Mississippi Consolidated Assessment and Listing Methodology
2018 Assessment and Listing Cycle

Data Requirements and Assessment and Listing Methodology to Fulfill the Requirements of Sections 305(b) and 303(d) of the Clean Water Act

INTRODUCTION

This document is Mississippi's Consolidated Assessment and Listing Methodology (CALM) for the 2018 Section 305(b) and Section 303(d) reporting cycle. It is subject to revision in subsequent reporting cycles.

Purpose

A primary goal of surface water quality assessments, as required by Section 305(b) of the federal Clean Water Act (CWA), is to describe the condition of the state's surface waters to the U. S. Environmental Protection Agency (EPA) and the public. A secondary goal of the §305(b) assessment process is to provide the assessment information needed by the Mississippi Department of Environmental Quality (MDEQ) to develop the state's CWA Section 303(d) List of Impaired Water Bodies. To achieve these goals, it is necessary to have requirements and guidelines for how water quality data are collected, analyzed, and assessed. The purpose of this document is to specify the MDEQ's data requirements and assessment guidelines for the 2018 §305(b) assessment and §303(d) listing cycle. This assessment and listing methodology establishes a process, consistent with EPA guidance, to assess the status of surface waters in Mississippi.

Assessment and Listing Process

All data used to make formal assessments of the quality of the state's waters, regardless of its source, will be evaluated in keeping with the requirements and guidelines contained herein. Monitoring data and information that may be considered when assessing state waters could include chemical, physical, bacteriological, toxicological, and/or biological (e.g., macroinvertebrate, fish, and algal community measurements) data. In addition to using MDEQ-generated data, MDEQ solicits and considers all readily available data and information within the assessment window collected by other Federal, State, local agencies/organizations, and the public. This data solicitation effort is facilitated through MDEQ's Basin Management Approach.

The water quality assessment process begins with the collection and compilation of the available data followed by the analysis of water quality data and information for the purpose of determining the quality of the state's surface water resources. Surface waters in Mississippi are used for a number of purposes. Waters are used for drinking and food processing, shellfishing, recreation, fishing, and aquatic life support. Water bodies are designated and assigned various use classifications by MDEQ in the state's Water Quality Standards (11 Miss. Admin. Code Pt. 6, Ch. 2) {WQS}. This designation is made based on the use(s) of the water body as identified by the public and other entities. The use classifications and associated USEPA designated uses for water quality assessment purposes recognized by the State of Mississippi are as follows:

Waterbody Classification	**USEPA Associated Designated Use**
Public Water Supply	Drinking Water Supply
Recreation	Contact Recreation
Fish and Wildlife	Aquatic Life Use, Fish Consumption, Secondary Contact Recreation
Shellfish Harvesting	Shellfish Consumption

Most of Mississippi's waters are classified as Fish and Wildlife. For each of the use classifications listed above, there are various water quality criteria that apply to those water body uses. These standards are used in the assessment process. A water body (part or all of a stream, river, lake, estuary or coastline) should support one or more of these uses. A full copy of the WQS can be found in Appendix C.

Mississippi's WQS specify the appropriate levels for which various water quality parameters or indicators support a water body's designated use(s). Each use assessed for a water body is determined to be either "Attaining" or "Not Attaining" in accordance with the applicable water quality standards and EPA guidelines for assessments pursuant to §305(b).

After assessing attainment status of the water body's designated use(s), each water body is assigned to an assessment unit that defines the length of the reach assessed and is placed into one of five assessment categories as per EPA guidance. These categories are summarized below in Table 1.

Table 1

Assessment Categories	Definitions of Categories
Category 1	Attaining all uses
Category 2	Attaining some uses but there is insufficient data to determine if remaining designated uses are met
Category 3	Insufficient data to determine whether any designated uses are met
Category 4	Not attaining a use but a TMDL is not needed
4A	- TMDL has been completed
4B	- other required control measures will result in attainment of WQS
4C	- impairment or threat not caused by a pollutant
Category 5	Not attaining a use and a TMDL is needed

Where data and information of appropriate quality and quantity indicate non-attainment of a designated use or uses and a Total Maximum Daily Load (TMDL) is needed for an assessed water body (Category 5), the water body pollutant combination will be placed on Mississippi's 2018 §303(d) List of Impaired Water Bodies.

