

Missouri Clean Water Commission Meeting
Department of Natural Resources
Lewis and Clark State Office Building
LaCharrette/Nightingale Creek Conference Rooms
1101 Riverside Drive
Jefferson City, Missouri

April 6, 2016

Proposed 2018 Listing Methodology Document

Issue: The proposed 2018 Listing Methodology Document (LMD) describes how the department will use water quality data to determine if waters of the state are impaired. Department staff meet with stakeholders and other interested members of the public approximately every two years to revise this document as needed. The document presented, when approved by the commission, will be the basis for the development of the 2018 Section 303(d) List.

Background: The department has a public participation process for revision of the LMD that runs concurrently with the public notice for the 303(d) List. All comments received on the proposed 2018 LMD are documented as either meeting minutes from public meetings, through letter, or through email correspondence.

During the public comment period for the draft 2018 LMD, the department held two public availability meetings to discuss the draft document. These meetings were held on November 3, 2015 and December 1, 2015. A list of attendees and a summary of the meetings are posted on the department's website at the link below. A public hearing on the draft 2018 LMD was held on January 6, 2016. In addition, the department held a Biological Assessment Workgroup meeting on November 18, 2015 to discuss the document in greater detail.

Public Comments: The department received and responded to four (4) written comments on the draft 2018 LMD. Comments were received from the Association of Missouri Clearwater Agencies, city of Springfield, the Environmental Protection Agency, and Newman, Comley & Ruth, P.C. All public comments, along with the department's responses, are provided here and are also available on the departments website

(<http://dnr.mo.gov/env/wpp/waterquality/303d/303d.htm>).

As a result of the comments, additional updates to the draft 2018 LMD are recommended. These updates were made using track changes within the attached document, which is also available on the department's website (see previous web link).

Changes from the 2016 LMD

There were several major updates from the 2016 LMD approved by the Commission in July 2014. As mentioned during the January 6, 2016 hearing, the proposed 2018 LMD incorporates revisions related to reformatting and consolidation of information, along with clarifying statements or information relating to biological assessments, and minor corrections to tables. Additional updates were made as a result of discussions from the Biological Assessment Workgroup meeting and public comments. Those updates are summarized below.

- Page 17; Additional wording was added to Data Code Three to include additional information for the minimum number of studies needed for aquatic assemblages.
- Page 18; Under the Weight of Evidence Approach. Missing wording that was previously included in the approved 2016 LMD was added back to the proposed 2018 LMD. Also, additional wording of examples of other relevant environmental data might include “physical and chemical” data.
- Page 19; Under Aquatic Macroinvertebrate Community Data. Clarification was added to state the department conducts aquatic macroinvertebrate assessments.
- Page 21; A map of Missouri’s Ecological Drainage Units and Biological Reference Locations was added.
- Page 28; Item 8. Examples of migration barriers were included.
- Page 47; Protection of Aquatic Life, dissolved oxygen. An additional statement was added to the note column to clarify only continuous (e.g. sonde) data with a quality rating of excellent or good will be used for assessments.
- Page 48; Protection of Aquatic Life use for Toxic Chemicals. The explanation of how hardness based metals would be assessed was moved to the note column.
- Page 53; Protection of Aquatic Life; Biological Aquatic Macroinvertebrates sampled by DNR Protocol. For clarification, reference to Table I of the Water Quality Standards was added.

Recommended Action: The department recommends the Commission approve the proposed 2018 Listing Methodology Document with the recommended changes.

Suggested Motion Language: None

List of Attachments:

- Proposed 2018 303(d) Listing Methodology Document. Additions from the 2016 LMD are shown in track changes and comment boxes.
- Summaries of Public Availability and Biological Workgroup Meeting discussions on the draft 2018 LMD.
- Summary of Public Comments and Department Responses on the draft 2018 LMD.

**Methodology for the Development
of the
2018 Section 303(d) List in Missouri**

Missouri Department of Natural Resources
Division of Environmental Quality
Water Protection Program



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I. Citation and Requirements

A. Citation of Section of Clean Water Act

The Missouri Department of Natural Resources (MDNR) is responsible for the implementation and administration of the Federal Clean Water Act in Missouri. Pursuant to Section 40 CFR 130.7, States, Territories or authorized Tribes must submit biennially to the United States Environmental Protection Agency (EPA) a list of water quality limited (impaired) segments, pollutants causing impairment, and the priority ranking of waters targeted for Total Maximum Daily Load (TMDL) development. Federal regulation at 40 CFR 130.7 also requires States, Territories, and authorized Tribes to submit to EPA a written methodology document describing the State's approach in considering, and evaluating existing readily available data used to develop their 303(d) list of impaired water bodies. The listing methodology must be submitted to the EPA each year the Section 303(d) list is due. While EPA does not approve or disapprove the listing methodology, the agency considers the methodology during its review of the states 303(d) impaired waters list and the determination to list or not to list waters.

Following the Missouri Clean Water Commission approval, Section 303(d) is submitted to EPA. This fulfills Missouri's biennial submission requirements of an integrated report required under Sections 303(d), 305(b) and 314 of the Clean Water Act. In years when no integrated report is submitted, the department submits a copy of its statewide water quality assessment database to EPA.

B. U.S. EPA Guidance

In 2001 the Office of General Counsel and the Office of Wetlands, Oceans, and Watersheds developed a recommended framework to assist EPA regions in the preparation of their approval letters for the States' 2002 Section 303(d) list submissions. This was to provide consistency in making approval decisions along with guidance for integrating the development and submission of the 2002 Section 305(b) water quality reports and Section 303(d) list of impaired waters¹.

The following sections provide an overview of EPA Integrated Report guidance documents from calendar year 2002 through 2015.

The 2002 Integrated Water Quality Monitoring and Assessment Report Guidance was the first document EPA provided to the States, Territories, and authorized Tribes with directions on how to integrate the development and submission of the 2002 305(b) water quality reports and Section 303(d) list of impaired waters.

The guidance recommended that States, Territories and authorized Tribes submit a combined integrated report that would satisfy the Clean Water Act requirements for both Section 305(b) water quality reports and Section 303(d) list. The 2002 Integrated Report was to include:

¹ Additional information can be obtained from EPA's website:
<http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/guidance.cfm>.

- Delineation of water quality assessment units based on the National Hydrography Dataset (NHD);
- Status of and progress toward achieving comprehensive assessments of all waters;
- Water quality standard attainment status for every assessment unit;
- Basis for the water quality standard attainment determinations for every assessment unit;
- Additional monitoring that may be needed to determine water quality standard attainment status and, if necessary, to support development of total maximum daily loads (TMDLs) for each pollutant/assessment unit combination;
- Schedules for additional monitoring planned for assessment units;
- Pollutant/assessment unit combinations still requiring TMDLs; and
- TMDL development schedules reflecting the priority ranking of each pollutant/assessment unit combination.

The 2002 EPA guidance described the requirements under Section 303(d) of the Clean Water Act where states were required to describe the methodology used to develop their 303(d) list. EPA's guidance recommended the states provide: (1) a description of the methodology used to develop Section 303(d) list; (2) a description of the data and information used to identify impaired and threatened waters; (3) a rationale for not using any readily available data and information; and (4) information on how interstate or international disagreements concerning the list are resolved. Lastly (5), it is recommended that "prior to submission of its Integrated Report, each state should provide the public the opportunity to review and comment on the methodology." In accordance with EPA guidance, the department reviews and updates the Listing Methodology Document (LMD) every two years. The LMD is made available to the public for review and comment at the same time the state's 303(d) impaired waters list is published for public comment. Following the public comment period, the department responds to public comments and provides EPA with a document summarizing all comments received.

In July 2003, EPA issued new guidance entitled "Guidance for 2004 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d) and 305(b) of the Clean Water Act." This guidance gave further recommendations about listing of 303(d) and other waters.

In July 2005, EPA published an amended version entitled "Guidance for 2006 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d), 305(b) and 314 of the Clean Water Act" (see Appendix A for Excerpt).

In October 2006, EPA issued a memorandum entitled "Information Concerning 2008 Clean Water Act Sections 303(d), 305(b) and 314 Integrated Reporting and Listing Decisions." This memorandum serves as EPA's guidance for the 2008 reporting cycle and beyond. This guidance recommended the use of a five-part categorization scheme and that each state provides a comprehensive description of the water quality standards attainment status of all segments within a state (reference Table 1 below). The guidance also defined a "segment" as being used synonymous with the term "assessment unit" used in previous Integrated Report Guidance. Overall, the selected segmentation approach should be consistent with the state's water quality standards and be capable of providing a spatial scale that is adequate to characterize the water quality standards attainment status for the segment.

It was in the 2006 guidance that EPA recommended all waters of the state be placed in one of five categories described below.

Table 1. Placement of Waters within the Five Categories in the 2006² EPA Assessment, Listing and Reporting Guidance

<p><u>Category 1</u></p>	<p>All designated uses are fully maintained. Data or other information supporting full use attainment for all designated uses must be consistent with the state’s Listing Methodology Document (LMD). The department will place a water in Category 1 if the following conditions are met:</p> <ul style="list-style-type: none"> • The water has physical and chemical data (at a minimum, water temperature, pH, dissolved oxygen, ammonia, total cobalt, and total copper for streams, and total nitrogen, total phosphorus and secchi depth for lakes) and biological water quality data (at a minimum, <i>E. coli</i> or fecal coliform bacteria) that indicates attainment with water quality standards. • The level of mercury in fish fillets or plugs used for human consumption is 0.3 mg/kg or less. Only samples of higher trophic level species (largemouth, smallmouth and spotted bass, sauger, walleye, northern pike, trout (rainbow and trout), striped bass, white bass, flathead catfish and blue catfish) will be used. • The water is not rated as “threatened.”
<p><u>Category 2</u></p>	<p>One or more designated uses are fully attained but at least one designated use has inadequate data or information to make a use attainment decision consistent with the state’s LMD. The department will place a water in Category 2 if at least one of the following conditions are met:</p> <ul style="list-style-type: none"> • There is inadequate data for water temperature, pH, dissolved oxygen, ammonia, total cobalt or total copper in streams to assess attainment with water quality standards or inadequate data for total nitrogen, total phosphorus or secchi depth in lakes. • There is inadequate <i>E. coli</i> or fecal coliform bacteria data to assess attainment of the whole body contact recreational use. • There are insufficient fish fillet tissue, or plug data available for mercury to assess attainment of the fish consumption use. <p>Category 2 waters will be placed in one of two sub-categories.</p> <p>Category 2A: Waters will be placed in this category if available data, using best professional judgement, suggests compliance with numerical water quality criteria of Tables A or B in Missouri’s Water Quality Standards (10 CSR 20-7.031) or other quantitative thresholds for determining use attainment.</p>

² <http://www.epa.gov/sites/production/files/2015-10/documents/2006irg-report.pdf>

