

US EPA ARCHIVE DOCUMENT

APPENDIX C: F.A.C. 62-303 Water Quality Standards Provisions Related to Biological Integrity

Florida water quality standards (62-302.530(10), F.A.C.) include percent reduction of the Shannon-Weaver Diversity Index as a numeric criterion for biological integrity. This criterion applies to Class I, II, and III waters, and states:

The Index for benthic macroinvertebrates shall not be reduced to less than 75% of background levels...

The State adopted certain provisions of the Impaired Waters Rule (IWR) 62-303, F.A.C., pertaining to biological assessments to supplement the numeric criteria based on the Shannon-Weaver Diversity Index for use in establishing a list of State waters under the authorities of the Clean Water Act (CWA) Section 303(d). The provisions that have been determined by the Environmental Protection Agency (EPA) to be new or revised water quality standards for the State are summarized in Table 1.

Table 1. Provisions of Rule 62-303, F.A.C. that are new or revised water quality standards relating to biological criteria	
Section	Why it is a standard
.200(1)	Defines bioassessment
.200(2)	Defines BioRecon
.200 (8)	Defines Lake Condition Index (LCI)
.200(22)	Defines Stream Condition Index (SCI)
.330(2), 430(2), 430(3), 720(2)(b)	Establishes bioassessment criteria. 330(2) limits application of LCI to lakes with color <20 platinum cobalt units.
.330(3)(a)&(b)	Establishes magnitude of biological criteria for streams (a) and lakes (b)
.430(1)	Specifies Standard Operating Procedures (SOPs) to be used for attainment decisions. SOPs include substantive definitions of magnitude terms used in 330(3)(a)&(b)

USE AND DESCRIPTION OF BIOASSESSMENTS

The bioassessments defined in 62-303.200, F.A.C. include BioRecons and the Stream Condition Indices (SCIs) for streams, and the benthic macroinvertebrate component of the Lake Condition Index (LCI) for lakes. The Florida Department of Environmental Protection (FDEP) has spent many years developing these bioassessment implementation protocols and incorporating them into the Department's Quality Assurance rule, 62-160. Table 2 indicates which Standard Operating Procedures (SOPs) are used for each bioassessment method.

Table 2. Bioassessment indices, related SOPs, and scores.			
Bioassessment Index	FS 7000 General Biological Community Sampling (subset)	LT 7000 Determination of Biological Indices (subset)	Scores
BioRecon	FS 7410	LT 7100; LT 7100-1, LT 7100-2, and LT 7100-3	“fail”
SCI	FS 7420	LT 7200; Tables LT 7200-1, LT 7200-2, and LT 7200-3	“poor” or “very poor”
LCI	FS 7460	LT 7300; Table 7300-1	“poor” or “very poor”

There are two situations in which bioassessment results may be used in attainment decisions related to designated uses. First, bioassessment results may be used to place impaired waters on the planning and verified lists for aquatic life use support to supplement the underlying biological integrity standard, 62-302.530(10), F.A.C. Second, bioassessments may be used to support determinations based on the natural background conditions clause as described in 62-303.420(1)(b), F.A.C.

These new bioassessment tools establish quantitative “impairment thresholds” for each assessment method. These methods are appropriate for Florida waters and aquatic species as the ratings/scores generated using these assessments, when compared to each impairment threshold, are an accurate and scientifically defensible measurement of designated use attainment in State waters.

As mentioned previously, Florida’s water quality standards include a biological integrity criterion that specifies no greater than a 75% percent reduction in Shannon-Weaver Diversity Index for Class I, II, and III waters, using the Hester-Dendy Artificial Substrate samplers for Class I and III Freshwater. The BioRecon, SCI and LCI tests further refine Florida water quality standards by providing a means of measuring the Class I and III Freshwater aquatic life designated use attainment by sampling natural habitat and establishing criteria for adding and removing waters to and from the planning and verified lists. The information presented in Table 3 describes the individual metrics that comprise each methodology, as well as the range of index values that represent designated use attainment and failure.