Data Quality and Assessment Window

MDEQ's ability to make meaningful and scientifically defensible statements about the overall water quality of a water body depends directly on the rigor and quality under which the water quality data are collected, analyzed, and reported. In order to ensure consistent and accurate decision-making for water quality assessments, MDEQ maintains a strong commitment to using only high quality data that are accompanied by acceptable quality assurance (QA) information that meet the established minimum data requirements. The selection of minimum data requirements for water quality assessment is intended to ensure that the most accurate water quality conditions are portrayed and to help minimize the probability of making an erroneous assessment. Data generated by MDEQ, other agencies, and individuals should also be of the quality necessary to make credible and realistic assessment decisions on the condition of the state's waters. Whenever possible, data need to be of the highest quality and developed using sampling and analytical protocols and standard operating procedures (SOPs) recognized by state and EPA quality assurance program plans (QAPPs). As such, no data will be assessed for the §305(b)/§303(d) process without supporting quality assurance documentation.

In most cases, MDEQ will use the most recent five years of readily available data. This data includes MDEQ and Non-MDEQ generated data. For the 2018 §305(b) Report, the data window is 2012-2016. According to EPA guidance, data more than five years old may be used on a case-by-case basis if the data are considered representative of present water quality conditions.

2018 CALM USE SUPPORT DETERMINATION GUIDELINES

MDEQ will utilize the following guidelines for data quality, data quantity, and data assessment for data used in the 2018 §305(b) assessment and §303(d) listing process. These guidelines apply, as appropriate, to rivers, streams, lakes, estuaries, and coastal waters.

AQUATIC LIFE USE SUPPORT (ALUS)

The aquatic life designated use is indicative of healthy aquatic life for such organisms as fish, benthic macroinvertebrates, and periphyton (algae). Indicators appropriate for use in ALUS determinations include biological, chemical/physical, and toxicological data. Biological community surveys are preferred datasets for ALUS determinations as these data directly measure the overall biological or ecological condition of a water body by responding to the effects of multiple chemical and physical stressors and/or conditions and integrating these effects over time. MDEQ has compiled an extensive benthic database and employed rigorous scientific methodology in the development of the Mississippi Benthic Index of Stream Quality (M-BISQ), an Index of Biological Integrity (IBI) for Mississippi freshwater wadeable streams. Biological measures are direct, integrative, and compelling indicators of water quality and aquatic life use condition. For this reason, where water chemical data are limited but biological indicator data exist, MDEQ considers the biological information sufficient for assessing aquatic life use and will weigh that information appropriately. When sufficient quantity of each type of data exist, all data will be considered. Use of M-BISQ is appropriate in freshwater wadeable streams statewide with the exception of the Mississippi Alluvial Plain (Mississippi Delta) streams.

Biological Community Data (Benthic Macroinvertebrates)

Data Quantity:

1. Minimum of one benthic macroinvertebrate community (i.e., bottom-dwelling aquatic insects, worms, clams, etc.) survey within the applicable §305(b) reporting period.

2. Sample collection methods, lab processing, taxonomy and enumeration methods are compatible with MDEQ SOPs used to develop the Mississippi Benthic Index of Stream Quality (M-BISQ), and meet programmatic measurement quality objectives (MQO).

Assessment Methodology:

MDEQ developed the M-BISQ to provide the state with a sound scientific methodology for accurately monitoring and assessing the overall ecological condition of most of the state's wadeable streams (streams in the Mississippi Alluvial Plain are not presently included) using benthic macroinvertebrates. The detailed assessment methodology based on M-BISQ for Aquatic Life Use Support and used for the 2018 §303(d) list is found in Appendix A.

Water Chemistry

Only data for physical/chemical parameters for which Mississippi has adopted numeric water quality criteria in Mississippi's WQS will be used for making a water body §305(b) use support determination and/or a §303(d) listing. Other parameters for which numeric criteria have not been adopted (e.g., nutrients, turbidity/suspended solids, chlorophyll-a) will be shown as impairment causes if there is an identified association with exceedances of a parameter for which the state has a numeric criterion (e.g., elevated nutrients causing excursions of the dissolved oxygen criterion). Where data indicate only a slight variation from a criterion, the magnitude of the variation, as well as other site-specific natural influences (e.g., low pH in geographic regions with natural acidic soils and blackwater streams, extended drought conditions) will be taken into consideration. Professional judgment by MDEQ monitoring and data assessment staff will be incorporated into the use support determination process in these cases. Furthermore, no monitoring location will be assessed as not attaining water quality standards based on the results of a single chemical sample WQS violation. This is due to the possibility of an anomalous environmental event. In addition, no water body will be assessed as attaining ALUS using a set of water chemistry data that does not include dissolved oxygen (DO) data, a critical piece of environmental information for ALUS in the absence of biological community data.