	<p>Category 2B: Waters will be placed in this category if the available data, using best professional judgment, suggests noncompliance with numeric water quality criteria of Tables A or B in Missouri's Water Quality Standards, or other quantitative thresholds for determining use attainment, and these data are insufficient to support a statistical test or to qualify as representative data. Category 2B waters will be given high priority for additional water quality monitoring.</p>
<p><u>Category 3</u></p>	<p>Water quality data are not adequate to assess any of the designated beneficial uses consistent with the LMD. The department will place a water in Category 3 if data are insufficient to support a statistical test or to qualify as representative data to assess any of the designated uses. Category 3 waters will be placed in one of two sub-categories.</p> <p>Category 3A. Waters will be placed in this category if available data, using best professional judgment, suggests compliance with numerical water quality criteria of Tables A or B in Missouri's Water Quality Standards (10 CSR 20-7.031) or other quantitative thresholds for determining use attainment. Category 3A waters will be tagged for additional water quality monitoring, but will be given lower priority than Category 3B waters.</p> <p>Category 3B. Waters will be placed in this category if the available data, using best professional judgment, suggest noncompliance with numerical water quality criteria of Tables A or B in Missouri's Water Quality Standards or other quantitative thresholds for determining use attainment. Category 3B waters will be given high priority for additional water quality monitoring.</p>
<p><u>Category 4</u></p>	<p>State water quality standards or other criteria, as per the requirements of Appendix B & C of this document, are not attained, but a Total Maximum Daily Load (TMDL) study is not required. Category 4 waters will be placed in one of three sub-categories.</p> <p>Category 4A. EPA has approved a TMDL study that addresses the impairment. The department will place a water in Category 4A if both the following conditions are met:</p> <ul style="list-style-type: none"> • Any portion of the water is rated as being in non-attainment with state water quality standards or other criteria as explained in

	<p>Appendix B & C of this document due to one or more discrete pollutants or discrete properties of the water³, and</p> <ul style="list-style-type: none"> • EPA has approved a TMDL for all pollutants that are causing non-attainment. <p>Category 4B. Water pollution controls required by a local, state or federal authority, are expected to correct the impairment in a reasonable period of time. The department will place a water in Category 4B if both of the following conditions are met:</p> <ul style="list-style-type: none"> • Any portion of the water is rated as being in non-attainment with state water quality standards or other criteria as explained in Appendix B & C of this document due to one or more discrete pollutants or discrete properties of water², and • A water quality based permit that addresses the pollutant(s) causing the designated use, impairment has been issued, and compliance with the permit limits will eliminate the impairment; or other pollution control requirements have been made that are expected to adequately address the pollutant(s) causing the impairment. This may include implemented voluntary watershed control plans as noted in EPA's guidance document. <p>Category 4C. Any portion of the water is rated as being in non-attainment with state water quality standards or other criteria as explained in Appendix B & C of this document, and a discrete pollutant(s) or other discrete property of the water² does not cause the impairment. Discrete pollutants may include specific chemical elements (e.g., lead, zinc), chemical compounds (e.g., ammonia, dieldrin, atrazine) or one of the following quantifiable physical, biological or bacteriological conditions: water temperature, percent of gas saturation, amount of dissolved oxygen, pH, deposited sediment, toxicity or counts of fecal coliform or <i>E. coli</i> bacteria.</p>
<p><u>Category 5</u></p>	<p>At least one discrete pollutant has caused non-attainment with state water quality standards or other criteria as explained in Appendix B & C of this document, and the water does not meet the qualifications for listing as either Categories 4A or 4B. Category 5 waters are those that are candidates for the state's 303(d) List⁴.</p> <p>If a designated use is not supported and the segment is impaired or threatened, the fact that a specific pollutant is not known does not provide a basis for excluding a segment from Category 5.</p>

³ A discrete pollutant or a discrete property of water is defined here as a specific chemical or other attribute of the water (such as temperature, dissolved oxygen or pH) that causes beneficial use impairment and that can be measured quantitatively.

⁴ The proposed state 303(d) List is determined by the Missouri Clean Water Commission and the final list is determined by the U.S. Environmental Protection Agency.

	<p>Category 5. These segments must be listed as Category 5 unless the state can demonstrate that no discrete pollutant(s) causes or contributes to the impairment. Pollutants causing the impairment will be identified through the 303(d) assessment and listing process before a TMDL study is written. The TMDL should be written within the time frame preferred in EPA guidance for TMDL development, when it fits within the state's TMDL prioritization scheme.</p> <p>Category 5-alt. A water body assigned to 5-alt is an impaired water without a completed TMDL but assigned a low priority for TMDL development because an alternative restoration approach is being pursued. This also provides transparency to the public that a state is pursuing restoration activities in those waters to achieve water quality standards. The addition of this sub-category will facilitate tracking alternative restoration approaches in 303(d) listed waters in priority areas.</p>
<p><u>Threatened Waters</u></p>	<p>When a water is currently attaining all designated uses, but the data shows an inverse (time) trend in quality for one or more discrete water quality pollutants indicating the water will not continue to meet these uses before the next listing cycle. Such water will be considered "threatened." A threatened water will be treated as an impaired water and placed in the appropriate Category (4A, 4B, or 5).</p>

In subsequent years, EPA has provided additional guidance, but only limited new supplemental information has been provided since the 2008 cycle.

In August 2015, the EPA provided draft guidance that would include a Category 5-alternative (5-alt) (reference Table 1 above). Additional information can be found at EPA's website: <http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/guidance.cfm>.

II. The Methodology Document

A. Procedures and Methods Used to Collect Water Quality Data

- Department Monitoring

The major purposes of the department's water quality monitoring program are to:

- characterize background or reference water quality conditions;
- better understand daily, flow event and seasonal water quality variations and their underlying processes;
- characterize aquatic biological communities;
- assess trends in water quality;
- characterize local and regional effects of point and nonpoint sources pollutants on water quality;
- check for compliance with water quality standards and/or wastewater permit limits;
- support development of strategies, including Total Maximum Daily Loads, to return impaired waters to compliance with Water Quality Standards. All of these objectives are statewide in scope.

- Coordination with Other Monitoring Efforts in Missouri

To maximize efficiency, the department routinely coordinates its monitoring activities with other agencies to avoid overlap, and to give and receive feedback on monitoring design. Data from other sources are used for meeting the same objectives as department-sponsored monitoring. The data must fit the criteria described in the data quality considerations section of this document. The agencies most often involved are the U.S. Geological Survey, the U.S. Army Corps of Engineers, EPA, the Missouri Department of Conservation (MDC), and the Missouri Department of Health and Senior Services. The Department of Natural Resources also tracks the monitoring efforts of the National Park Service; the U.S. Forest Service; several of the state's larger cities; the states of Oklahoma, Arkansas, Kansas, Iowa, and Illinois; and graduate level research conducted at universities within Missouri. For those wastewater discharges where the department has required instream water quality monitoring, the department may also use monitoring data acquired by wastewater dischargers as a condition of discharge permits issued by the department. In 1995, the department also began using data collected by volunteers that have passed Volunteer Water Quality Monitoring Program Quality Assurance/Quality Control tests.

- Existing Monitoring Networks and Programs

The following is a list and a brief description of the kinds of water quality monitoring activities presently occurring in Missouri.

1. Fixed Station Network

- a) Objective: To better characterize background or reference water quality conditions, to better understand daily, flow events, and seasonal water quality variations and their underlying processes, to assess trends and to check for compliance with water quality standards.
- b) Design Methodology: Sites are chosen based on one of the following criteria:
 - Site is believed to have water quality representative of many neighboring streams of similar size due to similarity in watershed geology, hydrology and land use, and the absence of any impact from a significant point or discrete nonpoint water pollution source.
 - Site is downstream of a significant point source or discrete nonpoint source area.
- c) Number of Sites, Sampling Methods, Sampling Frequency, and Parameters:
 - MDNR/U.S. Geological Survey cooperative network: approximately 70 sites statewide, horizontally and vertically integrated grab samples, four to twelve times per year. Samples are analyzed for major ions (e.g. calcium, magnesium, sulfate, and chloride), nutrients (e.g. phosphorus and nitrogen), temperature, pH, dissolved oxygen, specific conductance, bacteria (e.g. *Escherichia coli* (*E. coli*) and fecal coliform) and flow on all visits, two to four times annually for suspended solids and heavy metals, and for pesticides six times annually at four sites.
 - MDNR/University of Missouri-Columbia's lake monitoring network. This program has monitored about 249 lakes since 1989. About 75 lakes are monitored each year. Each lake is usually sampled four times during the summer and about 12 are monitored spring through fall for nutrients, chlorophyll, turbidity and suspended solids.
 - Department routine monitoring of finished public drinking water supplies for bacteria and trace contaminants.
 - Routine bacterial monitoring for *E. coli* of swimming beaches at Missouri's state parks during the recreational season by the department's Missouri State Parks.
 - Monitoring of sediment quality by the department at approximately 10-12 discretionary sites annually. Sites are monitored for several heavy metals (e.g. arsenic, cadmium, copper, lead, mercury, nickel, zinc, etc.) and/or organic contaminants (e.g. polycyclic aromatic hydrocarbons, etc.).

2. Special Water Quality Studies

- a) Objective: Special water quality studies are used to characterize water quality effects from a specific pollutant source area.

- b) **Design Methodology:** These studies are designed to verify and measure the contaminants of concern based on previous water quality studies, effluent sampling and/or Missouri State Operating Permit applications. These studies employ multiple sampling stations downstream and upstream (if appropriate). If contaminants of concern have significant seasonal or daily variation, the sampling design must account for such variation.
- c) **Number of Sites, Sampling Methods, Sampling Frequency and Parameters:** The department conducts or contracts up to 10 to 15 special studies annually, as funding allows. Each study has multiple sampling sites. The number of sites, sampling frequency and parameters all vary greatly depending on the study. Intensive studies would also require multiple samples per site over a relatively short time frame.

3. Toxics Monitoring Program

The fixed station network and many of the department's intensive studies monitor for acute and chronic toxic chemicals⁵. In addition, major municipal and industrial dischargers must monitor for acute and chronic toxicity in their effluents as a condition of their Missouri State Operating Permit.

4. Biological Monitoring Program

- a) **Objectives:** The objectives of the Biological Monitoring programs are to develop numeric criteria describing "reference" aquatic macroinvertebrate and fish communities in Missouri's streams, to implement these criteria within state water quality standards and to maintain a statewide fish and aquatic macroinvertebrate monitoring program.
- b) **Design Methodology:** Development of biocriteria for fish and aquatic macroinvertebrates⁶ involves identification of reference streams in each of Missouri's aquatic ecoregions and 17 ecological drainage units, respectively. It also includes intensive sampling of invertebrate and fish communities to quantify temporal and spatial variation in reference streams within ecoregions and variation among ecoregions, and the sampling of chemically and physically impaired streams to test sensitivity of various community metrics to differences in stream quality.
- c) **Number of Sites, Sampling Methods, Sampling Frequency and Parameters:** The department has conducted biological sampling of aquatic macroinvertebrates for many years. Since 1991, the department's aquatic macroinvertebrate monitoring program has consisted of standardized monitoring of approximately 45 to 55 sites twice annually. In addition, the MDC presently has a statewide fish and aquatic macroinvertebrate monitoring program, the Resource Assessment and Monitoring (RAM) Program, designed monitor and assess the health of Missouri's stream resources on a rotating basis. This program samples a minimum of 450 random and 30 reference sites every five years.