Table 3. Summary of Biological Indices and Metrics Referenced in F.A.C. 62-303

Index	Metrics	Metric calculation	Final Index Range
BioRecon	<u>Six Total:</u> • Total Taxa • Ephemeroptera Taxa • Trichoptera Taxa, • Long-Lived Taxa, • Clinger Taxa, • Sensitive Taxa	The metric values were calculated using the organisms collected from the field studies. The range of metric values was determined based on extensive collections from water bodies subjected to a range of disturbance from highly disturbed to minimally disturbed. The metric scores were calculated based on scoring formulae provided in DEP-SOP-002/01, Table LT 7100-2. The formulae normalized the scoring from each of the three bioregions so that the index ranges for final scoring of the biological condition was the same for all bioregions.	For one sample event: Pass = 6-10 Fail = 0-6
SCI	<u>Ten Total:</u> • Total Taxa, • Ephemeroptera Taxa • Trichoptera Taxa • Percent filterer • Long-Lived Taxa • Clinger Taxa • Percent Dominance • Percent Tanytarsini • Sensitive Taxa, • Percent Very Tolerant	The metric values were calculated using the organisms collected from the field studies. The range of metric values was determined based on extensive collections from water bodies subjected to a range of disturbance from highly disturbed to minimally disturbed. The metric scores were calculated based on scoring formulae provided in DEP-SOP-002/01, Table LT 7200-2. The formulae normalized the scoring from each of the three bioregions so that the index ranges for final scoring of the biological condition was the same for all bioregions.	For one sample event: Good = 73-100 Fair = 46-73 Poor = 19-46 Very Poor = 0-19

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LCI	<u>Six Total:</u> • Shannon-Weaver Diversity Index; • Hulbert Index • Taxa Score • Epmeroptera + Odonata + Trichoptera (EOT) • Percent EOT • Percent Diptera	The metric values were calculated using the organisms collected from the field studies. The metrics were selected based on comparison of lakes judged to be least stressed by anthropogenic activities to lakes judged to be stressed to some degree. The metric scores were calculated based on scoring formulae provided in DEP-SOP-002/01, TL 7300. Table LT 7300-1 provides the range of scores that represent the condition categories for each lake type.	For clear lakes (<20 PCU) <u>Region 65 Acid Lakes:</u> Very Good: ≥ 55 Good: 35-55 Poor: 18-34 Very Poor: <18 <u>Region 75 Acid Lakes:</u> Very Good: ≥ 44 Good: 30-43 Poor: 15-29 Very Poor: <15 <u>Alkaline Lakes:</u> Very Good: ≥ 50 Good: 35-49 Poor: 18-34 Very Poor: <18
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The 2004 versions of LT 7200 and FS 7420 (SCI) and associated SOPs have become binding as rule referenced. These SOPs establish the metrics that are used to apply the biological indices. As such, these SOPs establish the magnitude values associated with the terms “very poor”, “poor”, “fair”, etc. Because language specific to the 2004 version of LT 7200 (“poor” or “very poor”) is used in the IWR (62-303.330(3)(a)–(b)), subsequent changes to the LT 7200 and FS 7420 SOPs will not be immediately effective for Clean Water Act purposes. EPA must review and approve any revisions to the rule-referenced SOPs and, consequently, to the water quality standard provision within the IWR under CWA section 303(c) for it to gain status as an applicable water quality standard and be used for any Clean Water Act purpose.

These bioassessment methods delineate the aquatic communities that the state considers to be consistent with the Class III designated use, “propagation and maintenance of a healthy, well-balanced population of fish and wildlife.” Each methodology assesses a wide variety of aquatic species that are found in Florida waters. The types of metrics included in the assessment are appropriate for measurement of system characteristics that relate to the relative health of an aquatic community of organisms, such as relatively high percentages of sensitive taxa, relatively low percentages of stress-tolerant taxa, as well as the life cycle characteristics of the taxa present, e.g., length of life span, taxa that utilize filtering for food capture, ability to avoid pollution or stress events. The taxa at a site rated in the range of indices that fall into the use attainment range represent a robust and vigorous community of aquatic species, functioning as a healthy ecosystem in equilibrium. Alternatively, a rating of these indices that fall into the range of values in the aquatic life designated use failure category represents a community of taxa with important sensitive species that are at low levels or completely absent, with a

concomitant abundance of species that are stress- and pollution-tolerant, symptomatic of an unsound aquatic community subject to frequent disturbances.

