomorphic condition of the stream; otherwise, why are stream impacts regulated and why do we have mitigation banks, in-lieu fee projects or permittee responsible mitigation? Also, technical literature clearly addresses that as a stream degrades geomorphically (e.g., becomes more incised), the aquatic fauna (biota) and water quality are directly impacted. For example, Cluer and Thorne (2014) in their peer reviewed professional journal article that revised the Channel Evolution Model describes the process when a geomorphically stable stream becomes unstable and defines the stages that the unstable system transitions through to regain its stability. The key revision to the Channel Evolution Model (CEM) that Cluer and Thorne made is that the most stable stage for a stream is a wetland or braided stream or beaver impounded stream type, which is referred to as Stage 0, and not a single-thread stream, which is referred to as Stage 1. Thus, the transition from a Stage 0 stream condition to Stage 1 stream condition involves the stream becoming a single-thread stream and Cluer and Thorne identifies this transition as the start of channel degradation process. Subsequently, once the Channel Evolution process begins there are fundamentally eight (8) stages for stream instability to transition through in order to recover back to a wetland or braided stream type (i.e., Stage 0 condition) (refer to Appendix C, Figure 8 for a diagram of these Channel Evolution stages).

This same Cluer and Thorne (2014) journal article documents how the biota (aquatic flora and fauna) are adversely impacted as the stream transitions through the various stages of the CEM (refer to Appendix C, Figure 9). Simply refer to Appendix C, Figure 8 and compare to Figure 9 to view the geomorphic stream cross-section condition to visualize how biota, habitat and water quality degrade and/or improve throughout the CEM process. For example, the biota benefits are the greatest in Stage 0 or in recovered Stage 8. However, the biota benefits decline as a stream moves to Stage 1 and are the least in Stage 3-"Degradation (incision)" and Stage 4-"Degradation (incision) and Widening" and the biota begins to improve slightly in Stage 5-"Aggradation and Widening". In other words, Cluer and Thorne clearly demonstrate that as a stream's geomorphic condition degrades or becomes more unstable, the biota similarly degrades or is significantly impacted. The same scenarios occur for habitat and water quality.

Sullivan and Watzin (2009) provide another professional journal article that discusses the impacts of geomorphic condition on aquatic fauna regarding floodplain connectivity. They found that channel incision and widening were strongly correlated with fish assemblage diversity of the main channel, of the floodplain and of the stream-floodplain ecosystem as a whole. They go on to say that in both cases (i.e., incision and widening), physical and hydraulic disturbance may be the link determining the development of persistence of waterbody habitats suitable for high floodplain fish diversity, and that incision ratio proved to be a repeated proxy for floodplain connectivity, that is, higher incision ratios were correlated with not only lower numbers of fish species in both the floodplain and across the stream corridor but also with higher species turnover. No streams with incision ratios greater than two (2) exhibited floodplain connectivity. They conclude that both bed incision and channel widening were found to restrict fish diversity of stream-floodplain ecosystems, and these relationships suggest intact channel morphologies (i.e., geomorphically stable streams) are critical for providing floodplain and main channel habitats for fish communities. Further, this illustrates how the link between biota and physical structure of stream-floodplain ecosystems (i.e., geomorphically stable vs unstable stream conditions) can provide important insights into fish-habitat relationships.

Notably, Paul Powers of the US Forest Service (USFS) has been implementing Stage 0 restoration projects in the Deschutes National Forest using the guidance from Cluer and Thorne discussed above. The USFS is eliminating single-thread, incised streams by constructing log jams to restore historically natural braided or multi-thread channels that develop across the floodplain so that a large portion or all of the floodplain is frequently or continuously flooded. This high lateral channel-floodplain connectivity greatly reduces shear stresses and stream powers by spreading the water flow across the floodplain. This lateral connectivity greatly increases long-term geomorphic stability, results in smaller channel sizes, and the USFS is finding that the biota is flourishing within these restored multi-thread channel-floodplain systems. A significant result of this restoration effort is that the USFS has found that fish within these multi-thread streams are much larger because their main source of food is located on the floodplain and they now have regular access to the floodplain (refer to Appendix C, Figure 10).

4.2 Water Quality

The OEPA has commented that it has principally relied on biology as the ultimate measure of biological integrity because biological integrity is rooted into the goals of the CWA. The OEPA says that in other words, they rely on the biology to tell the water quality story since the biology is the ultimate receptor of any stressors present in the system. However, this narrow view used by the OEPA does not represent the *objective* of the Clean Water Act (CWA), which is to restore and maintain the chemical, biological and physical integrity of the Nation's waters. Clearly, as described in Section 4.1 above, the physical integrity or geomorphic condition of a stream has a significant impact on biology and the OEPA does not considered physical integrity, let alone use, in their stream assessment tools (e.g., HHEI or HMFEI). But the physical integrity or the geomorphic condition of a stream provides the water quality processes and habitat that create conditions for biology to improve or degrade. Examples of physical processes that need to be considered and understood include hydrologic (rainfall-runoff) processes, hydraulic processes (flow velocity and turbulence), sediment transport processes (caliber and load), geomorphic processes (channel evolution) and geotechnical processes (bank stability). None of these processes that directly affect aquatic systems are even considered by the PHW Manual, HHEI or HMFEI. Thus, the 'window' that the OEPA is viewing aquatic systems is very narrow, that is, the 'story' they are telling is incomplete and likely wrong in many cases.

If a stream incises (i.e., the degree of incision ratio increases), then its connectivity to its floodplain decreases and its water quality processes are directly degraded. That is, channel incision changes the hydraulic, sediment transport, geomorphic and geotechnical processes in a negative manner that reduces water quality and degrades habitat. However, if the stream is geomorphically stable, then hydraulic and sediment transport processes function at or near their best potential that results in improved water quality and also produces the best potential habitat. An example of hydraulic and sediment transport processes working to their best potential in a geomorphically stable stream is during a flood event (i.e., out-of-bank flow spreading across a broad floodplain). Refer to Appendix C, Figure 11 for a depiction of flow vectors during this type of event. This set of conditions provide for significant turbulence in the meander cross-over that works to purge sediment (sands, silts and clays) onto the floodplain. The coarser sands will deposit quickly onto the floodplain forming a slight berm along the edge of the channel, but the silts and clays will spread across the floodplain and settle to be stored on the floodplain. This type of flooding process produces some of the largest water quality improvement benefits, that is, pollutants such as nitrogen, phosphorus and other chemical constituents significantly attach to silts and clays and once these silt and clay particles are purged from the stream and stored onto the floodplain, all of these pollutants are removed from the channel and will typically remain there for years or decades providing time for these pollutants to decay and no longer be a problem. A larger scale example of the silt and clay deposition onto a floodplain during a flood event occurred along the Ohio River during Hurricane Ivan in September 2004. Refer to Appendix C, Figures 12 and 13 of pictures showing silts and clays deposited 3 to 6 inches thick on Wheeling Island. These geomorphically stable stream-floodplain fluvial processes were responsible for enormous water quality improvement in the Ohio River.

Another water quality process that is degraded when a stream incises (i.e., becomes geomorphically unstable) is hyporheic flows, which are reduced or eliminated altogether (refer to Appendix C, Figure 14 for hyporheic flow example). Alexander, et al., (2000) identifies benthic denitrification, a biologically mediated process, as a dominant in-stream nitrogen loss process and it occurs most effectively in smaller headwater streams. Their research shows that when mean stream depth is less than 1 meter (approximately 3 feet) that in-stream nitrogen removal is at its highest loss rate, but varies depending on benthic processes. That is, channel incision is a significant factor reducing or eliminating benthic dentification, because channel incision processes erode away a large percentage or all of the channel substrate where these benthic denitrification processes occur. Refer to Appendix C, Figure 15 showing a headwater stream (DA less than 1.0 square mile) that is severely incised where more than 6 feet of substrate has been eroded away all the way down to bedrock and hardpans, which has completely eliminated all benthic denitrification processes in this reach of stream. Thus, Alexander, et al., (2000) demonstrate the importance of having geomorphically stable streams to perform benthic denitrification processes to support water quality improvement processes not only locally but as far away as the Gulf of Mexico.

Clearly, the water quality 'story' is not just told by biology as claimed by the OEPA. That is, the water quality story is directly dependent on physical processes, and they occur at their highest potential when streams are in a geomorphically stable condition as opposed to geomorphically unstable condition when they occur in a diminished or adverse manner degrading water quality locally and further downstream. In short, the OEPA's "*biology only"* story is incomplete, likely tells the wrong story in many or even most cases, and does not address the objective of the CWA, which is to maintain and restore the chemical, biological and physical integrity of the Nation's waters. This CWA objective does not say "biology ONLY".

5.0 PHW Manual and HHEI used to establish Restoration/Mitigation Criteria

The OEPA in their 401 Water Quality Certification (WQC) permits under stream performance goals will regularly require a specific goal that states the following or something similar:

> "Each of the reconstructed stream channels shall, …, develop a minimum …HHEI score equal to or better than the corresponding pre-impact channel HHEI score."