⁵ As defined in 10 CSR 20-7.031(1)

⁶ For additional information visit: <http://dnr.mo.gov/env/esp/wqm/biologicalassessments.htm>

5. Fish Tissue Monitoring Program

- a) Objective: Fish tissue monitoring addresses two objectives: (1) the assessment of ecological health or the health of aquatic biota (usually accomplished by monitoring whole fish samples); and (2) the assessment of human health risk based on the level of contamination of fish tissue plugs, or fillets.
- b) Design Methodology: Fish tissue monitoring sites are chosen based on one of the following criteria:
- Site is believed to have water and sediment quality representative of many neighboring streams or lakes of similar size due to similarity in geology, hydrology and land use, and the absence of any known impact from a significant point source or discrete nonpoint water pollution source.
 - Site is downstream of a significant point source or discrete nonpoint source area.
 - Site has shown fish tissue contamination in the past.
- c) Number of Sites, Sampling Methods, Sampling Frequency and Parameters:

The department plans to maintain a fish tissue monitoring program to collect whole fish composite samples⁷ at approximately 13 fixed sites. In previous years, this was a cooperative effort between EPA and the department through EPA's Regional Ambient Fish Tissue (RAFT) Monitoring Program. Each site will be sampled once every two years. The preferred species for these sites are either Common Carp (*Cyprinus carpio*) or one of the Redhorse (a.k.a. sucker) species (*Moxostoma* sp.).

The department, EPA, and MDC also sample 40 to 50 discretionary sites annually for two fish fillet composite samples or fish tissue plug samples (mercury only) from fish of similar size and species. One sample is of a top carnivore such as Largemouth Bass (*Micropterus salmoides*), Smallmouth Bass (*Micropterus dolomieu*), Walleye (*Sander vitreum*), or Sauger (*Zander lucioperca*). The other sample is for a species of a lower trophic level such as catfish, Common Carp or sucker species (Catostomidae). This program occasionally samples fish eggs for certain fish species at selected locations. Both of these monitoring programs analyze for several chlorinated hydrocarbon insecticides, PCBs, lead, cadmium, mercury, and fat content.

6. Volunteer Monitoring Program

Two major volunteer monitoring programs generate water quality data in Missouri. The data generated from these programs are used for statewide 305(b) reporting on general water quality health, used as a screening level tool to determine where additional monitoring is needed, or used to supplement other water quality data for watershed planning purposes.

- Lakes of Missouri Volunteer Program⁸. This cooperative program consists of persons from the department, the University of Missouri-Columbia, and volunteers who monitor

⁷ A composite sample is one in which several individual fish are combined to produce one sample.

⁸ For additional program information visit: <http://www.lmvp.org/>

approximately 137 sites on 66 lakes, including Lake Taneycomo, Table Rock Lake and several lakes in the Kansas City area. Lake volunteers are trained to collect samples for total phosphorus, total nitrogen, chlorophyll and inorganic suspended sediments. Data from this program is used by the university as part of a long-term study on the limnology of mid-western reservoirs.

- **Volunteer Water Quality Monitoring Program.** The Volunteer Water Quality Monitoring Program⁹ is an activity of the Missouri Stream Team Program, which is a cooperative project sponsored by the department, the Missouri Department of Conservation, and the Conservation Federation of Missouri. The program involves volunteers who monitor water quality of streams throughout Missouri. There are currently over 5,000 Stream Teams and more than 3,600 trained water quality monitors. Approximately 80,000 citizens are served each year through the program. Since the beginning of the Stream Team program, 494,232 volunteers have donated about 2 million hours valued at more than \$38 million to the State of Missouri.

After the Introductory class, many attend at least one more class of higher level training: Levels 1, 2, 3 and 4. Each level of training is a prerequisite for the next higher level, as is appropriate data submission. Data generated by Levels 2, 3, and 4 and the new Cooperative Site Investigation (CSI) Program volunteers represent increasingly higher quality assurance. For CSI projects, the volunteers have completed a quality assurance/quality control workshop, completed field evaluation, and/or have been trained to collect samples following department protocols. Upon completing Introductory and Level 1 and 2 training, volunteers will have received the basic level training to conduct visual stream surveys, stream discharge measurements, biological monitoring, and collect physical and chemical measurements for pH, conductivity, dissolved oxygen, nitrate, phosphate, and turbidity.

Of those completing an Introductory course, about 35 percent proceed to Levels 1 and 2. To date, 104 volunteers have reached Level 3 and six volunteers have reached Level 4. The CSI Program uses trained volunteers to collect samples and transport them to laboratories approved by the department. Volunteers and department staff work together to develop a monitoring plan. Currently there are 39 volunteers qualified to work in the CSI Program. All Level 2, 3, and 4 volunteers, as well as all CSI trained volunteers, are required to attend a validation session every 3 years to ensure equipment, reagents and methods meet program standards. To date 106 individuals have attended a validation session at least once.

- Identification of All Existing and Readily Available Water Quality Data Sources

Data Solicitation Request

⁹ For additional program information visit: <http://dnr.mo.gov/env/wpp/VWQM.htm>

In calendar year 2014, the department sent out a request for all available water quality data (chemical and biological). The data solicitation requested water quality data for approximately a two year timeframe prior to the current listing year. The data solicitation request was sent to multiple agencies, neighboring states, and organizations. In addition, and as part of the data solicitation process, the department queries available water quality data from national databases such as EPA's Storage and Retrieval (STORET)/Water Quality Exchange (WQX) data warehouse¹⁰, and the USGS Water Quality Portal¹¹.

The data must be spatially and temporally representative of the actual annual ambient conditions of the water body. Sample locations should be characteristic and representative of the main water mass or distinct hydrologic areas. With the exception of the data collected for those designated uses that require seasonally based data (e.g., whole body contact recreation, biological community data, and critical season dissolved oxygen), data should be distributed over at least three seasons, over two years, and should not be biased toward specific conditions (such as runoff, season, or hydrologic conditions).

Data meeting the following criteria will be accepted.

- Samples must be collected and analyzed under a Quality Assurance/Quality Control (QA/QC) protocol that follows the EPA requirements for quality assurance project plans.
- Samples must be analyzed following protocols that are consistent with the EPA or Standard Method procedures.
- All data submitted must be accompanied by a copy of the organization's QA/QC protocol and standard operating procedures.
- All data must be reported in standard units as recommended in the relevant approved methods.
- All data must be accompanied by precise sample location(s), preferably in either decimal degrees or Universal Transverse Mercator (UTM).
- All data must be received in a Microsoft Excel or compatible format.
- All data must have been collected within the requested period of record.

All readily available and acceptable data are uploaded into the department's Water Quality Assessment Database¹², where the data undergoes quality control checks prior to 303(d) or 305(b) assessment processes.

- Laboratory Analytical Support

Laboratories used:

- Department/U.S. Geological Survey Cooperative Fixed Station Network: U.S. Geological Survey Lab, Denver, Colorado

¹⁰ http://www.epa.gov/storet/dw_home.html

¹¹ <http://www.waterqualitydata.us/>

¹² http://dnr.mo.gov/mocwis_public/wqa/waterbodySearch.do

- Intensive Surveys: Varies, many are done by the department's Environmental Services Program
- Toxicity Testing of Effluents: Many commercial laboratories
- Biological Criteria for Aquatic Macroinvertebrates: department's Environmental Services Program and University of Missouri-Columbia
- Fish Tissue: EPA Region VII Laboratory, Kansas City, Kansas, and miscellaneous contract laboratories (Missouri Department of Conservation or U.S. Geological Survey's Columbia Environmental Research Center)
- Missouri State Operating Permit: Self-monitoring or commercial laboratories
- Department's Public Drinking Water Monitoring: department's Environmental Services Program and commercial laboratories¹³
- Other water quality studies: Many commercial laboratories

B. Sources of Water Quality Data

The following data sources are used by the department to aid in the compilation of the state's integrated report (previously the 305(b) report). Where quality assurance programs are deemed acceptable, additional sources would also be used to develop the state's Section 303(d) list. These sources presently include, but are not limited to:

1. Fixed station water quality and sediment data collected and analyzed by the department's Environmental Services Program personnel.
2. Fixed station water quality data collected by the U.S. Geological Survey under contractual agreements with the department.
3. Fixed station water quality data collected by the U.S. Geological Survey under contractual agreements to agencies or organizations other than the department.
4. Fixed station water quality, sediment quality, and aquatic biological information collected by the U.S. Geological Survey under their National Stream Quality Accounting Network and the National Water Quality Assessment Monitoring Programs.
5. Fixed station raw water quality data collected by the Kansas City Water Services Department, the St. Louis City Water Company, the Missouri American Water Company (formerly St. Louis County Water Company), Springfield City Utilities, and Springfield's Department of Public Works.
6. Fixed station water quality data collected by the U.S. Army Corps of Engineers. The Kansas City, St. Louis, and Little Rock Corps Districts have monitoring programs for Corps-operated reservoirs in Missouri.
7. Fixed station water quality data collected by the Arkansas Department of Environmental Quality, the Kansas Department of Health and Environment, the Iowa Department of Natural Resources, and the Illinois Environmental Protection Agency.
8. Fixed station water quality monitoring by corporations.

¹³ For additional information visit: <http://dnr.mo.gov/env/wpp/labs/>

9. Annual fish tissue monitoring programs by EPA/Department RAFT Monitoring Program and MDC.
10. Special water quality surveys conducted by the department. Most of these surveys are focused on the water quality impacts of specific point source wastewater discharges. Some surveys are of well-delimited nonpoint sources such as abandoned mined lands. These surveys often include physical habitat evaluation and monitoring of aquatic macroinvertebrates as well as water chemistry monitoring.
11. Special water quality surveys conducted by U.S. Geological Survey, including but not limited to:
 - a) Geology, hydrology and water quality of various hazardous waste sites,
 - b) Geology, hydrology and water quality of various abandoned mining areas,
 - c) Hydrology and water quality of urban nonpoint source runoff in metropolitan areas of Missouri (e.g. St. Louis, Kansas City, and Springfield), and
 - d) Bacterial and nutrient contamination of streams in southern Missouri.
12. Special water quality studies by other agencies such as MDC, the U.S. Public Health Service, and the Missouri Department of Health and Senior Services.
13. Monitoring of fish occurrence and distribution by MDC.
14. Fish Kill and Water Pollution Investigations Reports published by MDC.
15. Selected graduate research projects pertaining to water quality and/or aquatic biology.
16. Water quality, sediment, and aquatic biological data collected by the department, EPA or their contractors at hazardous waste sites in Missouri.
17. Self-monitoring of receiving streams by cities, sewer districts and industries, or contractors on their behalf, for those discharges that require this kind of monitoring. This monitoring includes chemical and sometimes toxicity monitoring of some of the larger wastewater discharges, particularly those that discharge to smaller streams and have the greatest potential to affect instream water quality.
18. Compliance monitoring of receiving waters by the department and EPA. This can include chemical and toxicity monitoring.
19. Bacterial monitoring of streams and lakes by county health departments, community lake associations, and other organizations using acceptable analytical methods.
20. Other monitoring activities done under a quality assurance project plan approved by the department.
21. Fixed station water quality and aquatic macroinvertebrate monitoring by volunteers who have successfully completed the Volunteer Water Quality Monitoring Program Level 2 workshop. Data collected by volunteers who have successfully completed a training Level 2 workshop is considered to be Data Code One. Data generated from Volunteer Training Levels 2, 3 and 4 are considered "screening" level data and can be useful in providing an indication of a water quality problem. For this reason, the data are eligible

for use in distinguishing between waters in Categories 2A and 2B or Categories 3A and 3B. Most of this data are not used to place waters in main Categories (1, 2, 3, 4, and 5) because analytical procedures do not use EPA or Standard Methods or other department approved methods. Data from volunteers who have not yet completed a Level 2 training workshop do not have sufficient quality assurance to be used for assessment. Data generated by volunteers while participating in the department's Cooperative Site Investigation Program (Section II C1) or other volunteer data that otherwise meets the quality assurance outlined in Section II C2 may be used in Section 303(d) assessment.