Dissolved Oxygen (DO)

Mississippi's DO criteria are based on daily arithmetic (i.e., 24-hour) averages and an instantaneous minimum as defined in the state's water quality standards. In Mississippi streams, the minimum DO concentration is generally observed during the environmentally critical condition, which is near sunrise in the summer/fall or low-flow, warm-weather index period. Consequently, 24-hour or diel monitoring, conducted manually or using automated in-situ dataloggers or sondes, is the preferred means of data collection for dissolved oxygen in order to make a meaningful assessment. MDEQ realizes that the majority of ambient monitoring DO data are often collected instantaneously in the late morning to the early afternoon hours, from 10:00 a.m. to 2:00 p.m. Therefore, in the absence of diel monitoring data, MDEQ will compare DO data to the instantaneous minimum criterion of 4.0 mg/L when the data requirements (as outlined below) are achieved.

DO Data Quantity:

1. **Daily Average Measurements (diel monitoring):**
   A. A minimum of 3 sampling events distributed over a 2-year period within the §305(b) data window collected during the environmentally critical condition generally occurring during the summer/fall index period from June through October.
   B. A minimum of 24 consecutive hours of measurements per event. For events in excess of 24-hours, the time frame for the sampling event begins with the first quality-assured measurement taken after deployment of the data sonde.
   C. Each 24-hour sampling event should at a minimum be spaced 1 week apart. With the use of in-situ dataloggers or sondes, a minimum sampling interval of 1 measurement per hour is required. If monitoring is conducted manually, 1 measurement every 4 hours is the required minimum sampling interval.
   D. Measurements should include collection at the appropriate sample depth as specified for dissolved oxygen in 11 Miss. Admin. Code Pt. 6, R. 2.2, B of the state's WQS.

2. **Instantaneous Minimum:** Instantaneous measurements of DO will be considered for use support determinations as follows:
   A. Minimum of 10 data points within the assessment window.
   B. Measurements should include collection at the appropriate sample depth as specified for dissolved oxygen in 11 Miss. Admin. Code Pt. 6, R. 2.2, B of the state's WQS.

Assessment Methodology:

Daily Average: When assessing diel dissolved oxygen data against the daily average criterion, assessments for dissolved oxygen will be made as follows:

Not Attaining:

A daily average of less than 5.0 mg/L is observed in more than 10% of the 24-hour sampling events, where 10% exceedance is determined using a binomial distribution test with 90% confidence ($\alpha = 0.1$) where there are a minimum of 8 sampling events, described with the associated table in Appendix B. In order to use the binomial approach to determine 10% exceedance of the applicable criteria, a minimum of 8 sampling events is required. In situations where there are less than 8 diel sampling events, non-attainment will be indicated by a daily average of less than 5.0 mg/L in greater than 10% of the sampling events.

Instantaneous: In cases where only instantaneous DO data are collected during the critical condition, the instantaneous criterion of 4.0 mg/L will be used and assessments for dissolved oxygen will be made as follows:

Not Attaining:

Instantaneous criterion exceeded in more than 10% of the samples, where 10% exceedance is determined using a binomial distribution test ($\alpha = 0.1$), described with the associated table in Appendix B. In addition, when an exceedance of the instantaneous criterion is observed during the non-critical time of day and a second exceedance is observed at a minimum of one week later, the monitoring location may be assessed as not attaining. The magnitude of the exceedance, as well as other site-specific natural influences (e.g., low DO in estuaries and naturally stratified waters), will be taken into consideration and professional judgment applied in making use support determinations.

Note: Where a site-specific criterion exists, that criterion will be used for assessment.

Conventional Chemical Data Other Than DO

Some conventional parameters (e.g., temperature, pH, total dissolved solids, specific conductance, and chlorides) listed in the state's water quality standards do not have daily average criteria. These parameters may be measured instantaneously, but are often measured along with DO using automated equipment capable of recording diel measurements for extended periods of time. The assessment guidelines given below will be used for determining use support.

Data Quantity:

1. **Diel Measurements:**
   A. A minimum of 3 sampling events over a 2-year period within the §305(b) data window collected during the environmentally critical condition for the parameter of concern.
   B. A minimum of 24 consecutive hours of measurements per event. For events in excess of 24-hours, the time frame for the sampling event begins with the first quality-assured measurement taken after deployment.
   C. Each 24-hour sampling event should at a minimum be spaced 1 week apart. With the use of in-situ dataloggers or sondes, a minimum sampling interval of 1 measurement per hour is required. If monitoring is conducted manually, 1 measurement every 4 hours is the required minimum sampling interval.
   D. Measurements should include collection at the appropriate sample depth as specified for temperature in 11 Miss. Admin. Code Pt. 6, R. 2.2, E. of the state's WQS.