The question becomes how can the HHEI flow regime assessment tool that has no ability whatsoever to determine the geomorphic condition of a stream use its assessment attribute criteria (i.e., substrate, maximum pool depth, and bankfull width) for stream restoration/mitigation criteria when there is no knowledge whatsoever whether the original impacted stream assessed with the HHEI was geomorphically stable, unstable or in some degree of instability? Further, an HHEI score is categorical and independently has no meaning. Thus, it is completely inappropriate to use an HHEI assessment score and require stream attributes that are most likely from an unstable stream to be used in a stream restoration/mitigation project design. The design criteria for a stream restoration project should come from a similar stable stream (e.g., reference reach) and the restored stream would be restored with attributes from a stable stream, not from an unstable stream. This type of misapplication of the HHEI suggests the OEPA does not fully appreciate stream processes and restoration procedures. Further, as stated in Section 2.0 above, the purpose of the HHEI is to determine whether an existing stream has an ephemeral, intermittent or perennial flow regime (i.e., categorical) and has nothing to do whatsoever with stream restoration.

OCA encourages OEPA to see the environmental value in having the original impacted stream restored to a geomorphically stable stream condition. Indeed, a second common WQC permit performance goal states as follows:

> "Demonstrate that the stream mitigation channel and banks, including up and downstream, shall be stable and show no signs of excessive bank erosion, sedimentation, headcutting, aggradation, entrenchment or degradation."

First, this statement specifically refers to the term 'stable' and the phrase "not showing signs of excessive bank erosion, sedimentation, headcutting, aggradation, entrenchment or degradation," means the objective is to avoid the characteristics observed in geomorphically unstable streams. Given that the OEPA does not want to observe unstable stream characteristics in a restored stream, then why would the OEPA require the restored stream be restored using unstable stream attributes?
When a stream is geomorphically unstable, it is in some phase of the channel evolution process (refer to Appendix E, Figure 16 for a typical Channel Evolution Model (CEM) along with the varying stream channel cross-sections that occur along the unstable stream reach). For example, in the unstable "G" stream type reach, the channel cross-section will be much narrower and deeper than a stable reach (e.g., much narrower bankfull width, deeper pools and coarser substrate). In the unstable "F" stream type reach, the channel cross-section will be much wider and shallower than a stable reach (e.g., over-wide bankfull width, shallow pools and finer substrate). The point is that the HHEI does not account for unstable stream conditions so why would anyone use these unstable "G" and "F" stream attributes when developing and constructing a stream restoration/mitigation project?

5.1 River Continuum Concept

Another fundamental problem with the PHW Manual and HHEI is that this manual and assessment tool are rooted in the River Continuum Concept (RCC) described by Vannote, et al., 1980. A perceived tenet of the RCC suggests that single-thread streams must exist from the extreme headwaters to the mouth of streams, which is a false premise. This false perception is driving the OEPA to require in WQC's that every foot of headwater stream impacted be restored to this exact original length and that all in-stream ponds must be temporary and removed.

Historically, Ohio's watersheds had stream lengths that were much shorter because they were filled with beaver ponds and contained dense vegetation with deep soils that stored water in the soil horizons. This extensive watershed storage increased ground water recharge, reduced peak flows and downstream flooding, prevented the headwater advancement of unstable streams, and provided the water sources in the headwaters for insect, reptile, avian, terrestrial and aquatic wildlife to flourish as described by the earlier frontiersman and in literature.

Denise Burchsted, et al. (2010) and several other researchers reported in peer-reviewed journal articles that the RCC misrepresents reality which is much more correctly described by the River Discontinuum Concept. That is, streams were not single-threads from extreme headwaters to mouths of streams, but rather streams were disrupted nearly entirely along its length for several orders by natural beaver impoundments and log jams. They recommended that beaver pond analogs and log jams be a target restoration condition.

Similarly, Ben Goldfarb, who writes for Sierra Magazine, writes that the consequences of the RCC is that our watersheds are being drained so severely by single-thread streams extending to the headwaters that he refers to the massive regulatory created RCC drainage problem as the equivalent of creating the '*aquatic dust bowl*'. He states that the goal is retainage, not drainage. In short, if the water is drained from out watersheds, then the insect, reptile, avian, terrestrial and aquatic wildlife will have to go elsewhere or perish. Goldfarb, in his book Eager, The Surprising Life of Beavers and Why They Matter (2018) on page 6 states:

> "Close your eyes. Picture, if you will, a healthy stream. What comes to mind? Perhaps you've conjured a crystalline, fast-moving creek, bounding merrily over rocks, its course narrow and shallow enough that you could leap or wade across the channel. If, like me, you are a fly fisherman, you might add a cheerful, knee-deep angler, casting for trout in a limpid stream.
>
> It's a lovely picture, fit for an Orvis catalog. It's all wrong.
>
> Let's try again. This time, I want you to perform a more difficult imaginative feat. Instead of envisioning a present-day stream, I want you to reach into the past – before the mountain men, before the Pilgrims, before Hudson and Champlain and the other horsemen of the furpocalypse, all the way back to the 1500s. I want you to imagine the streams that existed before global capitalism purged the continent of its dam-building, water storing, wetland-creating engineers. I want you to imagine a landscape with its full complement of beavers.
>
> What do you see this time? No longer is our stream a pellucid, narrow racing trickle. Instead, it's a sluggish, murky swamp, backed up several acres by a messy concatenation of woody dams. Gnawed stumps ring the marsh like punji sticks; dead and dying trees aslant in the chest-deep pond. When you step into the water, you feel not rocks underfoot but sludge. The musty stink of decomposition wafts into your nostrils. If there's a fisherman here, he's thrashing angrily in the willows, his fly caught in a tree."

On pages 35-36, Goldfarb goes on to state:

> "In 1980, for instance, the field of aquatic ecology came to be dominated by "the river continuum," the notion that waterways transition along their course, seamlessly and predictably, from steep, forested headwaters to open valley bottoms. Three decades later, however, an engineer named Denise Burchsted proffered a different model: the *river discontinuum*, which held that pre-colonization streams were disrupted along their length by glacially scoured holes, downed trees, and, most of all, beaver dams. Rather than free-flowing chutes, Burchsted wrote, historical creeks were patchy networks of ponds, meadows, and braided channels – only fitfully connected upstream and down, but inseparable from the floodplains that bracketed their banks."

Based on these observations and discussions, the target stream restoration condition for headwater streams should be natural beaver ponds or analogs, wetland streams, braided (multi-thread) streams and log jams rather than the OEPA's single-thread stream only target restored foot per foot based on the PHW Manual's incorrect foundational premise.

5.2 Federal Stream Mitigation Rules

The Preamble in the April 10, 2008 Federal Register that discusses the rules for the *Compensatory Mitigation for Losses of Aquatic Resources* contained in 33 CFR Part 332 (USACE) and 40 CFR Part 230 (USEPA) provides guidance for restoration/mitigation. In regards to stream restoration/mitigation, neither the PHW Manual nor the HHEI consider these restoration/mitigation rules, which is detrimental in establishing proper stream impact restoration/mitigation.

These rules define *restoration* to mean the manipulation of the physical, chemical, or biological processes of a site with the goal of returning natural/**historic** functions to a former or degraded aquatic resource. Additionally, f*unctions* are defined as physical, chemical and biological processes that occur in aquatic resources. The PHW Manual and HHEI do not consider historic functions (e.g., lost storage) nor do they consider returning former aquatic resources, such as, natural beaver ponds or analogs, wetland streams or log jams and their vital, diverse processes necessary to maintain stream stability and health. The #1 issue facing streams in Ohio is the historic loss of watershed and in-stream water storage that results in increased peak flows (i.e., frequency and duration) that result in the continued degradation of Ohio's streams (refer to Appendix E, Stream Physical Integrity Condition Assessment).

This Preamble discussion explains that the rule encourages the use of *functional* and *condition assessments* to determine the appropriate amount of compensatory mitigation needed to offset authorized impacts, instead of relying primarily on surrogate measures such as acres or linear feet. The OEPA only considers replacing stream length foot per foot and the PHW Manual or HHEI has no capacity to determine functional or condition assessments because the HHEI does not and cannot evaluate the geomorphic stability of a stream. So, 14 years later, the OEPA still does not perform functional and condition stream assessments to determine the appropriate amount of mitigation and the only measure of mitigation that the OEPA uses is linear feet. Thus, they have failed to address this fundamental Federal stream mitigation rule.

The Preamble goes on to discuss that land use changes often alter local hydrology (rainfall-runoff processes), and that establishing appropriate hydrology patterns (i.e., frequency and duration) to support the desired aquatic habitat type is a key factor in successfully restoring or establishing those habitats. That is, ecological success is dependent upon establishing proper hydrology. Thus, the Preamble discussion directly acknowledges and affirms the discussion in Appendix E.

The Preamble further states that agencies believe that a *watershed approach* provides the appropriate framework for making compensatory mitigation decisions. The watershed approach should be based on a structured consideration of *watershed needs* and how wetlands and *other types of aquatic resources* in specific locations will address those needs. The primary (*#1*) need of watersheds in Ohio is for more storage (e.g., in-stream storage structures, such as, natural beaver ponds or analogs, log jams, braided or wetland streams) and this storage need should be addressed within a watershed approach. However, neither the PHW Manual nor the HHEI provide any consideration for a watershed approach to address watershed needs. As a result, the PHW Manual inappropriately requires all stream impact length to be replaced foot per foot and that all in-stream storage structures or features be removed. This approach leads directly to the 'aquatic dust bowl' condition described above by Ben Goldfarb, and this drained or dry watershed condition degrades habitat for insect, reptile, avian, terrestrial and aquatic wildlife. The intended effect of implementing a watershed approach to compensatory mitigation is to improve the success and effectiveness of aquatic resource restoration and to maintain and improve aquatic resource *functions* and *services* within watersheds, which is clearly not the result when the OEPA attempts to use PHW Manual and HHEI criteria for stream restoration/mitigation.