DEVELOPMENT OF BIOASSESSMENTS

The LCI was developed following the EPA guidance document for development of lake and reservoir bioassessment and biocriteria: *U.S. Environmental Protection Agency. 1998. Lake and Reservoir Bioassessment and Biocriteria: Technical Guidance Document. EPA 841-B-98-007*. The State's inclusion of the LCI as a water quality standard represents the first full scale application of this guidance.

The Stream Condition Index (SCI) and the BioRecon were also developed using principles included in EPA guidance. Both the SCI and the BioRecon and associated Standard SOPs are scientifically defensible methods and consistent with the EPA guidance documents. FDEP based their method development primarily on this EPA guidance document: *Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers: Periphyton, Benthic Macroinvertebrates, and Fish. 2nd Edition. 1999. EPA-841-B-99-00*. The field sampling, sampling preservation and handling, laboratory procedures, and QA procedures of the methods and associated SOPs closely follow EPA guidance. Metric development and scoring and ranking of the final biological condition also follow the guidance in the above referenced document with modifications. The modifications follow concepts that are included in the document: *Use of Biological Information to Better Define Designated Uses in State and Tribal Water Quality Standards: Tiered Aquatic Life Uses (Draft). 2005*. The principles from this document, which are based on published scientific literature, were used to refine the metric development to reflect organism and community structure response to a more refined and documented human disturbance gradient.

The indices used in the bioassessment methodologies were specifically developed from extensive testing of Florida waters and aquatic biological communities. Likewise, each metric was extensively tested for application in Florida waters using the information developed in Florida waters. A detailed description of the development process for the three indices can be found in these FDEP documents: *Development and Testing of Biomonitoring Tools for Macroinvertebrates in Florida Streams (2004)* and *Development of Lake Condition Indexes (LCI) for Florida (2000)*.

The SCI and BioRecon methods are applicable to freshwater wadeable streams and rivers for all areas of the state with the exception of the southern part of the state south of Lake Okeechobee. This area is unique to the state because of its hydrological conditions. The method is also not appropriate for use in artificial man-made canals at this time. The LCI applies to freshwater lakes with color less than 20 PCU. These indices are not applicable to estuarine and marine ecosystems.

During development, the SCI and BioRecon methods were tested over the range of geographical and ecological areas of the state. The testing was also performed during

different seasons over a period of years. The testing identified three distinct bioregions in the state where the biological condition expectations and consequently the ranges of individual metric values were slightly different. These areas are the panhandle area, the northeastern area, and the peninsular area. However, to determine a final bioassessment score the individual metric values are mathematically transformed to a value between 0 and 10 based on formulae developed for each specific bioregion. These metric scores are then tallied to provide a single site score and this score is compared to the range of scores assigned to each condition category for the SCI or BioRecon as appropriate. Details regarding the scoring method can be found in DEP-SOP-002/01 Appendix LT 7200.

TECHNICAL BASIS FOR FLORIDA'S BIOASSESSMENTS

The following discussion was taken from the document *Development and Testing of Biomonitoring Tools for Macroinvertebrates in Florida Streams* (Fore 2004).

“Multimetric indexes strive to integrate measures from a diverse set of biological categories for two reasons. First, monitoring different aspects of the biological assemblage improves the likelihood of detecting changes associated with different types of disturbance. Second, the potential exists to define metric signatures, that is, associations between specific metrics (or suites of metrics) that correspond to specific human activities (Norton et al., 2000; Yoder and Deshon, 2002). Metric signatures are particularly relevant to the TMDL process that allocates responsibility for degraded stream condition among the various human activities in the watershed (Karr and Yoder, in press, EPA, 2000).