2. **Instantaneous Measurements:**
   A. Minimum of 10 total data points within an assessment window.
   B. Measurements should include collection at the appropriate sample depth as specified for temperature in 11 Miss. Admin. Code Pt. 6, R. 2.2, E. of the state's WQS document.

Assessment Methodology:

When assessing data for temperature, pH, TDS, specific conductance, and chlorides, use support will be assigned as follows:

Not Attaining:

Instantaneous criterion exceeded in more than 10% of the samples, where 10% exceedance is determined using a binomial distribution test ($\alpha = 0.1$), described with the associated table in Appendix B. In addition, the magnitude of the exceedance, as well as other site-specific natural influences (e.g., low pH in naturally acidic waters, high conductivity in tidally affected freshwater streams), will be taken into consideration and professional judgment applied in making use support determinations.

Toxicants (including Ammonia)

During most routine ambient monitoring, water column toxicants are measured using screening level (i.e., "unclean") sampling and analytical techniques. These data will not be used to make use support determinations for §305(b) assessments or §303(d) decisions. However, these data will be reviewed as part of the §305(b) process. When concentrations above the state's water quality criteria are observed, follow-up sampling will be scheduled utilizing "clean" sampling and analytical procedures or techniques. Data for toxicants will be assessed against acute criteria (i.e., one-hour average concentration) when single grab samples are taken using "clean" techniques. Data for toxicants collected in a manner suitable for a computation of an average 4-day chronic concentration (minimum of one sample every hour for four consecutive days) using "clean" techniques will be assessed against the chronic standard. Data for toxicants will be assessed when data requirements (as outlined below) are achieved.

Data Quantity:

1. Minimum of 10 data points within a three-year period within the §305(b) data window collected using clean techniques.

Assessment Methodology:

Assessments will be made as follows:

Not Attaining:

More than 10% exceedance of the toxic acute/chronic criteria, where 10% exceedance is determined using a binomial distribution test ($\alpha = 0.1$), described with the associated table in Appendix B.

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It should be noted that monitoring for most toxicants (i.e., metals and organics) is costly because "clean" techniques are required to derive accurate results. In these cases, data sets will likely never exceed 10 samples. Also, due to the costly nature of "clean" samples, it is normal protocol to suspend sampling efforts once 2 violations of appropriate WQS are observed.

RECREATION USE SUPPORT

The recreation use is intended for the protection of waters suitable for recreational purposes including primary water contact activities such as swimming and water skiing as well as secondary incidental water contact activities such as wading, fishing, and boating. State waters classified for primary contact recreation status are specifically designated in the state's WQS. Waters not specifically designated as such are considered secondary contact waters. Indicators appropriate for use in recreation use support determination include fecal coliform, enterococci, and E. coli bacteria. Enterococcus is the bacteriological indicator for assessment of coastal recreational waters including bathing beaches. Fecal coliform is the bacteriological indicator that the state has adopted to assess recreation use for inland waters.

Enterococci Bacteria (Marine Water)

Data Quantity:

1. A minimum of 4 sampling events distributed over a 2-year period within the §305(b) data window.
2. A sampling event consists of a minimum of 20 samples distributed over a 6 month sampling period with each sample spaced at least 12 hours apart.
3. In each year, a minimum of 1 sampling event will be taken in each of the contact and non-contact recreational seasons defined in the state's WQS.

Assessment Methodology:

When assessing sites with more than two years of enterococci data, greater weight may be given to more recent sampling events during the data window. Assessments for Primary Contact Recreation or Secondary Contact Recreation will be assigned as follows:

Not Attaining:

If the geometric mean criterion for the water's applicable recreation classification as given in the state's water quality standards is exceeded in greater than 10% of the 6-month sampling events (based on a minimum of 20 samples per event), where 10% exceedance is determined using a binomial distribution test ($\alpha = 0.1$), described with the associated table in Appendix B. In order to use the binomial approach to determine 10% exceedance of the applicable criteria, a minimum of 8 sampling events is required. In situations where there is less than 8 sampling events, non-attainment will be indicated where the criterion is exceeded in greater than 25% of the sampling events.