Dr. David Allan in his textbook Stream Ecology, The Structure and Function of Flowing Waters (1995) provides a stream function improvement example provided by other aquatic resource types as compared to single-thread streams as it relates to organic matter retention. Organic matter is an energy source for the various consumers within a stream. Dr. Allan states that when beavers were unexploited, they contributed greatly to organic matter storage over large areas of the north temperate zone. Where beaver occur at natural densities today, their activities influence 2-40% of length of second- to fifth-order streams, and increase the retention of carbon roughly six-fold. Further, these natural obstructions clearly play a significant role in ecosystem function by allowing organic matter to accumulate and form hotspots of heterotrophic activity. In the absence of these retention devices the stream functions more like a pipe, allowing inputs to be flushed from the system, including a higher fraction of particulates. Again, the approach by the OEPA is to follow the RCC and construct streams from the extreme headwaters to the mouths of streams, which leads to the flushing of organic matter through single-thread 'pipes' rather than create more storage of organic matter via structures such as natural beaver ponds or analogs or log jams that increase heterotrophic activity.

5.3 ERAC Case No. 12-256581

The Environmental Review Appeals Commission (ERAC) in Case No. 12-156581 ruled that the PHW classification system, as employed by the OEPA in its 401 WQC permits, expands the scope of the regulatory definition of existing use classifications. Therefore, the PHW Manual does not function as a mere guidance document. And, because the PHW classification system has not been lawfully promulgated as a rule, it cannot serve as a legal basis for permit terms and conditions. In other words, the OEPA by inserting PHW Manual as a reference document into OAC 3745-1-03(B)(3)(vii) appears to be making an attempt to bypass rule-making. Clearly, the PHW Manual has serious flaws and its limitation and application has been extensively exceeded by the OEPA. Thus, again, this document should be removed from these draft rules.

Of note in this case is the testimony of an OEPA staff person that pertains to the HHEI being used as a mitigation criterion. The OEPA testimony states as follows: "I do not believe the HHEI is an appropriate tool for evaluating mitigation success." This statement aligns with concerns regarding the HHEI discussed above.

6.0 Conclusions

The purpose of including the PWH Manual as a reference document in OAC 3745-1-03(B)(3)(vii) has not been made clear by the OEPA. The PWH Manual and HHEI have been in use by the agency for two decades with no formal or substantive incorporation into the OAC. What benefit is served to business, industry, individuals and governments if this proposed change is adopted now? Upon our review and our extensive discussions with the agency, we do not see any benefit for stakeholders. OEPA has made no effort to limit the application of the current PWH Manual despite a clear ruling by ERAC stating its misuse. OCA objects to any attempt, direct or indirect, to place the PWH Manual in the OAC in circumvention of the rule-making process.

The purpose of the PHW Manual and HHEI is to determine a geomorphically stable single-thread stream's flow regime, that is, in general, is it an ephemeral, intermittent or perennial stream. Further, the HHEI score used in this determination is categorical and has no other meaning. However, these HHEI limitations are overlooked by the OEPA. The HHEI is not designed to be utilized on geomorphically unstable streams because the stream assessment database used to develop the HHEI was based on geomorphically stable streams and that the degree of incision ratio was not assessed in any of the streams in the database making it impossible to make any correlation of the HHEI to unstable streams. OCA urges OEPA to acknowledge this reality.

The HHEI is designed to be used on single-thread streams and makes *other aquatic resources* types that have been historically lost appear to have little to no value. But these other aquatic resource types are natural high-functioning stream types that are <u>critical</u> to the health of streams local and further downstream. Yet, the OEPA HHEI system cannot rationally assess these other aquatic resource types (e.g., in-stream natural beaver ponds or analogs, in-stream wetland streams, braided streams and logjams) because they are not single-thread streams, and thus, are made to appear as having little to now value in the "eyes" of the HHEI, which could not be further from the truth. In other words, the HHEI is strongly biased against these other aquatic resource types. This same bias also exists within the HMFEI.

The OEPA does not consider that geomorphic condition of a stream to have any effect on water quality, that is, biology only is the standard which they use to assess water quality. This is true regardless of the methodology used for assessment no matter the amount of inertia it carries. This narrow view of water quality does not align with the objective of the Clean Water Act which is to restore and maintain the chemical, biological <u>and</u> physical integrity of the Nation's waters.

The OEPA also uses the PHW Manual and HHEI to establish stream restoration/mitigation criteria, which was never an intended use of the HHEI flow regime assessment procedure. Further, this requirement forces stream restoration/mitigation projects to irrationally incorporate unstable stream characteristics. Also, this PHW Manual and HHEI is rooted in the River Continuum Concept, which has been discredited in the literature. In addition, the PHW Manual and a HHEI fails to address the stream restoration/mitigation requirements contained in the 2008 Federal Mitigation Rules, which even further demonstrates the misuse of the PHW Manual and HHEI.

The improper application of the PHW Manual and HHEI is requiring business, industry, government and individuals to needlessly expend resources on stream restoration and monitoring that is environmentally detrimental, leading to further stream degradation locally and to channels further downstream. These consequences not only cause water quality degradation both locally and further downstream, they also are leading to increasing flooding and stream bank erosion that adversely impact infrastructure.

To conclude, OEPA's "*Field Methods for Evaluating Primary Headwater Streams in Ohio 2020"*, Version 4.1, and referred to as the PHW Manual above should not be listed as a reference document in OAC 3745-1-03(B)(3) for the reasons discussed. Further, this reference is unnecessary since this document is never cited in OAC 3745-1. More broadly, OCA urges OEPA to reevaluate the PHW manual and HHEI for all the reasons stated above.

Appendix A

The *degree of incision* or *bank height ratio* (BHR) is the measure of the degree of channel incision leading towards channel entrenchment for single-thread streams. BHR is defined as the *lowest bank height* (LBH) divided by the maximum bankfull depth (Dmax). If the BHR equal to 1.0, then a flow just greater than the bankfull flow (e.g., annual flood) will flow out onto the floodplain. As the BHR increases the channel becomes more incised, which requires flows great than the bankfull flow to have water flow onto the floodplain (refer to Figure 1 – Diagrams A, B, C and D describe increasing BHR's or incision.) As the degree of incision increases the channel velocities increase and the channel functions more like a pipe rapidly conveying stormwater runoff downstream leading to increased downstream channel erosion (incision), water quality degradation, loss of aquatic habitat and flooding.

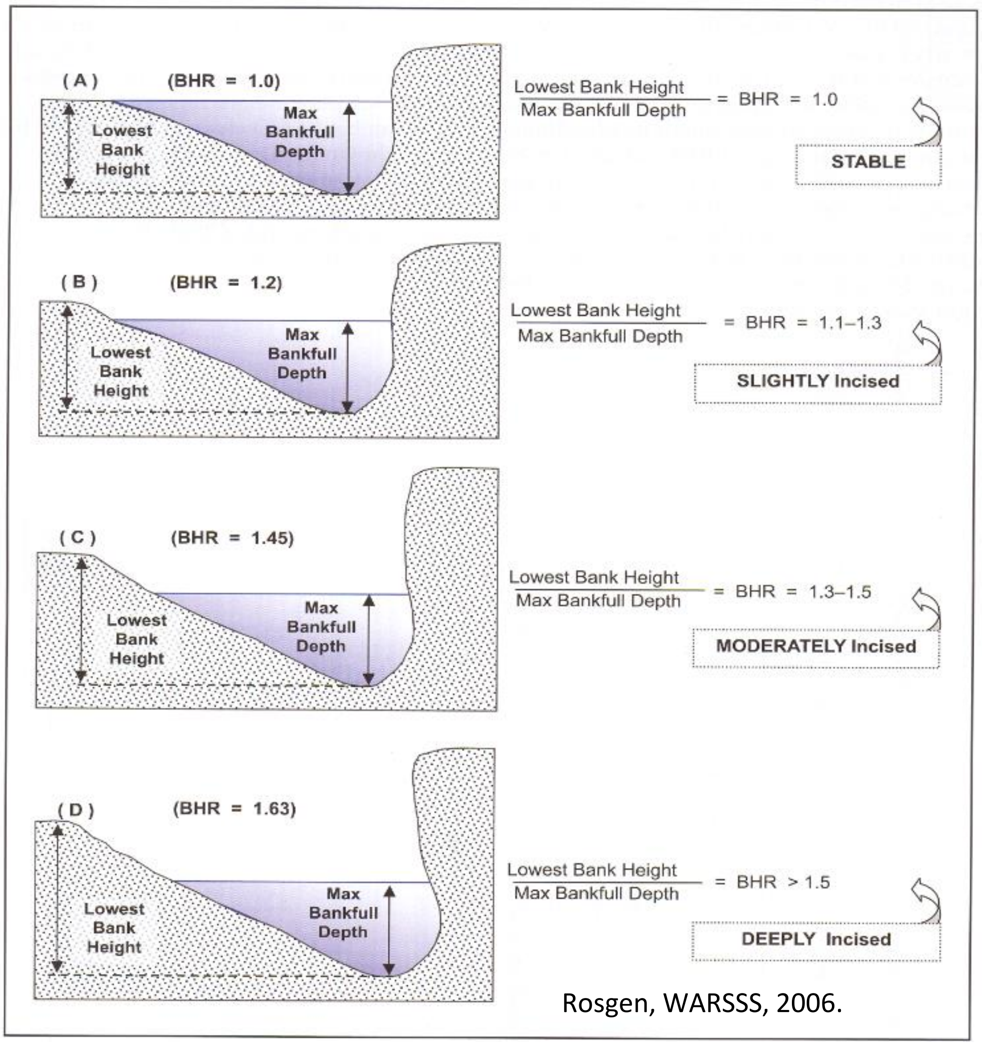

Figure 1 – Diagrams demonstrating the *Degree of Incision* or *Bank Height Ratio* (BHR).