Though not specific to any particular group, total taxa richness represents a general measure of the biological complexity found at the sample site. This metric is one of the most widely applied in biomonitoring programs because of its consistent decline with human disturbance with stream invertebrates (Kerans and Karr, 1994; Fore et al., 1996; Karr and Chu, 1999; Klemm et al., 2002) as well as fish (Hughes et al., 1998), terrestrial invertebrates (Kimberling et al., 2001), and birds (Bryce et al., 2002). Ephemeroptera (mayflies) and Trichoptera (caddisflies) taxa richness have also been widely applied, though often combined with Plecoptera (stoneflies) as a single (EPT) metric. Splitting these taxonomic groups apart provides the opportunity for metric signatures associated with different types of disturbance. For example, Ephemeroptera taxa are known to be particularly sensitive to metals and will disappear before other taxa (Clements, et al., 2000; Fore, 2002). On the other hand, an increase in Ephemeroptera may indicate an increase in nutrients (Miltner and Rankin, 1998). Filterers are expected to decline in response to disturbance because of the increase in sediment and silt that can damage or clog nets. Long-lived taxa are expected to decline as human disturbance alters the natural flow regime, because these taxa require water in the channel year-round. Pollution events of short duration may also eliminate these taxa and they will not colonize quickly from other sites while other shorter lived taxa may colonize from other sites.

Clinger taxa may have morphological and behavioral adaptations that allow them to cling in fast water. Human development in stream sites in Florida often translates into eroding sand that can smother habitat and can eliminate these taxa. Other studies have found these taxa to be sensitive to disturbance associated with mining and urbanization (Fore et al., 2001; Mebane, 2000). Percentage dominance of the most abundant taxon increases with disturbance as the natural taxonomic diversity declines and very tolerant taxa dominate samples. This metric represents a measure of the overall structure of the assemblage and has been associated with disturbance in several regions (Klemm et al., 2002). The Tanytarsini midges are used as indicators by Ohio because of their general sensitivity to human disturbance (Deshon, 1995).

Florida DEP performed extensive testing of metric responses to disturbance. Thirty-six candidate metrics were evaluated for use based on association with a human disturbance gradient (HDG). Within each category representing important features of the aquatic community FDEP selected the metrics with the highest appropriate correlation with the HDG. All correlations of selected metrics with HDG were statistically significant (using Spearman's r , p , <0.01 , one-sided test). Within the taxa richness component, Ephemeroptera and Trichoptera taxa had the highest correlation with the HDG followed by the total taxa metric. The relative abundance of filterers showed a consistent decline with the increase of HDG and was chosen to represent the feeding group component of the community. Long-lived taxa richness was more highly correlated with the HDG than relative abundance of long-lived taxa and was selected to represent the voltinism aspect of the biological community. Clinger taxa richness was among the most highly correlated metrics with the HDG and was selected to represent the habitat preference component. Percentage dominance of most abundant taxa and percent Tanytarsini were selected to represent important components of community structure. The number of sensitive taxa was also selected as a metric that was responsive to the HDG. All metrics were tested against each other for redundancy to eliminate similar metrics.

The SCI was found to be highly correlated with the HDG with minimal overlap of values between extremely disturbed and minimally disturbed sites. In a test of the SCI with previously unstudied streams, the correlation was high (Spearman's $r = -81$, $p < 0.01$). The BioRecon was also highly associated with the HDG. The SCI was also tested against watershed size and different years of sampling. The results indicated that the SCI was not associated with watershed size and the relationship between SCI and HDG was consistent across years as well.

As described in Fore (2004), the set of metrics selected for Florida represents a convergence with similar studies and programs in other states (Karr 1998). Many of the Florida metrics also had strong correlation with disturbance in Colorado, Idaho, Washington, Tennessee, and Japan, where they responded to a diverse set of human activities including timber harvest (Fore et al. 1996), recreation (Karr 1998), urbanization (Fore et al. 2001; Karr and Rossano 2001; Morley and Karr 2002), agriculture (Kerans and Karr 1994), and mining (Mebane 2001; Fore 2002; Mebane 2002). The emergence

of a core set of metrics across a variety of geographic contexts further supports the use of these metrics as biological indicators.

TECHNICAL BASIS FOR SCORES

As previously stated, the taxa at a site rated in the range of indices that fall into the use attainment range, “Excellent,” “Good,” and “Fair,” represent a robust community of aquatic species, functioning as a healthy ecosystem in equilibrium. A rating of “Poor” or “Very Poor,” represents a community of taxa with important sensitive species that are at low levels or completely absent, and may have an abundance of species that are stress- and pollution-tolerant, symptomatic of an unsound aquatic community.