Fecal Coliform Bacteria (Fresh Water)

Data Quantity:

1. A minimum of 4 sampling events distributed over a 2-year period within the §305(b) data window.
2. A sampling event consists of a minimum of 5 samples distributed over a 30-day sampling period with each sample spaced at least 12 hours apart.
3. In each year, a minimum of 1 sampling event will be taken in each of the contact and non-contact recreational seasons defined in the state's WQS.

Assessment Methodology:

When assessing sites with more than two years of fecal coliform data, greater weight may be given to more recent sampling events during the 5-year data window. Assessments for Primary Contact Recreation or Secondary Contact Recreation will be assigned as follows:

Not Attaining:

If the geometric mean criterion for the water's applicable recreation classification as given in the state's water quality standards is exceeded in greater than 10% of the 30-day sampling events; or, if monitoring data indicate that the instantaneous criterion for fecal coliform is exceeded in more that 10% of the 30-day sampling events (based on a minimum of 5 samples), where 10% exceedance is determined using a binomial distribution test ($\alpha = 0.1$), described with the associated table in Appendix B. In order to use the binomial approach to determine 10% exceedance of the applicable criteria, a minimum of 8 sampling events is required. In situations where there is less than 8 sampling events, non-attainment will be indicated where the criterion is exceeded in greater than 25% of the sampling events.

FISH CONSUMPTION USE SUPPORT

The fish consumption designated use is intended to provide for the protection of human health from fish tissue obtained for human consumption. Indicators appropriate for fish consumption use support determinations include the actual levels of bioaccumulative chemicals in fish tissue.

For the 2018 §305(b), the only assessment rendered will be that for non-attainment of the fish consumption use. This assessment will be based on the existence of a fish consumption advisory that is supported by water body specific fish tissue monitoring. These advisories are issued by MDEQ and the Mississippi Department of Health after consultation with the Mississippi Fish Advisory Task Force made up of representatives from several state agencies. Water bodies that have fish consumption advisories (i.e., restricted or no consumption advisories), based on actual data for the specific water body, will be assessed as not attaining the Fish Consumption Use Support designation.

SHELLFISH CONSUMPTION USE SUPPORT

The shellfish consumption designated use is applicable to coastal estuarine waters in Mississippi specifically identified for shellfish harvesting in the state's WQS. This use is intended to provide for the safe propagation and harvesting of shellfish for human consumption. The National Shellfish Sanitation Program (NSSP) determines these classifications. The Mississippi Department of Marine Resources administers this program for Mississippi coastal waters. Indicators appropriate for shellfish consumption use support determinations include the actual levels of pollutants in shellfish tissue and ambient waters.

Attainment of the Shellfish Harvesting Use is primarily assessed based on the Shellfish Classification system as defined under the NSSP and is supported by actual bacteria (fecal coliform) data for the water bodies being assessed. Waters classified as approved or conditionally approved and open at least 75% of the season, will be assessed as attaining the shellfish consumption use. Waters classified as restricted or prohibited will be assessed as non-attaining. However, if a water body classified for shellfishing is restricted and/or prohibited solely because of its geographic location (i.e., proximity to a shoreline or a permitted NPDES wastewater discharge point) and no data are available, the water body will not be assessed. Currently, MDEQ has developed TMDLs for all waters classified for the Shellfish Harvesting Use.

DRINKING WATER SUPPLY USE

The drinking water supply designated use is applicable to surface waters in Mississippi specifically identified under the Public Water Supply classification in the state's WQS. This use is intended to provide for a safe source of raw water supply for drinking and food processing purposes. Indicators appropriate for use in drinking water supply use determination include chemical data. Chemical parameters as specifically denoted in the state's WQS document will be utilized for assessment. Data quantity and assessment methodology will follow the same requirements as for those parameters identified under **Conventional Chemical Data Other Than DO.**

Datasets Not Meeting Minimum Quantity/Quality Requirements:

All data and information collection activities may not meet the quality, quantity, and sampling frequency requirements described in this document. Nevertheless, these data and information collection activities have value in assessing water quality and MDEQ will consider these data in the §305(b) assessment process. Datasets of this type are screened using a determination of percent exceedances of water quality thresholds and WQS using the same process established for data that meet CALM requirements. This is followed by a case-by-case review and use of professional judgment to determine if the limited datasets adequately represent existing water quality conditions.