The following data sources (22-23) **cannot** be used to rate a water as impaired (Categories 4A, 4B, 4C or 5); however, these data sources may be used to direct additional monitoring that would allow a water quality assessment for Section 303(d) listing.

22. Fish Management Basin Plans published by MDC.
23. Fish Consumption Advisories published annually by the Missouri Department of Health and Senior Services. Note: the department may use data from data source listed as Number 9 above, to list individual waters as impaired due to contaminated fish tissue.

As previously stated, the department will review all data of acceptable quality that are submitted to the department prior to the first public notice of the draft 303(d) list. However, the department will reserve the right to review and use data of acceptable quality submitted after this date if the data results in a change to the assessment outcome of the water.

C. Data Quality Considerations

- DNR Quality Assurance/Quality Control Program

The department and EPA Region VII have completed a Quality Management Plan. All environmental data generated directly by the department, or through contracts funded by the department, or EPA require a Quality Assurance Project Plan¹⁴. The agency or organization responsible for collecting and/or analyzing environmental data must write and adhere to a Quality Assurance Project Plan approved through the department's Quality Management Plan. Any environmental data generated via a monitoring plan with a department approved Quality Assurance Project Plan are considered suitable for use in water quality assessment and the 303(d) listing. This includes data generated by volunteers participating in the department's CSI Program. Under this program, the department's Environmental Services Program will audit selected non-profit (governmental and university) laboratories. Laboratories that pass this audit will be approved for the CSI Program. Individual volunteers who collect field samples and deliver them to an approved laboratory must first successfully complete department training on how to properly collect and handle environmental samples. The types of information that will allow the department to make a judgment on the acceptability of a

¹⁴ For additional information visit: <http://www.epa.gov/quality/qapps.html>

quality assurance program are: (1) a description of the training, and work experience of the persons involved in the program, (2) a description of the field meters and maintenance and calibration procedures, (3) a description of sample collection and handling procedures, and (4) a description of all analytical methods used in the laboratory for analysis.

- Other Quality Assurance/Quality Control Programs

Data generated in the absence of a department-approved Quality Assurance Project Plan may be used to assess a water body if the department determines that the data are adequate after reviewing and accepting the quality assurance procedures plan used by the data generator. This review would include: (1) names of all persons involved in the monitoring program, their duties, and a description of their training and work related experience, (2) all written procedures, Standard Operating Procedures, or Quality Assurance Project Plans pertaining to this monitoring effort, (3) a description of all field methods used, brand names and model numbers of any equipment, and a description of calibration and maintenance procedures, and (4) a description of laboratory analytical methods. This review may also include an audit by the department's Environmental Services Program.

- Other Data Quality Considerations

Data Age. For assessing present conditions, more recent data are preferable; however, older data may be used to assess present conditions if the data remains representative of present conditions.

If the department uses data older than seven years to make a Section 303(d) list decision a written justification for the use of such data will be provided.

A second consideration is the age of the data relative to significant events that may have an effect on water quality. Data collected prior to the initiation, closure, or significant change in a wastewater discharge, or prior to a large spill event or the reclamation of a mining or hazardous waste site, for example, may not be representative of present conditions. Such data would not be used to assess present conditions even if it was less than seven years old. Such "pre-event" data can be used to determine changes in water quality before and after the event or to show water quality trends.

Data Type, Amount and Information Content. EPA recommends establishing a series of data codes, and rating data quality by the kind and amount of data present at a particular location (EPA 1997¹⁵). The codes are single-digit numbers from one to four, indicating the relative degree of assurance the user has in the value of a particular environmental data set. Data Code One indicates the least assurance or the least number of samples or

¹⁵ *Guidelines for the Preparation of the Comprehensive State Water Quality Assessments (305b) and Electronic Updates*, 1997. (<http://water.epa.gov/type/watersheds/monitoring/repguid.cfm>)

analytes and Data Code Four the greatest. Based on EPA's guidance, the department uses the following rules to assign code numbers to data.

- Data Code¹⁶ One: All data not meeting the requirements of the other data codes.
- Data Code Two: Chemical data collected quarterly to bimonthly for at least three years, or intensive studies that monitor several nearby sites repeatedly over short periods of time, or at least three composite or plug fish tissue samples per water body, or at least five bacterial samples collected during the recreational season of one calendar year.
- Data Code Three: Chemical data collected at least monthly for more than three years on a variety of water quality constituents including heavy metals and pesticides; or a minimum of one quantitative biological monitoring study of at least one aquatic assemblage (fish, macroinvertebrates, or algae) at multiple sites, multiple seasons (spring and fall), or multiple samples at a single site when data from that site is supported by biological monitoring at an appropriate control site.
- Data Code Four: Chemical data collected at least monthly for more than three years that provides data on a variety of water quality constituents including heavy metals and pesticides, and including chemical sampling of sediments and fish tissue; or a minimum of one quantitative biological monitoring study of at least two aquatic assemblages (fish, macroinvertebrates, or algae) at multiple sites.

In Missouri, the primary purpose of Data Code One data is to provide a rapid and inexpensive method of screening large numbers of waters for obvious water quality problems and to determine where more intensive monitoring is needed. In the preparation of the state's Integrated Report, data from all four data quality levels are used. Most of the data is of Data Code One quality, and without Data Code One data, the department would not be able to assess a majority of the state's waters.

In general, when selecting water bodies for the Missouri 303(d) List, only Data Code Two or higher are used, unless the problem can be accurately characterized by Data Code One data.¹⁷ The reason is that Data Code Two data provides a higher level of assurance that a Water Quality Standard is not actually being attained and that a TMDL study is necessary. All water bodies placed in Categories 2 or 3 receive high priority for additional monitoring so that data quality is upgraded to at least Data Code Two. Category 2B and 3B waters will be given higher priority than Categories 2A and 3A.

¹⁶ Data Code One is equivalent to data water quality assurance Level One in 10 CSR 20-7.050 General Methodology for Development of Impaired Waters List, subsection (2)(C), Data Code Two is equivalent to Level 2, etc.

¹⁷ When a listing, amendment or delisting of a 303(d) water is made with only Data Code One data, a document will be prepared that includes a display of all data and a presentation of all statistical tests or other evaluative techniques that documents the scientific defensibility of the data. This requirement applies to all Data Code One data identified in Appendix B of this document.

D. How Water Quality Data is Evaluated to Determine Whether or Not Waters are Impaired for 303(d) Listing Purposes

- Physical, Chemical, Biological and Toxicity Data

During each reporting cycle, the department and stakeholders review and revise the guidelines for determining water quality impairment. The guidelines shown in Appendix B & C provides the general rules of data use and assessment and Appendix D provides details about the specific analytical procedure used. In addition, if trend analysis indicates that presently unimpaired waters will become impaired prior to the next listing cycle, these “threatened waters” will be judged as impaired. Where antidegradation provisions in Missouri’s Water Quality Standards apply, those provisions shall be upheld. The numerical criteria included in Appendix B have been adopted into the state water quality standards, 10 CSR 20-7.031, and are used, as described in Appendix B to make use attainment decisions.

- Weight of Evidence Approach

When evaluating narrative criteria described in the state water quality standards, 10 CSR 20-7.031, the department will use a weight of evidence analysis for assessing numerical translators that have not been adopted into state water quality standards (see Appendix C). Under the weight of evidence approach, all available information is examined and the greatest weight is given to data providing the “best supporting evidence” for an attainment decision. Determination of “best supporting evidence” will be made using best professional judgment, considering factors such as data quality, and site-specific environmental conditions. For those analytes with numeric thresholds, the threshold values given in Appendix C will trigger a weight of evidence analysis to determine the existence or likelihood of a use impairment and the appropriateness of proposing a 303(d) listing based on narrative criteria. This weight of evidence analysis will include the use of other types of environmental data when it is available or collection of additional data to make the most informed use attainment decision. Examples of other relevant environmental data might include physical or chemical data, biological data on fish [Fish Index of Biotic Integrity (fIBI)] or aquatic macroinvertebrate [Macroinvertebrate Stream Condition Index (MSCI)] scores, fish tissue, or toxicity testing of water or sediments.

Biological data will be given greater weight in a weight of evidence analysis for making attainment decisions for aquatic life use and subsequent Section 303(d) listings. Whether or not numeric translators of biological criteria are met is a strong indicator for the attainment of aquatic life use. Moreover, the department retains a high degree of confidence in an attainment decision based on biological data that is representative of water quality condition.

When the weight of evidence analysis suggests, but does not provide strong scientifically valid evidence of impairment, the department will place the water body in question in Categories 2B or 3B. The department will produce a document showing all relevant data

and the rationale for the attainment decision. All such documents will be available to the public at the time of the first public notice of the proposed 303(d) list. A final recommendation on the listing of a water body based on narrative criteria will only be made after full consideration of all comments on the proposed list.

- Biological Data

Methods for assessing biological data typically receive considerable attention during the public comment period of development of the Listing Methodology Document. Currently, a defined set of biocriteria are used to evaluate biological data for assessing compliance with water quality standards. These biological criteria contain numeric thresholds, that when exceeded relative to prescribed assessment methods, serve as a basis for identifying candidate waters for Section 303(d) listing. Biocriteria are based on three types of biological data, including: (1) aquatic macroinvertebrate community data; (2) fish community data; and, (3) a catch-all class referred to as “other biological data.”

In general, for interpretation of macroinvertebrate data where habitat assessment scores indicate habitat is less than 75 percent of reference or appropriate control stream scores, and in the absence of other data indicating impairment by a discrete pollutant, a water body judged to be impaired will be placed in Category 4C. When interpreting fish community data, a provisional multi-metric habitat index called the QCPH1 index is used to identify stream habitat in poor condition. The QCPH1 index separates adequate habitat from poor habitat using a 0.39 threshold value; whereby, QCPH1 scores < 0.39 indicate stream habitat is of poor quality, and scores greater than 0.39 indicate available stream habitat is adequate. In the absence of other data indicating impairment by a discrete pollutant, impaired fish communities with poor habitat will be placed in Category 4C. Additional information about QCPH1 is provided in the *Considerations for the Influence of Habitat Quality and Sample Representativeness* section.

The sections below describe the methods used to evaluate the three types of biological data (macroinvertebrate community, fish community, and other biological data), along with background information on the development and scoring of biological criteria, procedures for assessing biological data, methods used to ensure sample representativeness, and additional information used to aid in assessing biological data such as the weight of evidence approach.