Appendix B

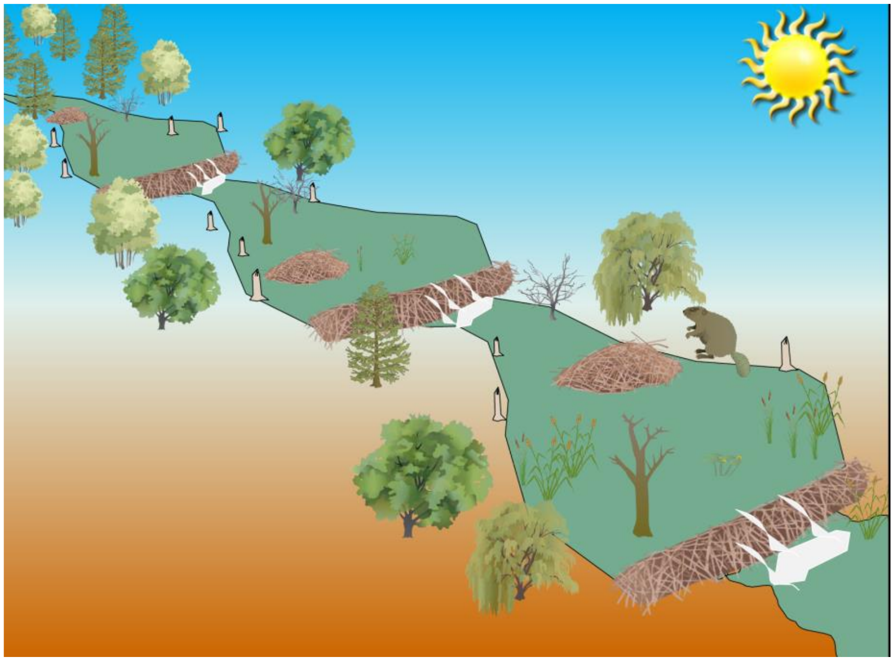

Figure 2 – Depiction of how an extensive in-stream network of beaver ponds likely appeared in pre-settlement times.

Figure 3 – Meadow formation immediately upstream of abandoned beaver impoundment.

Appendix B

Figure 4 – Wetland located just beyond meadow formation within an abandoned beaver impoundment.

Figure 5 – Low-gradient wetland stream formed upstream of an old beaver dam. This wetland stream typically forms a narrow & deep channel with silt-clay substrate and frequently floods onto a broad floodplain that captures and stores silts & clays and the pollutants that attached to the them, which provides a significant water quality improvement process and diversity of habitat.

Appendix B

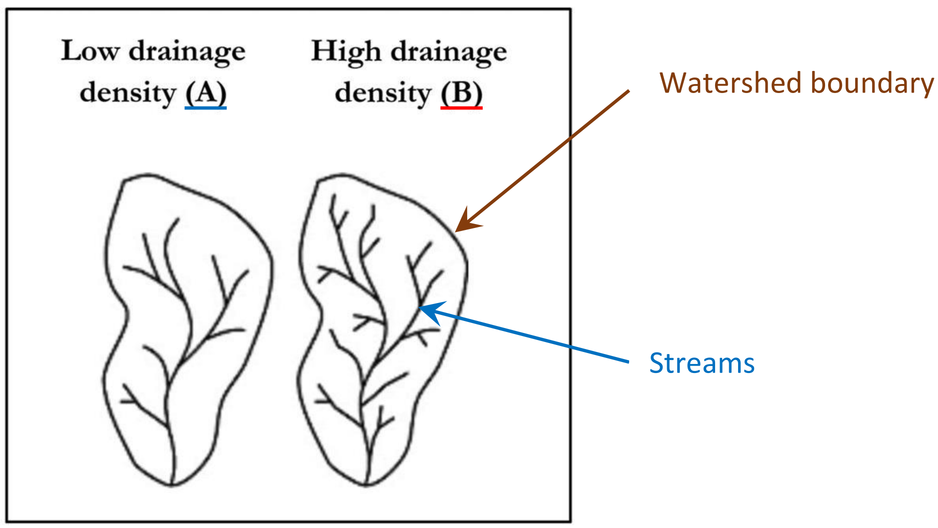

Figure 6 - Plan view of low-density stream drainage network (A) within the watershed boundary expanding to a high-density drainage network (B) due to the develop and headward advancement of single-thread streams to the upper extents of watersheds that have resulted from the loss of beaver storage impoundments and land use changes.

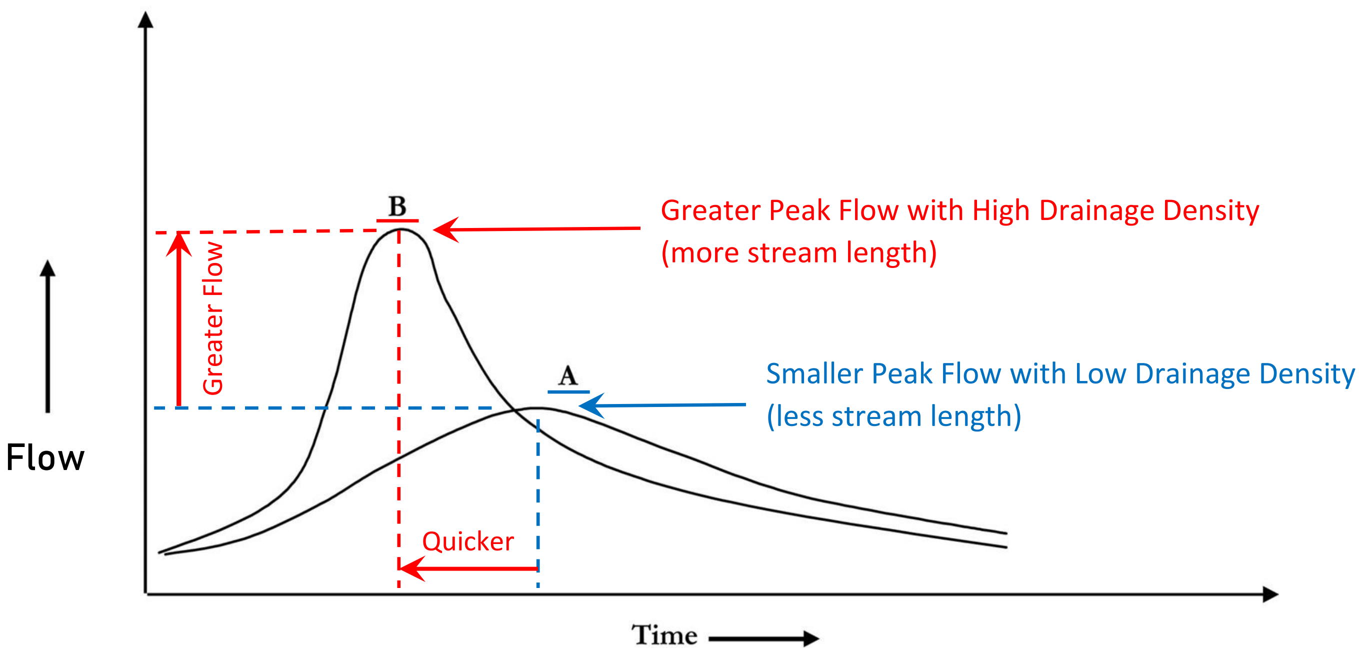

Figure 7 – The development and expansion of single-thread streams creating a high-drainage density network result in quicker runoff and greater peak flows (Curve A – low drainage density and Curve B – high drainage density as described to in Figure 5).