These limited datasets and information that do not meet the CALM requirements stated in this methodology will only be used for a §303(d) listing decision when the following conditions are met:

1. Those data demonstrate compelling evidence (CE) of the water quality and,

2. The data are supported by data quality documentation and MDEQ determines that the data is scientifically defensible after conducting a review of the quality assurance procedures used by the data generator.

Monitoring sites identified as potentially impaired or potentially supporting but with less evidence and/or a lack of data quality documentation are considered insufficient data for §305(b) assessment and §303(d) listing. However, these data are not dismissed. In order to confirm the water quality condition, the water body is assigned to a monitoring or watch list where it can be scheduled for future monitoring by MDEQ through its Surface Water Monitoring Strategy implementation.

APPENDIX A

Mississippi Benthic Index of Stream Quality (M-BISQ) Assessment Methodology for Aquatic Life Use Support (ALUS)

Background

For a detailed discussion of the M-BISQ development effort see Development and Application of the Mississippi Benthic Index of Stream Quality (M-BISQ) (MDEQ, 2003) and Evaluation and Recalibration of the Mississippi Benthic Index of Stream Quality (MBISQ), (MDEQ, 2008) and The Mississippi-Benthic Index of Stream Quality (MBISQ): Recalibration and Testing (MDEQ 2016). For the 2018 assessment, M-BISQ scores determined from biological samples collected from 2012-2016 will be used to make ALUS assessments. M-BISQ scores for biological data collected within the assessment window will be compared to bioregions and metrics as determined by the recalibration of the M-BISQ. The assessment threshold for each calibration set remains the 25^{th} percentile of the least disturbed sites for the appropriate bioregion.

Least Disturbed Condition (i.e.,"reference"):

The "least disturbed" sites within each bioregion are considered as a comparison set for that bioregion. The numeric M-BISQ scores for each bioregion's comparison set make up a distribution from which a statistical reference point reflects the concept of "least disturbed" or "best attainable" conditions. The 25^{th} percentile of the M-BISQ score distribution for each bioregional comparison set (Figure 1) is used as the reference point or threshold of attainment. The 25^{th} percentile is considered to approximate the desired reference condition and thus serves as a threshold of attainment of ALUS. This threshold of ALUS attainment for each bioregion is used for comparing biological data collected from wadeable streams in each respective bioregion. It is also considered to capture and reflect the inherent certainty, and uncertainty, of the measurement process. To allow for comparison to the ALUS attainment threshold, the biological data from each wadeable site sampled are combined to calculate the final multi-metric index score (M-BISQ) for each site. The relationship of the final score to the attainment threshold of the appropriate bioregion determines the assessment status for the site. A detailed explanation of the 2018 §305(b) listing process is given below in the Assessment Guidelines Section.