Aquatic Macroinvertebrate Community Data

The department conducts aquatic macroinvertebrate assessments to determine macroinvertebrate community health as a function of water quality and habitat. The health of a macroinvertebrate community is directly related to water quality and habitat. Almost all macroinvertebrate evaluation consists of comparing the health of the community of the “target” to healthy macroinvertebrate communities from reference streams of the same general size and usually in the same Ecological Drainage Unit (EDU).

The department's approach to monitoring and evaluating aquatic macroinvertebrates is largely based on *Biological Criteria for Wadeable/Perennial Streams of Missouri* (MDNR 2002). This document provides the framework for numerical biological criteria (biocriteria) relevant to the protection of aquatic life use for wadeable streams in the state. Biocriteria were developed using wadeable reference streams that occur in specific EDUs as mapped by the Missouri Resource Assessment Partnership (reference Figure 1 below). For macroinvertebrates, the numerical biocriterion translator is expressed as a multiple metric index referred to as the MSCI. The MSCI includes four metrics: Taxa Richness (TR); Ephemeroptera, Plecoptera, and Trichoptera Taxa (EPTT); Biotic Index (BI); and the Shannon Diversity Index (SDI). These metrics are considered indicators of stream health, and change predictably in response to the environmental condition of a stream.

Metric values are determined directly from macroinvertebrate sampling. To calculate the MSCI, each metric is normalized to unitless values of 5, 3, or 1, which are then added together for a total possible score of 20. MSCI scores are divided into three levels of stream condition:

- Fully Biologically Supporting (16-20),
- Partially Biologically Supporting (10-14), and
- Non-Biologically Supporting (4-8).

Partially and Non-Biologically Supporting streams may be considered impaired and are candidates for Section 303(d) listing.

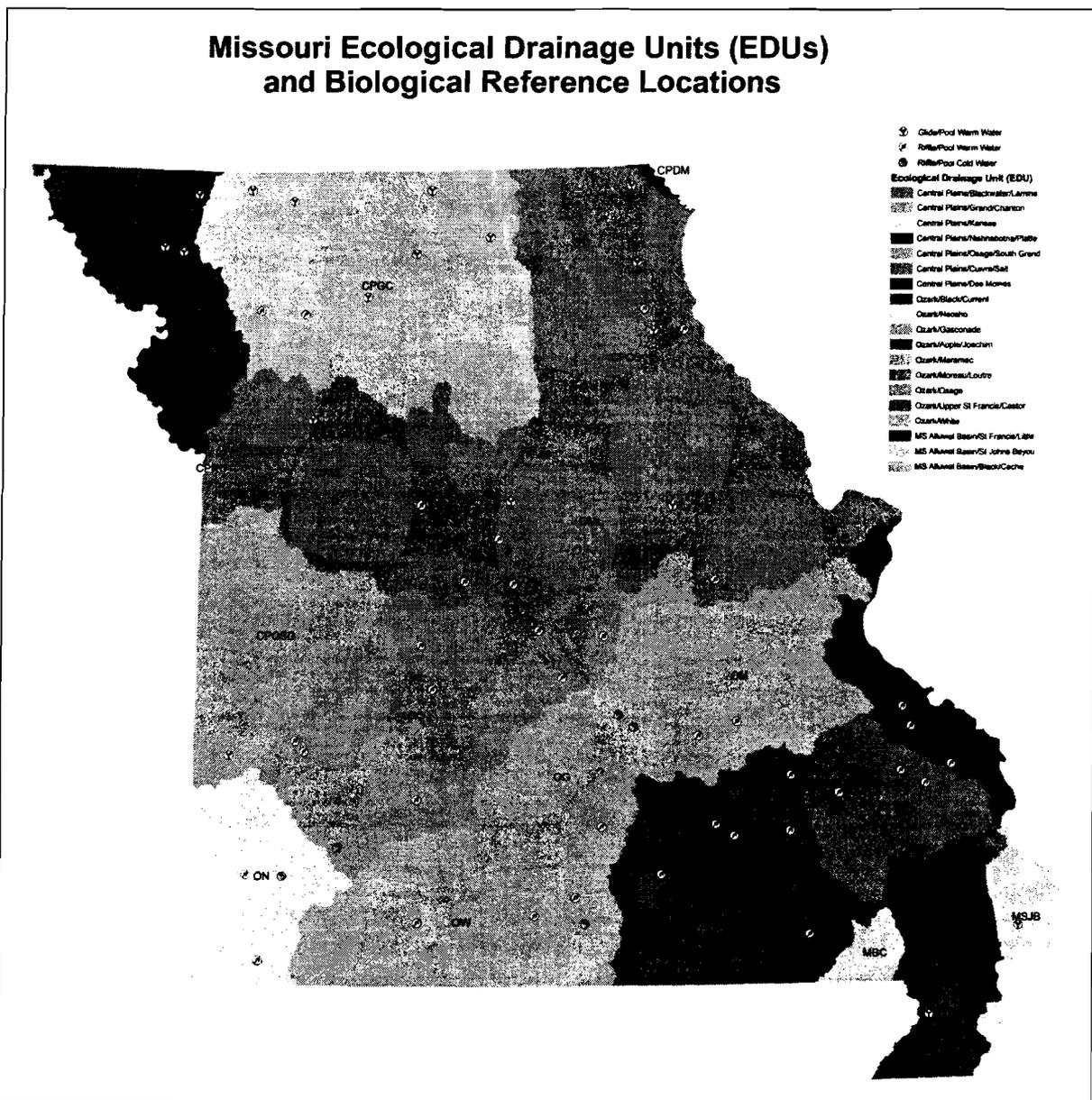


Figure 1: Missouri Ecological Drainage Units (EDUs) and Biological Reference Locations

Unitless metric values (5, 3, or 1) were developed from the lower quartile of the distribution of each metric as calculated from reference streams for each EDU. The lower quartile (25th percentile) of each metric equates to the minimum value still representative of unimpaired conditions. In operational assessments, metric values below the lower quartile of reference conditions are typically judged as impaired (United States Environmental Protection Agency 1996, Ohio Environmental Protection Agency 1990, Barbour *et al.* 1996). Moreover, using the 25th percentile of reference conditions for each metric as a standard for impairment allows natural variability to be filtered out. For metrics with values that decrease with increasing impairment (TR, EPTT, SDI), any value above the lower quartile of the reference distribution receives a score of five. For

the BI, whose value increases with increasing impairment, any value below the upper quartile (75th percentile) of the reference distribution receives a score of five. The remainder of each metric's potential quartile range below the lower quartile is bisected, and scored either a three or a one. If the metric value is less than or equal to the quartile value and greater than the bisection value it is scored a three. If the metric value is less than or equal to the bisection value it is scored a one.

MSCI scores meeting data quality considerations may be assessed for the protection of aquatic life using the following procedures.

Determining Full Attainment of Aquatic Life Use:

- For seven or fewer samples, 75% of the MSCI scores must be 16 or greater. Fauna achieving these scores are considered to be very similar to biocriteria reference streams.
- For eight or more samples, results must be statistically similar to representative reference or control streams.

Determining Non-Attainment of Aquatic Life Use:

- For seven or fewer samples, 75% of the MSCI scores must be 14 or lower. Fauna achieving these scores are considered to be substantially different from biocriteria reference streams.
- For eight or more samples, results must be statistically dissimilar to representative reference or control streams.

Data will be judged inconclusive when outcomes do not meet requirements for decisions of full or non-attainment.

As noted, when eight or more samples are available, results must be statistically similar or dissimilar to reference or control conditions in order to make an attainment decision. To accomplish this, a binomial probability with an appropriate level of significance (α =alpha), is calculated based on the null hypothesis that the test stream would have a similar percentage of MSCI scores that are 16 or greater as reference streams. The significance level is set at $\alpha=0.1$, meaning if the p-value of the hypothesis test is less than α , the hypothesis is considered statistically significant. The significance level of α is in fact the probability of making a wrong decision and committing a Type I error (rejecting a true null hypothesis). When the Type I error rate is less than $\alpha=0.1$, the null hypothesis is rejected. Inversely, when the Type I error rate is greater than $\alpha=0.1$, the null hypothesis is accepted. For comparing samples from a test stream to samples collected from reference streams in the same EDU, the percentage of samples from reference streams scoring 16 or greater is used to determine the probability of "success" and "failure" in the binomial probability equation. For example, if 84% of the reference stream MSCI scores in a particular EDU are 16 or greater, then 0.84 would be used as the probability of success and 0.16 would be used as the probability of failure. Note that Appendix D states to "rate a stream as impaired if biological criteria reference

stream frequency of fully biologically supporting scores is greater than five percent more than the test stream,” thus, a value of 0.79 (0.84 - 0.05) would actually be used as the probability of success in the binomial distribution equation.

Binomial Probability Example:

Reference streams from the Ozark/Gasconade EDU classified as riffle/pool stream types with warm water temperature regimes produce fully biologically supporting streams 85.7% of the time. In the test stream of interest, six out of ten samples resulted in MSCI scores of 16 or more. Calculate the Type I error rate for the probability of getting six or fewer fully biologically supporting scores in ten samples.

The binomial probability formula may be summarized as:

$$p^n + (n!/ X!(n-X)! * p^n q^{n-x}) = 1$$

Where,

Sample Size (n) = 10

Number of Successes (X) = 6

Probability of Success (p) = 0.857 - 0.05 = 0.807

Probability of Failure (q) = 0.193

Binomial Distribution Coefficients = n!/ X!(n-X)!

The equation may then be written as:

$$= 1 - ((0.807^{10}) + ((10*(0.807^9)*(0.193))) + ((45*(0.807^8)*(0.193^2)) + ((120*(0.807^7) * (0.193^3)))$$

$$= 0.109$$

Since 0.109 is greater than the test significance level (minimum allowable Type I error rate) of $\alpha=0.1$, we accept the null hypothesis that the test stream has the same percent of fully biologically supporting scores as the same type of reference streams from the Ozark/Gasconade EDU. Thus, this test stream would be judged as unimpaired.

If under the same scenario, there were only 5 samples from the test stream with MSCI scores of 16 or greater, the Type I error rate would change to 0.028, and since this value is less than the significance level of $\alpha=0.1$, the stream would be judged as impaired.

Within each EDU, MSCI scores are categorized by sampling regime (Glide/Pool vs. Riffle/Pool) and temperature regime (warm water vs. cold water). The percentage of fully biologically supporting scores for the Mississippi River Alluvial Basin/Black/Cache EDU is not available due to the lack of reference sites in this region. Percentages of fully

biologically supporting samples per EDU is not included here, but can be made available upon request. The percentage of reference streams per EDU that are fully biologically supporting may change periodically as additional macroinvertebrate samples are collected and processed from reference samples within an EDU.

Sample Representativeness

The departments field and laboratory methods used to collect and process macroinvertebrate samples are contained in the document *Semi-Quantitative Macroinvertebrate Stream Bioassessment* (MDNR 2012a). Macroinvertebrates are identified to levels following standard operating procedures contained in *Taxonomic Levels for Macroinvertebrate Identifications* (MDNR 2012b). Macroinvertebrate monitoring is accompanied by physical habitat evaluations as described in the document *Stream Habitat Assessment* (MDNR 2010). For the assessment of macroinvertebrate samples, available information must meet data code levels three and four as described in Section II.C of this LMD. Data coded as levels three and four represent environmental data providing the greatest degree of assurance. Thus, at a minimum, macroinvertebrate assessments include multiple samples from a single site, or samples from multiple sites within a single reach.