Appendix C

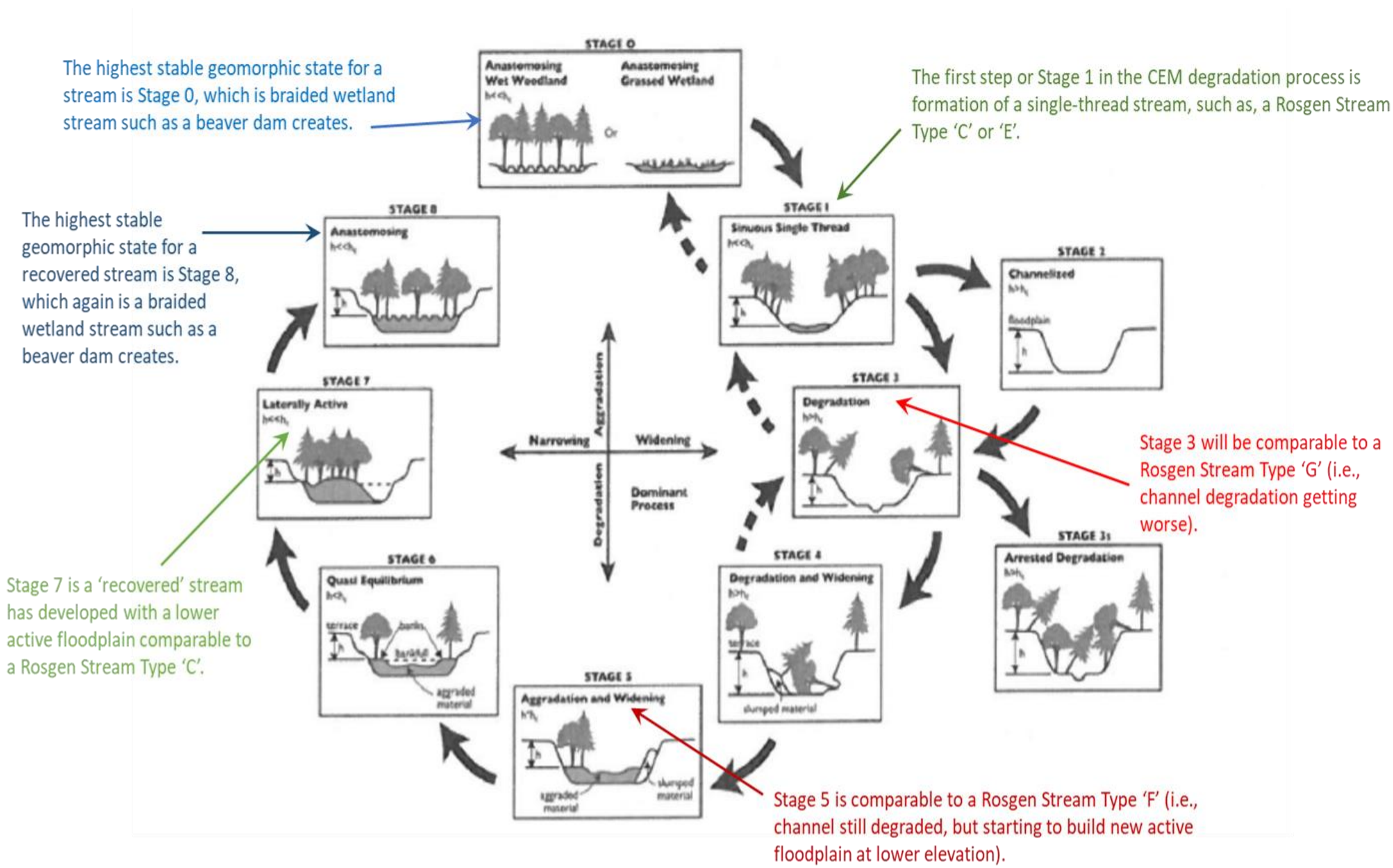

Figure 8 – Cluer and Thorne (2014) revised the Channel Evolution Model to include Stage 0, which represents multi-thread (braided) streams, wetland stream or beaver impounded streams as the initial and most geomorphically stable stream types. The Channel Evolution model address the eight stages that a stream goes through to transition from a stable stream type into unstable stream types and back to the initial stable stream type or Stage 0.

Appendix C

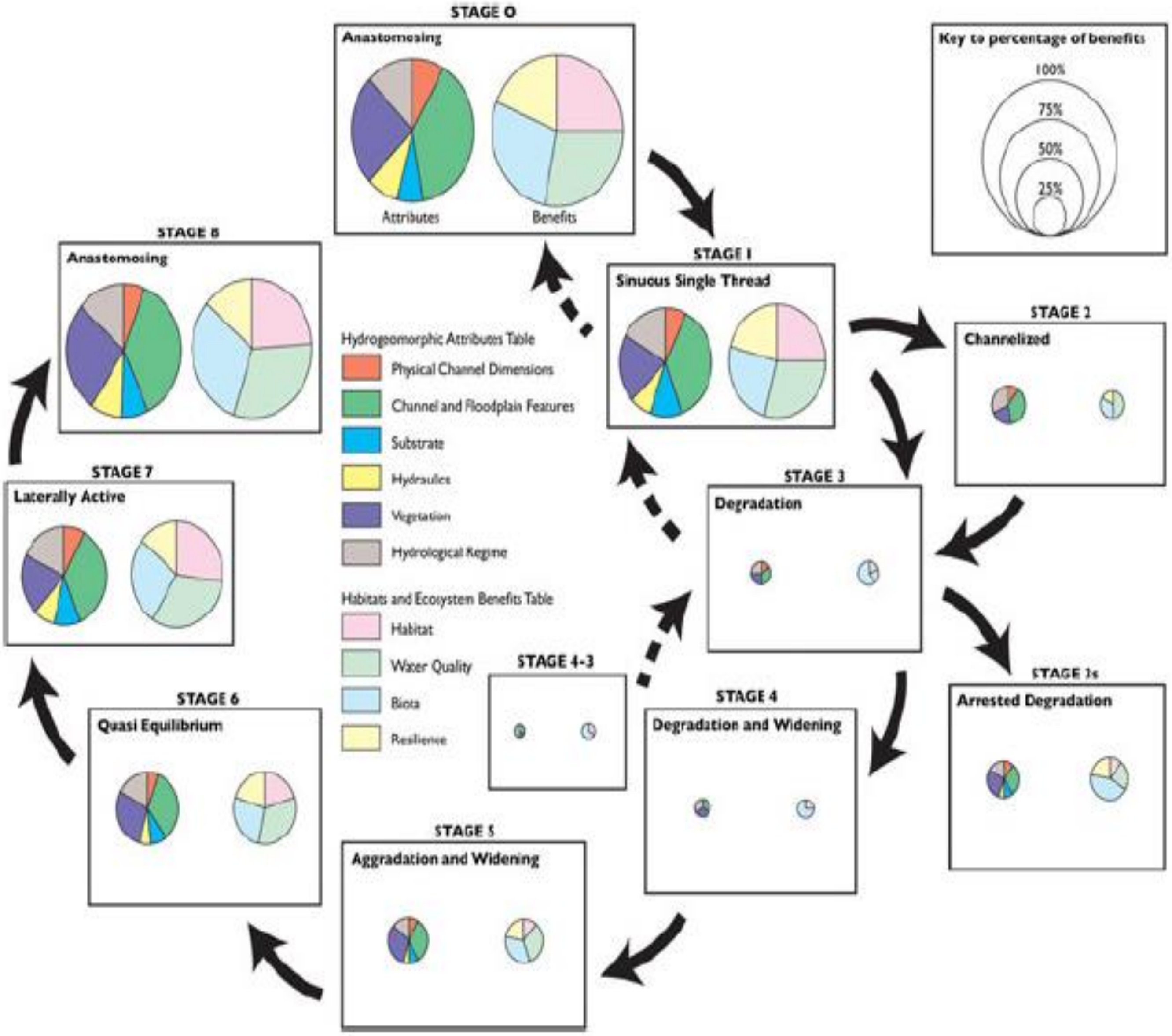

Figure 9 – Cluer and Thorne (2014) revised the Channel Evolution Model (CEM) to include Stage 0, but it also provides this diagram that directly correlates habitat and ecosystem benefits with the channel degradation stages. This diagram clearly shows that the biota benefits greatly decline as the CEM reaches Stage 3-Degradation (incision) and Stage 4-Degradation (incision) and Widening and starts to improve slightly as Stage 5-Aggradation and Widening is reached. In other words, the geomorphic condition of a stream directly impacts stream biota, which is shown to be similar for habitat and water quality.