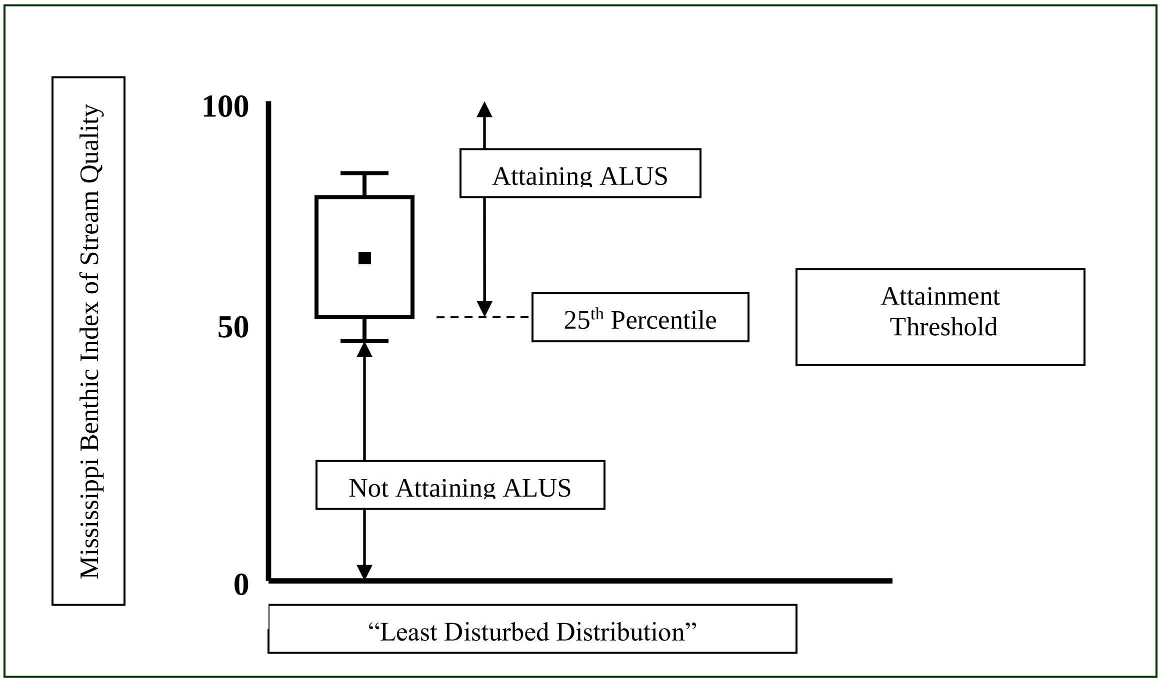

Figure 1. Sample M-BISQ Score Distribution for a Bioregional Comparison Set

<u>M-BISQ Assessment Guidelines for the 2018 §305(b) Assessment Process</u>

1. Streams with initial (first time monitored) M-BISQ site scores at or above the attainment threshold (25th percentile) score of the comparison set, for their respective bioregion, will be considered as ***attaining*** ALUS.

2. Streams with initial (first time monitored) M-BISQ site scores below the minimum score of the comparison set, for their respective bioregion, will be considered ***not attaining*** ALUS caused by biological impairment.

3. For streams having two or more M-BISQ scores, each score will be taken into account when making water quality assessment and listing decisions. Before using multiple IBI scores from a given site, the following conditions will be considered:

   - Each M-BISQ score was developed according to M-BISQ methodology and is QA-approved,
   - Each M-BISQ score was obtained within the applicable data window for the §305(b) reporting period,
   - Environmental conditions (climatic and flow) were considered representative of the site for both M-BISQ sampling events.

When these conditions are met and scores are within 20 points of each other, the two scores will be averaged. Only scores developed within the same calibration dataset will be averaged. Based on this average score, the site will be assessed as follows:

- If the average score falls below the 25^{th} percentile of the comparison set, the site will be assessed as ***not attaining*** ALUS with the assessment cause of biological impairment.
- If the average score falls at or above the 25^{th} percentile of the comparison set, the site will be assessed as ***attaining*** ALUS.

4. If the individual M-BISQ scores of the sampling events at the same sampling location are substantially different (> 20 points), the difference will be investigated. The significant difference in scores may indicate that site conditions changed or that one of the scores may not be representative of the ambient condition (i.e. an anomalous event). In these cases, additional data review for the two sampling events will be performed to evaluate possible reasons that account for the large variability and to determine which, if either, of the two scores is more representative of current water quality conditions at the site. Based on this evaluation, the following conditions will apply in using these scores for assessments:

- If the reason for the discrepancy in scores cannot be determined, the most recent score will be used and assessments made by using the 25^{th} percentile of the comparison set.
- If the reason for the discrepancy in scores is determined, the score most representative of current site specific water quality conditions will be used and assessments made using the 25^{th} percentile of the comparison set.

APPENDIX B

Use of the Binomial Test for Evaluating 10% Exceedance:

The sample proportion of exceedance of the criterion for a specific pollutant is an estimate of the true exceedance probability of that pollutant. Given the random variability in estimating a true exceedance probability, as for the estimate of any parameter, there is uncertainty in the estimated sample proportion of exceedance. The degree of this uncertainty is a function of sample size and the number of exceedances. The fewer samples taken, the more uncertainty there is in the sample estimate of the true exceedance probability. MDEQ has chosen to consider this uncertainty when making determinations with regards to evaluating the sample proportion of exceedances of criteria. MDEQ will use a nonparametric hypothesis testing approach based on the binomial distribution.

A pollutant concentration can be converted into a simple binomial where a single observation either exceeds (1) or does not exceed (0) a criterion. The actual distribution is unknown, but by using the number of measured exceedances and the total number of samples, the unknown distribution can be converted into a binomial distribution that depends only on the sample size and the true exceedance probability (p). One can then use a simple hypothesis test about the sample, with the target exceedance (e.g., 10%) used as the true exceedance probability to test the hypothesis of "whether the sample exceedance probability is significantly larger than the assumed target exceedance probability". The null hypothesis (H_o) in such a case is that the sample exceedance probability (p) is less than or equal to the target (e.g., 10% or 0.1):

H_o: $p \leq 0.1$,

and the water body is unimpaired, versus the alternative (H_a):

H_a: $p > 0.1$,

and the waterbody is impaired.