It is important to avoid situations where poor or inadequate habitat prohibits macroinvertebrate communities from being assessed as fully biologically supporting. Therefore, when assessing macroinvertebrate samples, the quality of available habitat must be similar to that of reference streams within the appropriate EDU. The department's policy for addressing this concern has been to exclude MSCI scores from an assessment when accompanying habitat scores are less than 75 percent of the mean habitat scores from reference streams of the appropriate EDU. The following procedures outline the department's method for assessing macroinvertebrate communities from sites with poor or inadequate habitat.

Assessing Macroinvertebrate Communities from Poor/Inadequate Habitat:

- If less than half the macroinvertebrate samples in an assessed stream segment have habitat scores less than 75 percent of the mean score for reference streams in that EDU, any sample that scores less than 16 and has a habitat score less than 75 percent of the mean reference stream score for that EDU, is excluded from the assessment process.
- If at least half the macroinvertebrate samples in an assessed stream segment have habitat scores less than 75 percent of the mean score for reference streams in that EDU and the assessment results in a judgment that the macroinvertebrate community is impaired, the assessed segment will be placed in Category 4C impairment due to poor aquatic habitat.
- If one portion of the assessment reach contains two or more samples with habitat scores less than 75 percent of reference streams from that EDU while the remaining portion does not, the portion of the stream with poor habitat

scores could be separately assessed as a category 4C stream permitting low MSCI scores.

Macroinvertebrate sampling methods vary by stream type. One method is used in riffle/pool predominant streams, and the other method is for glide/pool predominant streams. For each stream type, macroinvertebrate sampling targets three habitats.

- For riffle/pool streams, the three habitats sampled are flowing water over coarse substrate, non-flowing water over depositional substrate, and rootmat substrate.
- For glide/pool streams, the three habitats sampled are non-flowing water over depositional substrate, large woody debris substrate, and rootmat substrate.

In some instances, one or more of the habitats sampled can be limited or missing from a stream reach, which may affect an MSCI score. Macroinvertebrate samples based on only two habitats may have an MSCI score equal to or greater than 16, but it is also possible that a missing habitat may lead to a decreased MSCI score. Although MDNR stream habitat assessment procedures take into account a number of physical habitat parameters from the sample reach (for example, riparian vegetation width, channel alteration, bank stability, bank vegetation protection, etc.), they do not exclusively measure the quality or quantity of the three predominant habitats from each stream. When evaluating potentially impaired macroinvertebrate communities, the number of habitats sampled, in addition to the stream habitat assessment score, will be considered to ensure MSCI scores less than 16 are properly attributed to poor water quality or poor/inadequate habitat condition.

Biologists responsible for conducting biological assessments will determine the extent to which habitat availability is responsible for a non-supporting (<16) MSCI score. If it is apparent that a non-supporting MSCI score was due to limited habitat, these effects will be stated in the biological assessment report. This limitation will then be considered when deciding which Listing Methodology category is most appropriate for an individual stream. This procedure, as part of an MDNR biological assessment, will aid in determining whether impaired macroinvertebrate samples have MSCI scores based on poor water quality conditions versus habitat limitations.

To ensure assessments are based on representative macroinvertebrate samples, samples collected during or shortly after prolonged drought, shortly after major flood events, or any other conditions that fall outside the range of environmental conditions under which reference streams in the EDU were sampled, will not be used to make an attainment decision for a Section 303(d) listing or any other water quality assessment purposes. Sample "representativeness" is judged by Water Protection Program (WPP) staff after reading the biomonitoring report for that stream, and if needed, consultation with biologists from the department's Environmental Services Program. Regarding smaller deviations from "normal" conditions, roughly 20 percent of reference samples failing to meet a fully biologically supporting MSCI score were collected following weather/climate extremes; as a result, biological criteria for a given EDU are inclusive of samples collected during not

only ideal macroinvertebrate-rearing conditions, but also during the weather extremes that Missouri experiences.

Assessing Small Streams

Occasionally, macroinvertebrate monitoring is needed to assess streams smaller than the typical Wadeable/Perennial reference streams listed in Table I of Missouri's Water Quality Standards. Smaller streams may include Class C streams (streams that may cease flow in dry periods but maintain permanent pools which support aquatic life) or those that are unclassified. Assessing small streams involves comparing test stream and candidate reference stream MSCI scores first, to Wadeable/Perennial Reference Stream (WPRS) criteria, and second to each other. In MDNR's Biological Criteria Database, there are 16 candidate reference streams labeled as Class P, 23 labeled as Class C, and 24 labeled as Class U. In previous work by MDNR, when the MSCI was calculated according to WPRS criteria, the failure rate for such candidate reference streams was 31% for Class P, 39% for Class C, and 70% for Class U. The data trend showed a higher failure rate for increasingly smaller high quality streams when scored using WPRS biological criteria. This trend demonstrates the need to include the utilization of candidate reference streams in biological stream assessments.

For test streams that are smaller than Wadeable/Perennial reference streams, MDNR also samples five candidate reference streams (small control streams) of same or similar size and Valley Segment Type (VST) in the same EDU twice during the same year the test stream is sampled (additional information about the selection small control streams is provided below). Although in most cases the MDNR samples small candidate reference streams concurrently with test streams, existing data may be used if a robust candidate reference stream data set exists for the EDU.

If the ten small candidate reference stream scores are similar to Wadeable/Perennial reference stream criteria, then they and the test stream are considered to have a Class C or Class P general warm water beneficial use, and the MSCI scoring system in the LMD should be used. If the small candidate reference streams have scores lower than the Wadeable/Perennial reference streams, the assumption is that the small candidate reference streams, and the test stream, represent designated uses related to stream size that are not yet approved by EPA in the state's water quality standards. The current assessment method for test streams that are smaller than reference streams is stated below.

- If the ten candidate reference stream (small control stream) scores are similar to WPRSs and meet LMD criteria for an unimpaired macroinvertebrate community, then the test stream will be assessed using MSCI based procedures in the LMD.
- If the ten candidate reference stream scores are lower than those of WPRSs and do not meet the LMD criteria for an unimpaired macroinvertebrate community, then:

- a) The test stream will be assessed as having an unimpaired macroinvertebrate community if the test stream scores meet the LMD criteria for an unimpaired community;
- b) The test stream data will be judged inconclusive if test stream scores are similar to candidate reference stream scores;
- c) The test stream will be assessed as having a “suspect” macroinvertebrate community if its scores are found to be low but statistically close to candidate reference streams; or,
- d) The test stream will be assessed as having an “impaired” macroinvertebrate community if its scores are found to be statistically lower than the candidate reference streams.

This method of assessing small streams will be used only until such time as the aquatic habitat protection use categories based on watershed size classifications of Headwater, Creek, Small River, Large River and Great River are promulgated into Missouri Water Quality Standards and appropriate biological metrics are established for stream size and permanence.

The approach for determining a “suspect” or “impaired” macroinvertebrate community will be made using a direct comparison between all streams being evaluated, which may include the use of percent and/or mean calculations as determined on a case by case basis. All work will be documented on the macroinvertebrate assessment worksheet and be made available during the public notice period.

Selecting Small Candidate Reference Streams

Accurately assessing streams that are smaller than reference streams begins with properly selecting small candidate reference streams. Candidate reference streams are smaller than WPRS streams and have been identified as “best available” reference stream segments in the same EDU as the test stream according to watershed, riparian, and in-channel conditions. The selection of candidate reference streams is consistent with framework provided by Hughes *et al.* (1986) with added requirements that candidate reference streams must be from the same EDU and have the same or similar values for VST parameters. If candidate reference streams perform well when compared to WPRS, then test streams of similar size and VST are expected to do so as well. VST parameters important for selection are based on temperature, stream size, flow, geology, and relative gradient, with emphasis placed on the first three parameters.

The stepwise process for candidate reference stream selection is listed below.

1. Determine test stream reaches to be assessed.
2. Identify appropriate EDU.
3. Determine five variable VST of test stream segments (1st digit = temperature; 2nd digit = size; 3rd digit = flow; 4th digit = geology; and 5th digit = relative gradient).

4. Filter all stream segments within the same EDU for the relevant five variable VSTs (1st and 2nd digits especially critical for small streams).
5. Filter all potential VST stream segments for stressors against available GIS layers (e.g. point source, landfills, CAFOs, lakes, reservoirs, mining, etc.).
6. Filter all potential VST stream segments against historical reports and databases.
7. Develop candidate stream list with coordinates for field verification.
8. Field verify candidate list for actual use (e.g. animal grazing, in-stream habitat, riparian habitat, migration barriers (e.g. culverts, low water bridge crossings) representativeness, gravel mining, and other obvious human stressors).
9. Rank order candidate sites, eliminate obvious stressed sites, and select at least top five sites.
10. Calculate land use-land cover and compare to EDU.
11. Collect chemical, biological, habitat, and possibly sediment field data.
12. After multiple sampling events evaluate field data, land use, and historical data in biological assessment report.
13. If field data are satisfactory, retain candidate reference stream label in database.

Fish Community Data

The department utilizes fish community data to determine if aquatic life use is supported in certain types of Missouri streams. When properly evaluated, fish communities serve as important indicators of stream health. In Missouri, fish communities are surveyed by the MDC. MDC selects an aquatic subregion to sample each year, and therein, surveys randomly selected streams of 2nd to 5th order in size. Fish sampling follows procedures described in the document *Resource Assessment and Monitoring Program: Standard Operational Procedures--Fish Sampling* (Combes 2011). Numeric biocriteria for fish are represented by the fish Index of Biotic Integrity (fIBI). Development of the fIBI is described in the document *Biological Criteria for Stream Fish Communities of Missouri* (Doisy *et al.* 2008).

The fIBI is a multi-metric index made up of nine individual metrics, which include:

- number (#) of native individuals;
- # of native darter species;
- # of native benthic species;
- # of native water column species;
- # of native minnow species;
- # of all native lithophilic species;
- percentage (%) of native insectivore cyprinid individuals;
- % of native sunfish individuals; and,
- % of the three top dominant species.

Values for each metric, as directly calculated from the fish community sample, are converted to unitless scores of 1, 3, or 5 according to criteria in Doisy *et al.* (2008). The fIBI is then calculated by adding these unitless values together for a total possible score of 45. Doisy *et al.* (2008) established an impairment threshold of 36 (where the 25th percentile of reference sites represented a score of 37), with values equal to or greater than 36 representing unimpaired communities, and values less than 36 representing impaired communities. For more information regarding fIBI scoring, please see Doisy *et al.* (2008).

Based on consultation between the department and MDC, the fIBI impairment threshold value of 36 was used as the numeric biocriterion translator for making an attainment decision for aquatic life (Appendix C). Work by Doisy *et al.* (2008) focused on streams 3rd to 5th order in size, and the fIBI was only validated for streams in the Ozark ecoregion, not for streams in the Central Plains and Mississippi Alluvial Basin. Therefore, when assessing streams with the fIBI, the index may only be applied to streams 3rd to 5th order in size from the Ozark ecoregion. Assessment procedures are outlined below.