Appendix C

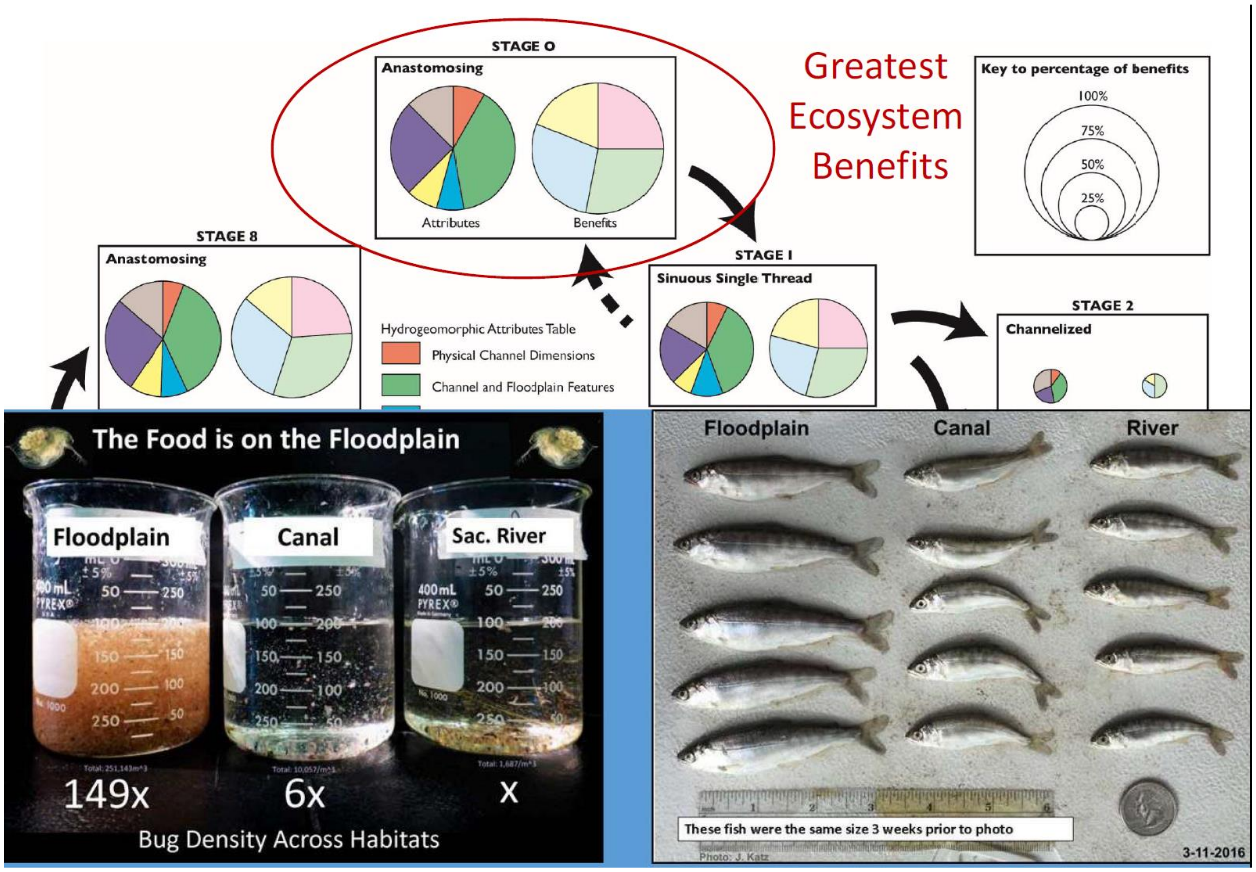

Figure 10 – Paul Powers, US Forest Service, presentation slide demonstrating aquatic fauna development after the completion of Stage 0 stream restoration that created multi-thread channels by building log jams that result in frequently or continuously flooded floodplains. The assessment of aquatic fauna (fish) in this slide show that the most food and largest fish are found on the floodplains.

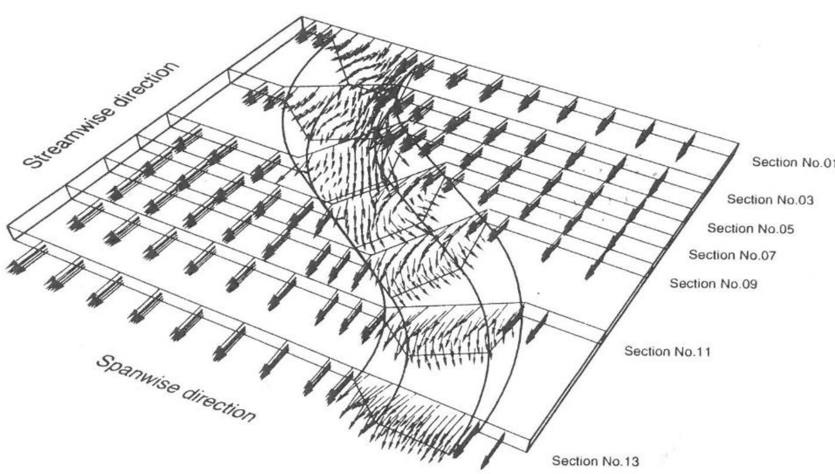

Figure 11 – Velocity vectors for flow in a geomorphically stable meandering channel with overbank flow and a straight floodplain alignment. This geomorphically stable condition produces potentially the best potential water quality improvement processes (Walling, 1996, Floodplain Processes).

Appendix C

Figure 12 – Post Ohio River flooding after Hurricane Ivan in September 2004, which shows silts and clays deposited on the Wheeling Island floodplain. The pollutants attached to these silts and clays have been removed from the channel, which provides for enormous water quality benefits.

Figure 13 – Post Ohio River flooding after Hurricane Ivan in September 2004, which shows silts and clays deposited across the Wheeling Island football stadium field.

Appendix C

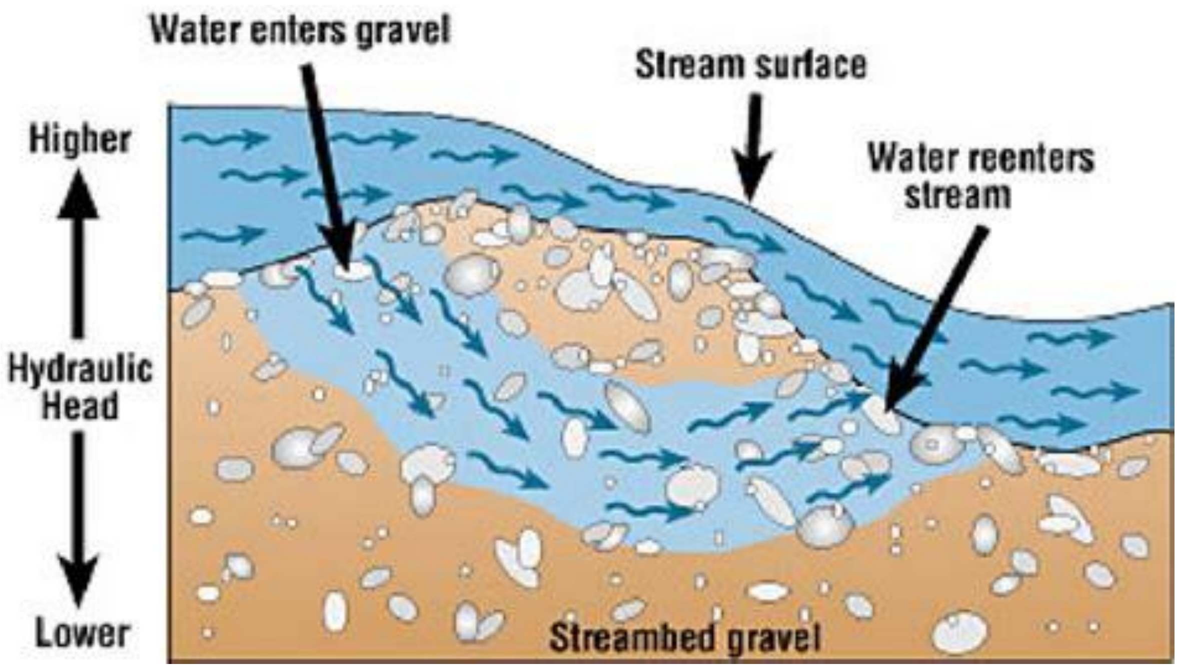

Figure 14 – Stream riffle showing hyporheic flows passing through the riffle substrate, which produces significant denitrification processes that reduce oxygen depletion for aquatic fauna. The combination of too much nitrogen and the loss of stream denitrification processes is resulting in eutrophication and hypoxia or "Dead Zones" such as in the Gulf of Mexico.

Figure 15 – Severely incised ephemeral stream showing nearly 6 feet of channel substrate has been eroded away down to rock and hardpans completely eliminate highly beneficial hyporheic flows that directly improve water quality and provides habitat for aquatic fauna.