This test is performed by comparing the observed percent exceedances (x) to a binomial probability table. For example, for sample size of 10 (N), the probability of observing 2 or less exceedances in a population with a true exceedance probability of 10% or less (p = 0.l) is 0.9298 and of observing 3 or more is 0.0702. That is, one is pretty confident (93%) that a sample of 10 observations will have 2 or less exceedances observed. Note that this is true even though the observed percent exceedance is 20% (2/10). A 20% exceedance percentage is not significantly larger than the assumed 10% exceedance probability at 7% level of significance (93% confidence). Therefore, to be 95% confident in rejecting the null hypothesis, one would need to observe more than 2 exceedances in a sample of 10. However, for the same test, to be 90% confident in rejecting the null hypothesis, one would conclude that more than 1 exceedance in a sample of 10 would constitute a 10% exceedance, since 93% exceeds 90%. The decision about confidence is a policy decision that must weigh the risks of type I error (falsely rejecting the null hypothesis) against the type II error (falsely accepting the null hypothesis). Small sample sizes can carry a significant risk of committing type II errors.

Using many software packages, one can quickly calculate the number of exceedances needed to list an impaired waterbody as exceeding any target frequency of exceedance for any confidence level. The Microsoft Excel function CRITBINOM(N, *p*, 1-α) can be used to estimate the maximum number of exceedances (x) out of N observations or trials that meets the target probability (p) for a specific type I error rate (α) or confidence level (1- α). This function, therefore, provides the critical value for testing the null hypothesis above at a (100α) % level of significance, where p and α are selected by MDEQ. The number of exceedances that is one greater than this value represents, therefore, the minimum number of exceedances that violate the exceedance probability. Table B-1 lists these exceedance values for $\alpha = 0.1$for $p = 10\%$ exceedance probability. These critical values (the number of exceedances that indicate greater than 10% exceedance with 90% confidence) will be used to assess against the 10% exceedance frequencies as described in the CALM process listed above for different sample sizes. Critical values for sample sizes above those listed here will be calculated using the CRITBINOM function listed above in Microsoft Excel. In order to use the binomial approach to determine 10% exceedance of the applicable criteria, a minimum of 8 sampling events is required.

Table B-1 provides the number of exceedances (x) for a given sample size (N) where one can conclude with 90% confidence ($\alpha = 0.1$) that percent exceedances is significantly greater than $p = 0.1$ (10%).

N	x	N	x	N	x	N	x	N	x
1	2	41	8	81	13	121	17	161	22
2	2	42	8	82	13	122	18	162	22
3	2	43	8	83	13	123	18	163	22
4	2	44	8	84	13	124	18	164	22
5	2	45	8	85	13	125	18	165	23
6	3	46	8	86	13	126	18	166	23
7	3	47	8	87	13	127	18	167	23
8	3	48	9	88	13	128	18	168	23
9	3	49	9	89	14	129	18	169	23
10	3	50	9	90	14	130	18	170	23
11	3	51	9	91	14	131	19	171	23
12	4	52	9	92	14	132	19	172	23
13	4	53	9	93	14	133	19	173	23
14	4	54	9	94	14	134	19	174	24
15	4	55	9	95	14	135	19	175	24
16	4	56	10	96	14	136	19	176	24
17	4	57	10	97	15	137	19	177	24
18	4	58	10	98	15	138	19	178	24
19	5	59	10	99	15	139	20	179	24
20	5	60	10	100	15	140	20	180	24
21	5	61	10	101	15	141	20	181	24
22	5	62	10	102	15	142	20	182	24
23	5	63	10	103	15	143	20	183	25
24	5	64	11	104	15	144	20	184	25
25	5	65	11	105	16	145	20	185	25
26	6	66	11	106	16	146	20	186	25
27	6	67	11	107	16	147	20	187	25
28	6	68	11	108	16	148	21	188	25
29	6	69	11	109	16	149	21	189	25
30	6	70	11	110	16	150	21	190	25
31	6	71	11	111	16	151	21	191	25
32	6	72	12	112	16	152	21	192	26
33	7	73	12	113	16	153	21	193	26
34	7	74	12	114	17	154	21	194	26
35	7	75	12	115	17	155	21	195	26
36	7	76	12	116	17	156	21	196	26
37	7	77	12	117	17	157	22	197	26
38	7	78	12	118	17	158	22	198	26
39	7	79	12	119	17	159	22	199	26
40	7	80	13	120	17	160	22	200	27

APPENDIX C

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