Specifically, the SCI score of “Excellent” represents a proportion and abundance of taxa similar to natural condition with minimal loss of taxa. The SCI score of “Good” represents conditions similar to natural with a loss of up 10% of taxa and 25% loss of Ephemeroptera, Trichoptera, clinger, and sensitive taxa expected. A fair rating corresponds to a 25% loss of total taxa and up to a 50% loss of Ephemeroptera, Trichoptera, clinger and sensitive taxa expected, and a 33% loss of long-lived taxa. “Poor” represents a condition where a high percentage of individuals that occur belong to very tolerant taxa and only tolerant Ephemeroptera, Trichoptera, and clinger taxa are present; only one sensitive or long-lived taxon may be present. “Very Poor” is an extremely degraded condition with 50% loss of expected taxa. Ephemeroptera, Trichoptera, clingers, sensitive taxa and long-lived taxa are missing or rare in this condition.

The “passing” category for the BioRecon is roughly equivalent to the “Good” and “Fair” categories of the SCI. The “failing” category is roughly equivalent to the “Poor” and “Very Poor” categories of the SCI. However, as discussed in the development document these categories for BioRecon may be somewhat conservative due to variability associated with repeat site visits during index development (Fore 2004).

The LCI thresholds for lake ratings are based on conditions in reference lakes. The categories of “Very Good” and “Good” represent acceptable quality and are considered to meet use attainment. The “Very Good” category corresponds to the conditions above the 25th percentile of the reference condition. The “Good” category represents those lakes that are similar in condition to the lower 25th percentile of the reference condition. The “Poor” and “Very Poor” categories represent those conditions not meeting use attainment. These categories represent conditions that are less than conditions found in the lower quartile of the reference lakes.

IWR PROVISIONS RELATED TO BIOASSESSMENT

The definitions related to biological assessments in 62-303.200, F.A.C., listed below are new water quality standards because they add or further define water quality criteria in 62-302.530, F.A.C.

- (1) “Bioassessment” shall mean a BioRecon, Lake Condition Index, or Stream Condition Index.
- (2) “BioRecon” shall mean a biological evaluation conducted in accordance with standard operating procedures (SOPs) FT 3000, FS 7410, and LT 7100, as promulgated in Rule 62-160.800 F.A.C.
- (8) “Lake Condition Index” shall mean the benthic macroinvertebrate component of a biological evaluation conducted following the procedures outlined in “Development of Lake Condition Indexes (LCI) for Florida,” Florida Department of Environmental Protection, July, 2000, which is incorporated by reference.
- (22) “Stream Condition Index” shall mean a biological evaluation conducted in accordance with SOPs FT 3000, FS 7420, and LT 7200, as promulgated in Rule 62-160.800, F.A.C.

As stated in 62-303.200, F.A.C, these definitions also refer to specific procedural documents that incorporate sampling and analytical methodologies for implementation of these definitions and other provisions of the regulation. These protocols are similar to those used by other states and EPA to measure aquatic life use attainment.

Rule 62-303.330, F.A.C., describes when a water segment shall be included on the planning list for biological assessments and the existing Biological Integrity criterion in Florida water quality standards. Subsection (2) states:

Bioassessments used to assess streams and lakes under this rule shall include BioRecons, Stream Condition Indices (SCIs), and the benthic macroinvertebrate component of the Lake Condition Index (LCI), which only applies to clear lakes with a color less than 20 platinum cobalt units. Because these bioassessment procedures require specific training and expertise, persons conducting the bioassessments must comply with the quality assurance requirements of Chapter 62-160, F.A.C., attend at least eight hours of Department sanctioned field training, and pass a Department sanctioned field audit that verifies the sampler follows the applicable SOPs in Chapter 62-160, F.A.C., before their bioassessment data will be considered valid for use under this rule.

This subsection further clarifies the use of the biological indices discussed above as well as placing restrictions on the use of data collected using the methodologies. Only the portion in bold is considered a new or revised water quality standard.

Subsection (3) of 62-303.330, F.A.C., establishes the magnitude of biological criteria for streams and for lakes for planning list placement. This subsection states:

(a) In streams, the bioassessment shall be either an SCI or a BioRecon. Failure of a bioassessment for streams consists of a “poor” or “very poor” rating on the Stream Condition Index, or a “fail” rating on the BioRecon.

(b) Failure for lakes consists of a “poor” or “very poor” rating on the Lake Condition Index.