Full Attainment

- For seven or fewer samples and following MDC RAM fish community protocols, 75% of fIBI scores must be 36 or greater. Fauna achieving these scores are considered to be very similar to Ozark reference streams.
- For eight or more samples, the percent of samples scoring 36 or greater must be statistically similar to representative reference or control streams. To determine statistical similarity, a binomial probability Type I error rate (0.1) is calculated based on the null hypothesis that the test stream would have the same percentage (75%) of fIBI scores greater than 36 as reference streams. If the Type I error rate is more than the significance level $\alpha=0.1$, the fish community would be rated as unimpaired.

Non-Attainment

- For seven or fewer samples and following MDC RAM fish community protocols, 75% of the fIBI scores must be lower than 36. Fauna achieving these scores are considered to be substantially different than regional reference streams.
- For eight or more samples, the percent of samples scoring 36 or less must be statistically dissimilar to representative reference or control streams. To determine statistical dissimilarity, a binomial probability Type I error rate is calculated based on the null hypothesis that the test stream would have the same percentage (75%) of fIBI scores greater than 36 as reference streams. If the Type I error rate is less than 0.1, the null hypothesis is rejected and the fish community would be rated as impaired.

Data will be judged inconclusive when outcomes do not meet requirements for decisions of full or non-attainment.

With the exception of two subtle differences, use of the binomial probability for fish community samples will follow the example provided for macroinvertebrate samples in the previous section. First, instead of test stream samples being compared to reference streams of the same EDU, they will be compared to reference streams from the Ozark ecoregion. Secondly, the probability of success used in the binomial distribution equation will always be set to 0.70 since Appendix D states to “rate a stream as impaired if biological criteria reference stream frequency of fully biologically supporting scores is greater than five percent more than the test stream.”

Although 1st and 2nd order stream data will not be used to judge a stream as impaired for Section 303(d) purposes, the department may use the above assessment procedures to judge 1st and 2nd order streams as unimpaired. Moreover, should samples contain fIBI scores less than 29, the department may judge the stream as “suspected of impairment” using the above procedures.

Considerations for the Influence of Habitat Quality and Sample Representativeness

Low fIBI scores that are substantially different than reference streams could be the result of water quality problems, habitat problems, or both. When low fIBI scores are established, it is necessary to review additional information to differentiate between an impairment caused by water quality and one that is caused by habitat. The collection of a fish community sample is also accompanied by a survey of physical habitat from the sampled reach. MDC sampling protocol for stream habitat follows procedures provided by Peck *et al.* (2006). With MDC guidance, the department utilizes this habitat data and other available information to assure that an assessment of aquatic life attainment based on fish data is only the result of water quality, and that an impairment resulting from habitat is categorized as such. This section describes the procedures used to assure low fIBI scores are the result of water quality problems and not habitat degradation. The information below outlines the department’s provisional method to identify unrepresentative samples and low fIBI scores with questionable habitat condition, and ensure corresponding fish IBI scores are not used for Section 303(d) listing.

- a) Following recommendations from the biocriteria workgroup, the department will consult MDC about the habitat condition of particular streams when assessing low fIBI scores.
- b) Samples may be considered for Section 303(d) listing ONLY if they were collected in the Ozark ecoregion, and the samples were collected during normal representative conditions, based upon best professional judgment from MDC staff. Samples collected from the Central Plains and Mississippi Alluvial Basin are excluded from Section 303(d) listing.
- c) Only samples from streams 3rd to 5th order in size may be considered for Section 303(d) listing. Samples from 1st or 2nd order stream sizes are excluded from Section 303(d) consideration; however, they may be placed

into Categories 2B and 3B if impairment is suspected, or into Categories 1, 2A, or 3A if sample scores indicate a stream is unimpaired. Samples from lower stream orders are surveyed under a different RAM Program protocol than 3rd to 5th order streams.

- d) Samples that are ineligible for Section 303(d) listing include those collected from losing streams, as defined by the Department of Geology and Land Survey, or collected in close proximity to losing streams. Additionally, ineligible samples may include those collected on streams that were considered to have natural flow issues (such as streams reduced predominately to subsurface flow) preventing good fish IBI scores from being obtained, as determined through best professional judgment of MDC staff.
- e) Fish IBI scores must be accompanied by habitat samples with a QCPH1 habitat index score. MDC was asked to analyze meaningful habitat metrics and identify samples where habitat metrics seemed to indicate potential habitat concerns. As a result, a provisional index named QCPH1 was developed. QCPH1 values less than 0.39 indicate poor habitat, and values greater than 0.39 suggest adequate habitat is available. The QCPH1 comprises six sub-metrics indicative of substrate quality, channel disturbance, channel volume, channel spatial complexity, fish cover, and tractive force and velocity.

The QCPH1 index is calculated as follows:

$$\text{QCPH1} = ((\text{Substrate Quality} * \text{Channel Disturbance} * \text{Channel Volume} * \text{Channel Spatial Complexity} * \text{Fish Cover} * \text{Tractive Force \& Velocity})^{1/6})$$

Where sub-metrics are determined by:

Substrate Quality = [(embeddedness + small particles)/2] * [(filamentous algae + aquatic macrophyte)/2] * bedrock and hardpan

Channel Disturbance = concrete * riprap * inlet/outlet pipes * relative bed stability * residual pool observed to expected ratio

Channel Volume = [(dry substrate + width depth product + residual pool + wetted width)/4]

Channel Spatial Complexity = (coefficient of variation of mean depth + coefficient of variation of mean wetted width + fish cover variety)/3

Fish Cover = [(all natural fish cover + ((brush and overhanging vegetation + boulders + undercut bank + large woody debris)/4) + large types of fish cover)/3]

Tractive Force & Velocity = [(mean slope + depth * slope)/2]

Unimpaired fish IBI samples (fIBI ≥ 36) with QCPH1 index scores below the 0.39 threshold value, or samples without a QCPH1 score altogether, are eliminated from consideration for Category 5 and instead placed into Categories 2B or 3B should an impairment be suspected. Impaired fish communities (fIBI < 36) with QCPH1 scores < 0.39 can be placed into Category 4C (non-discrete pollutant/habitat impairment). Impaired fish communities (fIBI < 36) with adequate habitat scores (QCPH1 > 0.39) can be placed into Category 5. Appropriate streams with unimpaired fish communities and adequate habitat (QCPH1 > 0.39) may be used to judge a stream as unimpaired.

Similar to macroinvertebrates, assessment of fish community information must be based on data coded level three or four as described in Section II.C of this document. Data coded as levels three and four represent environmental data with the greatest degree of assurance, and thus, assessments will include multiple samples from a single site, or samples from multiple sites within a single reach.

Following the department's provisional methodology, fish community samples available for assessment (using procedures in Appendix C & D include only those from 3rd to 5th order Ozark Plateau streams, collected under normal, representative conditions, where habitat seemed to be good, and where there were no issues with inadequate flow or water volume.

- **Other Biological Data**

On a case by case basis, the department may use biological data other than MSCI or fIBI scores for assessing attainment of aquatic life. Other biological data may include information on single indicator aquatic species that are ecologically or recreationally important, or individual measures of community health that respond predictably to environmental stress. Measures of community health could be represented by aspects of structure, composition, individual health, and processes of the aquatic biota. Examples could include measures of density or diversity of aquatic organisms, replacement of pollution intolerant taxa, or even the presence of biochemical markers.

Other biological data should be collected under a well vetted study that is documented in a scientific report, a weight of evidence approach should be established, and the report should be referenced in the 303(d) listing worksheet. If other biological data is a critical component of the community and has been adversely affected by the presence of a pollutant or stressor, then such data would indicate a water body is impaired. The department's use of other biological data is consistent with EPA's policy on independent applicability for making attainment decisions, which is intended to protect against dismissing valuable information when diagnosing an impairment of aquatic life.

The use of other biological data in water body assessments occurs infrequently, but when available, it is usually assessed in combination with other information collected within the water body of interest. The department will avoid using other biological data as the sole justification for a Section 303(d) listing; however, other biological data will be used as part of a weight of evidence analysis for making the most informed assessment decision.

- Toxic Chemicals

Water

For the interpretation of toxicity test data, standard acute or chronic bioassay procedures using freshwater aquatic fauna such as, but not limited to, *Ceriodaphnia dubia*, Fathead Minnows (*Pimephales promelas*), *Hyalella azteca*, or Rainbow Trout (*Oncorhynchus mykiss*)¹⁸ will provide adequate evidence of toxicity for 303(d) listing purposes. Microtox[®] toxicity tests may be used to list a water as affected by “toxicity” only if there are data of another kind (freshwater toxicity tests, sediment chemistry, water chemistry, or biological sampling) that indicate water quality impairment.

For any given water, available data may occur throughout the system and/or be concentrated in certain areas. When the location of pollution sources are known, the department reserves the right to assess data representative of impacted conditions separately from data representative of unimpacted conditions. Pollution sources include those that may occur at discrete points along a water body, or those that are more diffuse.

Sediment

For toxic chemicals occurring in benthic sediments, data interpretation will include calculation of a geometric mean for specific toxins from an adequate number of samples, and comparing that value to a corresponding Probable Effect Concentration (PEC) given by MacDonald *et al.* (2000). The PEC is the level of a pollutant above which harmful effects on the aquatic community are likely to be observed. MacDonald (2000) gave an estimate of accuracy for the ability of individual PECs to predict toxicity. For all metals except arsenic, pollutant geometric means will be compared to 150% of the recommended PEC values. This comparison should meet confidence requirements applied elsewhere in this document. When multiple contaminants occur in sediment, toxicity may occur even though the level of each individual pollutant does not reach toxic levels. The method of estimating the synergistic effects of multiple pollutants in sediments is described below.

The Meaning of the Sediment Quotient and How to Calculate It

Although sediment criteria in the form of a PEC are given for several individual contaminants, it is recognized that when multiple contaminants occur in sediment, toxicity may occur even though the level of each individual pollutant does not reach toxic levels. The method of estimating the synergistic effects of multiple pollutants in sediments given in MacDonald *et al.* (2000) includes the calculation of a PECQ. PECQs greater than 0.75 will be judged as toxic.

¹⁸ Reference 10 CSR 20-7.015(9)(L) for additional information

This calculation is made by dividing the pollutant concentration in the sample by the PEC value for that pollutant. For single samples, the quotients are summed, and then normalized by dividing that sum by the number of pollutants in the formula. When multiple samples are available, the geomean (as calculated for specific pollutants) will be placed in the numerator position for each pollutant included in the equation.

Example: A sediment sample contains the following results in mg/kg:

Arsenic 2.5, Cadmium 4.5, Copper 17, Lead 100, and Zinc 260.

The PEC values for these five pollutants in respective order are:

33, 4.98, 149, 128, and 459 mg/kg.

PECQ =

$$[(2.5/33) + (4.5/4.98) + (17/149) + (100/128) + (260/459)]/5 = 0.488$$

Using PECQ to Judge Toxicity

Based on research by MacDonald *et al.* (2000) 83% of sediment samples with PECQ less than 0.5 were non-toxic while 85% of sediment samples with PECQ greater than 0.5 were toxic. Therefore, to accurately assess the synergistic effects of sediment contaminants on aquatic life, the department will judge PECQ greater than 0.75 as toxic.

- **Duration of Assessment Period.**

Except where the assessment period is specifically noted in Appendix B, the time period during which data will be used in making the assessments will be determined by data age and data code considerations, as well as representativeness considerations such as those described in footnote 14.