Appendix D

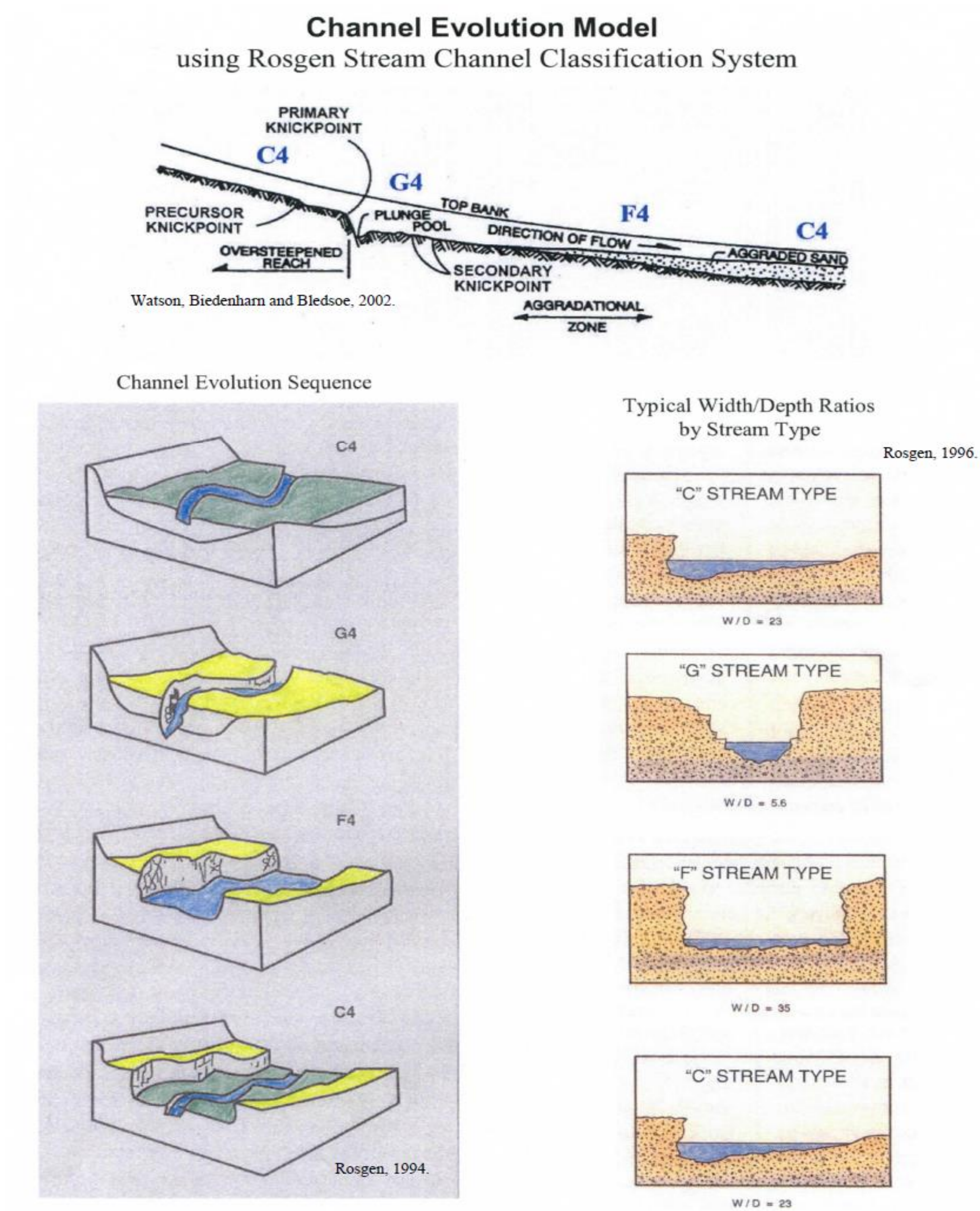

Figure 16 – The top drawing is the stream profile with the streambed eroding and advancing headward with resultant aggradation downstream. The left drawing provides a 3D view of the physical stream condition along the stream profile at the various stream types locations in the top drawing (C4, G4, F4 and C4). The right drawing shows the typical cross-section form and W/D ratio representative of each stream type.

Appendix E

Stream Physical Integrity Condition Assessment

The *objective* of the Clean Water Act (CWA) is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters.

As the objective states, an assessment of the stream physical integrity condition needs to be understood in order to maintain and restore the Nation's waters. A physical integrity condition assessment should be the primary assessment relative to chemical and biological integrity assessments, because the physical integrity condition establishes the foundation or framework that produces the stream functions that support the chemical and biological conditions.

As described by Asmus, B., et al. (2009), physical integrity is the result of the interaction of the hydrologic (runoff) and stream geomorphic conditions. The hydrologic condition is most often represented by a flow-duration curve as shown in Figure 1 below. However, increases in surface water runoff volumes and peak flows due to land use changes will shift the flow-duration curve up and to the right. This type of shift in the flow-duration curve produces more stream power that will concomitantly change the stream geomorphic condition (e.g., channel cross-section dimensions, profile and pattern) by creating an *imbalance* in sediment transport processes (e.g., more sediment leaving a reach of stream than is being transported into that reach of stream). This imbalance leads to degradation of the stream geomorphic condition or physical integrity (Hey, R., 2003).

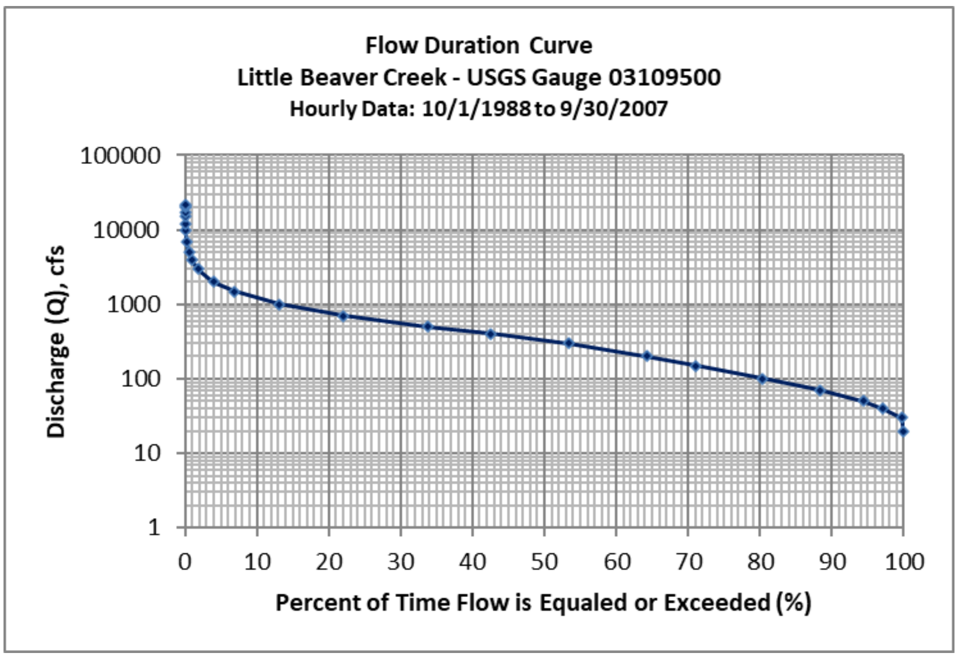

Figure 1 – Example flow duration curve for Little Beaver Creek, Columbiana County, Ohio.

Stream power is the power available for stream flow to transport a sediment load, and it may be defined as γQS, where γ is the specific weight of water, Q is the stream discharge, and S is channel slope (Bull, W., 1979). Stream discharge (Q) over time is represented by the flow-duration curve (e.g., Figure 1).

Increases in surface water runoff due to land use changes that shift the flow-duration curve up and to the right may be more easily understood in Figure 2 below, which compares surface water runoff volumes and peak flows from an 'undisturbed' or pre-development condition to a 'disturbed' or post-development condition. The area underneath the pre- and post-development curves (stream flow x time) represents the total volume of runoff for the time period. A certain flow rate or discharge will fill a channel to a flow depth that initiates sediment transport. This flow depth is roughly about 50% of the bankfull channel depth, and this sediment transport threshold is referred to as the critical discharge (Q_*) as shown in Figure 2. The subsequent increase in runoff volume and peak flows will create an imbalance in the stream sediment transport rates, which leads to channel degradation (i.e., channel bed incision), unless the peak flows are mitigated. Mitigation involves capturing and storing stormwater runoff in basins and releasing the captured portion of the runoff slowly below the critical discharge (Q_*) threshold. This reduces stream power or shifts the flow duration curve down and to the left (refer to Figure 1).

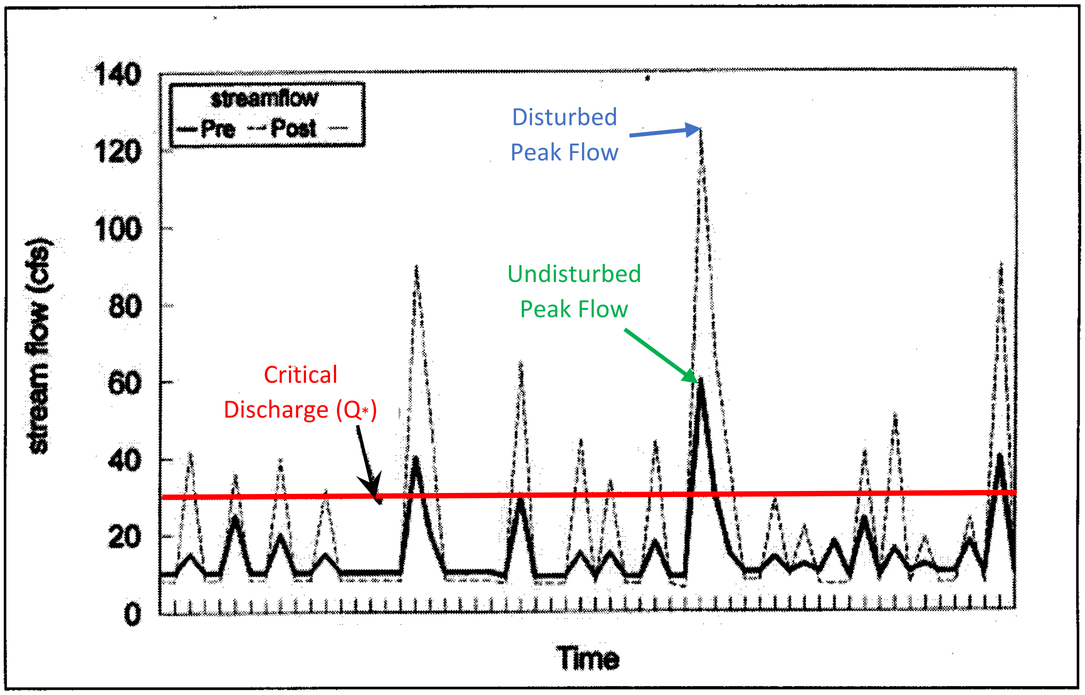

Figure 2 – Pre- and post-development flow-duration curves shown in a manner that represents the relative increase in peak flow for an 'undisturbed' as compared to the 'disturbed' condition, and shows the relative increase in flows greater than the critical discharge (Q_*) or increase in stream power.