Rule 62-303.430 describes how planning list waters are moved to the verified list for TMDL development. Subsection (1) refers to SOPs which are binding by rule-reference and constitute scientifically defensible methods consistent with 40 CFR 131.11.

(1) All bioassessments used to list a water on the verified list shall be conducted in accordance with Chapter 62-160, F.A.C., including Department-approved Standard Operating Procedures. To be used for placing waters on the verified list, any bioassessments conducted before the adoption of applicable SOPs for such bioassessments as part of Chapter 62-160, F.A.C., shall substantially comply with the subsequent SOPs.

Subsection (2) establishes bioassessments as a means of placing waters on the verified list when they were also used as a means of placing waters on the planning list:

(2) If the water was listed on the planning list based on bioassessment results, the water shall be determined to be biologically impaired if there were two or more failed bioassessments within the five years preceding the planning list assessment. If there were less than two failed bioassessments during the last five years preceding the planning list assessment, the Department will conduct an additional bioassessment. If the previous failed bioassessment was a BioRecon, then an SCI will be conducted. Failure of this additional bioassessment shall constitute verification that the water is biologically impaired.

Subsection (3) establishes bioassessments as a means of placing waters on the verified list when they were not used as means of placing waters on the planning list:

(3) If the water was listed on the planning list based on other information specified in rule 62-303.330(4), F.A.C., indicating biological impairment, the Department will conduct a bioassessment in the water segment, conducted in accordance with the methodology in rule 62-303.330, F.A.C., to verify whether the water is impaired. For streams, the bioassessment shall be an SCI. Failure of this bioassessment shall constitute verification that the water is biologically impaired.”

Both Subsection (2) and (3) above are new/revised water quality standards. These sections also include sample size requirements, and these aspects do not constitute new or revised water quality standards. Similar to the construction of other sample size requirements of the IWR, if insufficient information is available from the planning list period, FDEP commits to obtain the necessary information.

Similar to the methods used to place waters on the verified list, delisting procedures in 62-303.720, F.A.C., include provisions for use of bioassessments:

(2)(b) For waters listed due to failure to meet aquatic life use support based on biological data, the water shall be delisted when the segment passes two independent follow-up bioassessments and there have been no failed

bioassessments for at least one year. The follow-up tests must meet the following requirements:

- 1. For streams, the new data may be two BioRecons or any combination of BioRecons and SCIs.*
- 2. The bioassessments must be conducted during similar conditions (same seasons and general flow conditions) under which the previous bioassessments used to determine impairment were collected.*

Florida elects to place waters on the verified list based on two or more failed bioassessments, except in circumstances where other information relevant to biological integrity placed a water on the planning list whereby Florida requires one confirmatory failed bioassessment. Likewise, Florida elects to delist waters from the verified list based on two bioassessments that do not indicate failure. While EPA's guidance is not specific on the number of assessments required to make attainment/non-attainment determinations, most states typically use one assessment as sufficient information. However, Florida uses two to be certain of impairment and attainment.

The state has indicated their preference for two positive or negative results because of the potential variability associated with hurricanes, drought cycles, and inherent variability associated with biological sampling. Since the topography of Florida is predominantly flat and streams often have very little slope, many streams in the state are susceptible to periods of little or no flow during periods of little rainfall. This results in conditions where the streams either dry up or become stagnant. Both of these conditions can cause severe limitations or alterations of the macroinvertebrate communities. If these limited flow conditions occur, it can take six months or longer for the macroinvertebrate communities to return to normal populations after normal flow conditions are reestablished (FDEP 2007). Since dry conditions or stagnant flow conditions can severely impact the biological communities and it is not possible to be certain of antecedent flow conditions at sample locations for the six months prior to all sampling, FDEP considers the confirmatory test necessary to verify impairment status.

For the reasons discussed above, EPA concludes that identified provisions which constitute new or revised water quality standards are based on use of scientifically defensible methodologies and metrics for assessment of instream biological integrity. These scientifically defensible methodologies, when implemented for Florida's waters, will result in protection of the designated uses for aquatic life in Florida's water quality standards, i.e., "propagation and maintenance of a healthy, well-balanced population of fish and wildlife." As such, these provisions are consistent with EPA's regulations at 40 CFR 131.11 and the Clean Water Act.