As described by D. Rosgen (1996), natural channel stability is achieved by allowing the stream to develop a stable cross-section, profile and pattern, such that, over time, channel features are maintained and the stream neither aggrades (fills up) nor degrades (incision).

A stream that has natural geomorphic stability will just fill the channel to the bankfull stage and this discharge is referred to as the bankfull discharge (Q_{bkf}). The bankfull discharge corresponds to the discharge at which channel maintenance is the most effective. Thus, the bankfull channel discharge (Q_{bkf}) is considered to be the *effective discharge* (Q_{eff}) (Rosgen, 1996).

Appendix E

An effective discharge analysis is shown graphically in Figure 3 and is performed by integrating the flow duration curve (B) and sediment transport curve (A) at a specific stream location to produce the effective discharge curve (C). The effective discharge (Q_{eff}) occurs at the peak of the effective discharge curve (C), which, as discussed, is the bankfull channel flow (Q_{bkf}) for streams with a stable geomorphic condition (Rosgen, 1996).

If land use changes occur and the stormwater runoff is not controlled properly by stormwater best management practices (BMPs), then the flow-duration curve will increase or shift up and to the right as described by curve B' in Figure 4. This change in the flow-duration curve increases and shifts the effective discharge curve C to the right to position C', which results in the effective discharge increasing (i.e., it increases from Q_{eff1} to Q_{eff2} as shown in Figure 4) (Beyerlein, D., 2005). This change in effective discharge will also result in the stream channel cross-sectional area concomitantly increasing through erosion to accommodate the larger effective discharge (Q_{eff2}) and simultaneously changing the stream pattern and profile. However, the erosional transition to a larger channel cross-sectional area results in an imbalance in the sediment transport rate that leads to unstable geomorphic conditions (e.g., channel bed incision). Thus, it is critical for stormwater BMPs to be properly designed to maintain the flow-duration curve at its current position or shift it down and to the left (i.e., decrease stream power) (Beyerlein, D., 2005). Therefore, a primary goal of stormwater management through the use of stormwater BMPs is to maintain or reduce the stream power so that post-development runoff conditions produce the same or less stream power than the pre-development runoff conditions in order to maintain the physical integrity of the Nation's waters as required by the CWA (Beyerlein, D., 2005 and Hawley, B., 2015).

When a geomorphically stable stream is impacted by a change in surface water hydrology (i.e., the flow-duration curve shifts up and to the right), channels with gradients greater than 2% will most always degrade by channel bed erosion (incision), because the increased flows from the watershed provide excess stream power or sediment transport capacity to erode the stream bed and banks (Bull, W., 1979). The incision creates a knickpoint that advances the channel erosion in the upstream direction (headwards), which further increases the sediment supply to the downstream channels. As the channel bed continues to incise headwards through erosional processes, the streambanks become more unstable and sediment supply is increased even more. Eventually, the downstream channel capacity is over-whelmed by the imbalance created by the upstream excess sediment supply and the downstream channels aggrade, which results in pools filled and riffles smothered by the excess sediment load (i.e., stream habitat for aquatic life is significantly degraded).

Appendix E

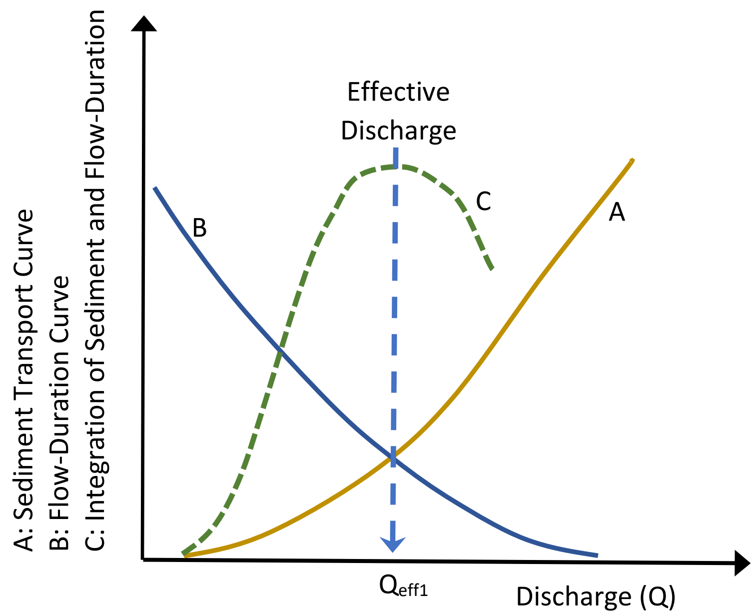

Figure 3 – Integration of flow-duration curve B and sediment transport curve A produces the effective discharge curve C and the peak of this curve is the effective discharge (Q_{eff}), which is the bankfull discharge associated with the stable geomorphic condition (Rosgen, 1996).

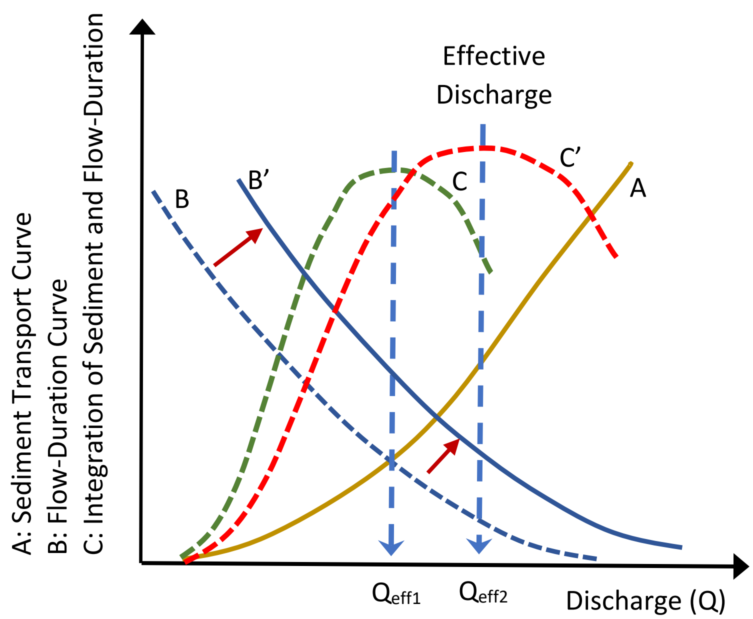

Figure 4 – If land use change is not controlled with proper stormwater BMPs, then the flow-duration curve will shift to the right (B to B'), which results in a larger effective discharge (Q_{eff2}) due to the effective discharge curve moving from C to C'. The channel adjusts to this change in effective discharge through erosional processes creating unstable geomorphic conditions (Rosgen, 1996).

Appendix E

The channel structure or geomorphic condition of the stream channel provides the habitat or 'homes' for aquatic life. When a stream channel is geomorphically stable, the stream structure provides the best potential habitat for aquatic life. As stream channel structure is degraded and the channel becomes geomorphically unstable through either incision or aggradation, the channel habitat is simultaneously degraded making the 'homes' for aquatic life less hospitable and more difficult to remain or survive within. Therefore, the quality of stream channel habitat for aquatic life is a direct by-product or result of the interaction between surface water hydrologic (hydrology) and stream geomorphic processes (geomorphology) as described in the diagram in Figure 5 below (Asmus, et al., 2009). If the stream structure is not maintained in a stable geomorphic condition, then aquatic life will be directly and adversely impacted (Sullivan, et al., 2009).

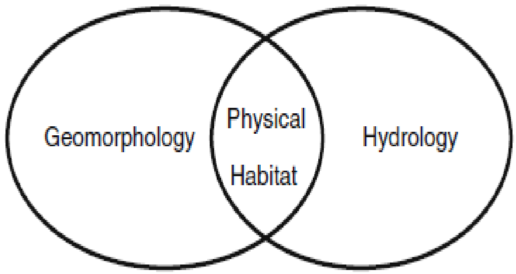

Figure 5 – Stream physical habitat is determined by the interaction between surface water hydrologic (Hydrology) and stream geomorphic processes (Geomorphology) and the quality of this habitat is dependent on the resultant stream geomorphic condition (Asmus, B., et al., 2009).

In conclusion, the physical integrity of streams requires an assessment of the surface water hydrologic (hydrology) and stream geomorphic processes (geomorphology) by evaluating the stream geomorphic condition or physical integrity to determine the quality of the channel structure and stream geomorphic processes that produce the habitat for aquatic life in the stream channel. The stream channel structure and the resultant habitat is the by-product of the interaction between the surface water hydrologic and stream morphologic processes.

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