- **Assessment of Tier Three Waters**

Waters given Tier Three protection by the antidegradation rule at 10 CSR 20-7.031(2) shall be considered impaired if data indicate water quality has been reduced in comparison to its historical quality. Historical quality is determined from past data that best describes a water body's water quality following promulgation of the antidegradation rule and at the time the water was given Tier Three protection.

Historical data gathered at the time waters were given Tier Three protection will be used if available. Because historical data may be limited, the historical quality of the waters may be determined by comparing data from the assessed segment with data from a "representative" segment. A representative segment is a body or stretch of water that best

reflects the conditions that probably existed at the time the antidegradation rule first applied to the waters being assessed. Examples of possible representative data include 1) data from stream segments upstream of assessed segments that receive discharges, and 2) data from other water bodies in the same ecoregion having similar watershed and landscape characters. These representative stream segments also would be characterized by receiving discharges similar to the quality and quantity of historic discharges of the assessed segment. The assessment may also use data from the assessed segment gathered between the time of the initiation of Tier Three protection and the last known time in which upstream discharges, runoff, and watershed conditions remained the same, provided that the data do not show any significant trends of declining water quality during that period.

The data used in the comparisons will be tested for normality and an appropriate statistical test will be applied. The null hypothesis for statistical analysis will be that water quality at the test segment and representative segment is the same. This will be a one-tailed test (the test will consider only the possibility that the assessed segment has poorer water quality) with the alpha level of 0.1, meaning that the test must show greater than a 90 percent probability that the assessed segment has poorer water quality than the representative segment before the assessed segment can be listed as impaired.

- Other Types of Information

1. Observation and evaluation of waters for noncompliance with state narrative water quality criteria. Missouri's narrative water quality criteria, as described in 10 CSR 20-7.031 Section (3), may be used to evaluate waters when a quantitative (narrative) value can be applied to the pollutant. These narrative criteria apply to both classified and unclassified waters and prohibit the following in waters of the state:
 - a. Waters shall be free from substances in sufficient amounts to cause the formation of putrescent, unsightly, or harmful bottom deposits or prevent full maintenance of beneficial uses;
 - b. Waters shall be free from oil, scum, and floating debris in sufficient amounts to be unsightly or prevent full maintenance of beneficial uses;
 - c. Waters shall be free from substances in sufficient amounts to cause unsightly color or turbidity, offensive odor, or prevent full maintenance of beneficial uses;
 - d. Waters shall be free from substances or conditions in sufficient amounts to result in toxicity to human, animal, or aquatic life;
 - e. There shall be no significant human health hazard from incidental contact with the water;
 - f. There shall be no acute toxicity to livestock or wildlife watering;
 - g. Waters shall be free from physical, chemical, or hydrologic changes that would impair the natural biological community;
 - h. Waters shall be free from used tires, car bodies, appliances, demolition debris, used vehicles or equipment, and solid waste as defined in Missouri's Solid Waste

Law, section 260.200, RSMo, except as the use of such materials is specifically permitted pursuant to sections 260.200–260.247, RSMo;

2. Habitat assessment protocols for wadeable streams have been established and are conducted in conjunction with sampling aquatic macroinvertebrates and fish. Methods for evaluating aquatic macroinvertebrate and fish community data include assessment procedures that account for the presence or absence of representative habitat quality. The department will not use habitat data alone for assessment purposes.

E. Other 303(d) Listing Considerations

- Adding to the Existing List or Expanding the Scope of Impairment to a Previously Listed Water.

The listed portion of impaired water bodies may be increased based on recent monitoring data following the guidelines in this document. One or more new pollutants may be added to the listing for a water body already on the list based on recent monitoring data following these same guidelines. Waters not previously listed may be added to the list following the guidelines in this document.

- Deleting from the Existing List or Decreasing the Scope of Impairment to a Previously Listed Water

The listed portion of an impaired water body may be decreased based on recent monitoring data following the guidelines in this document. One or more pollutants may be deleted from the listing for a water body already on the list based on recent monitoring data following guidelines in Appendix D. Waters may be completely removed from the list for several reasons¹⁹, the most common being (1) water has returned to compliance with water quality standards, or (2) the water has an approved TMDL study or Permit in Lieu of a TMDL.

F. Prioritization of Waters for TMDL Development

Section 303(d) of the Clean Water Act and federal regulation 40 CFR 130.7(b)(4) require states to submit a priority ranking of waters requiring TMDLs. The department will prioritize development of TMDLs based on several variables including:

- social impact/public interest and risk to public health
- complexity and cost (including consideration of budget constraints), availability of data of sufficient quality and quantity for TMDL modeling
- court orders, consent decrees, or other formal agreements
- source of impairments
- existence of appropriate numeric quality criteria, and
- implementation potential and amenability of the problem to treatment

¹⁹ See, “Guidance for 2006 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d), 305(b) and 314 of the Clean Water Act”. USEPA, Office of Water, Washington DC.

The department's TMDL schedule will represent its prioritization. The TMDL Program develops the TMDL schedule and maintains it at the following website:

<http://www.dnr.mo.gov/env/wpp/tmdl/>.

G. Resolution of Interstate/International Disagreements

The department will review the draft 303(d) Lists of all other states with which it shares a border (Missouri River, Mississippi River, Des Moines River and the St. Francis River) or other interstate waters. Where the listing for the same water body in another state is different than the one in Missouri, the department will request the data and the listing justification. These data will be reviewed following the evaluation guidelines in this document. The Missouri Section 303(d) list may be changed pending the evaluation of this additional data.

H. Statistical Considerations

The most recent EPA guidance on the use of statistics in the 303(d) listing methodology document is given in Appendix A. Within this guidance there are three major recommendations regarding statistics:

- Provide a description of analytical tools the state uses under various circumstances
 - When conducting hypothesis testing, explain the various circumstances under which the burden of proof is placed on proving the water is impaired and when it is placed on proving the water is unimpaired, and
 - Explain the level of statistical significance (α) used under various circumstances.
- Description of Analytical Tools

Appendix D, describes the analytical tools the department will use to determine whether a water body is impaired and whether or when a listed water body is no longer impaired.

- Rationale for the Burden-of-Proof

Hypothesis testing is a common statistical practice. The procedure involves first stating a hypothesis you want to test, such as “the most frequently seen color on clothing at a St. Louis Cardinals game is red” and then the opposite or null hypothesis “red is not the most frequently seen color on clothing at a Cardinals game.” Then a statistical test is applied to the data (a sample of the predominant color of clothing worn by 200 fans at a Cardinals game on July 12) and based on an analysis of that data, one of the two hypotheses is chosen as correct.

In hypothesis testing, the burden-of-proof is always on the alternate hypothesis. In other words, there must be very convincing data to make us conclude that the null hypothesis is not true and that we must accept the alternate hypothesis. How convincing the data must be is stated as the “significance level” of the test. A significance level of $\alpha=0.10$ means that there must be at least a 90 percent probability that the alternate hypothesis is true before we can accept it and reject the null hypothesis.

For analysis of a specific kind of data, either the test significance level or the statement of null and alternative hypotheses, or both, can be varied to achieve the desired degree of statistical rigor. The department has chosen to maintain a consistent set of null and alternate hypotheses for all our statistical procedures. The null hypothesis will be that the water body in question is unimpaired and the alternate hypothesis will be that it is impaired. Varying the level of statistical rigor will be accomplished by varying the test significance level. For determining impairment (Appendix D) test significance levels are set at either $\alpha=0.1$ or $\alpha=0.4$, meaning the data must show at minimum 90% or 60% probability, respectively that the water body is impaired. However, if the department retained these same test significance levels in determining when an impaired water body had been restored to an unimpaired status (Appendix D) some undesirable results can occur.

For example, using a 0.1 significance level for determining both impairment and non-impairment, if the sample data indicate the stream had a 92 percent probability of being impaired, it would be rated as impaired. If subsequent data were collected and added to the database, and the data now showed the water had an 88 percent chance of being impaired, it would be rated as unimpaired. Judging as unimpaired a water body with only a 12 percent probability of being unimpaired is clearly a poor decision. To correct this problem, the department will use a test significance level of 0.4 for some analytes and 0.6 for others. This will increase our confidence in determining compliance with criteria to 40 percent and 60 percent, respectively under the worst case conditions, and for most databases will provide an even higher level of confidence.

- Level of Significance Used in Tests

The choice of significance levels is largely related to two concerns. The first concern is with matching error rates with the severity of the consequences of making a decision error. The second addresses the need to balance, to the degree practicable, Type I and Type II error rates. For relatively small number of samples, the disparity between Type I and Type II errors can be large. The tables 2.0 and 3.0 below shows error rates calculated using the binomial distribution for two very similar situations. Type I error rates are based on a stream with a 10 percent exceedence rate of a standard, and Type II error rates are based on a stream with a 15 percent exceedence rate of a standard. Note that when sample size remains the same, Type II error rates increase as Type I error rates decrease (Table 2.0). Also note that for a given Type I error rate, the Type II error rate declines as sample size increases (Table 3.0).

Table 2.0. Effects of Type I error rates on Type II error rates. Type I error rates are based on a stream with a 10 percent exceedence rate of a standard and Type II error rates for a stream with a 15 percent exceedence rate of a standard.

Total No. of Samples	No. Samples Meeting Std.	Type I Error Rate	Type II Error Rate
18	17	0.850	0.479
18	16	0.550	0.719
18	15	0.266	0.897
18	14	0.098	0.958
18	13	0.028	0.988

Table 3.0. Effects of Type I error rates and sample size on Type II error rates. Type I error rates are based on a stream with a 10 percent exceedence rate of a standard and Type II error rates for a stream with a 15 percent exceedence rate of a standard.

Total No. of Samples	No. Samples Meeting Std.	Type I Error Rate	Type II Error Rate
6	5	0.469	0.953
11	9	0.303	0.930
18	15	0.266	0.897
25	21	0.236	0.836

- Use of the Binomial Probability Distribution for Interpretation of the 10 Percent Rule

There are two options for assessing data for compliance with the 10 percent rule. One is to simply calculate the percent of time the criterion value is not met, and to judge the water to be impaired if this value is greater than 10 percent. The second method is to use some evaluative procedure that can review the data and provide a probability statement regarding compliance with the 10 percent rule. Since the latter option allows assessment decisions relative to specific

test significance levels and the first option does not, the latter option is preferred. The procedure chosen is the binomial probability distribution and calculation of the Type I error rate.

- Other Statistical Considerations

Prior to calculation of confidence limits, the normality of the data set will be evaluated. If normality is improved by a data transformation, the confidence limits will be calculated on the transformed data.

Time of sample collection may be biased and interfere with an accurate measurement of frequency of exceedance of a criterion. Data sets composed mainly or entirely of storm water data or data collected only during a season when water quality problems are expected could result in a biased estimate of the true exceedance frequency. In these cases, the department may use methods to estimate the true annual frequency and display these calculations whenever they result in a change in the impairment status of a water body.

For waters judged to be impaired based on biological data where data evaluation procedures are not specifically noted in Table 1, the statistical procedure used, test assumptions, and results will be reported.

- Examples of Statistical Procedures

Two Sample "t" Test for Color

Null Hypothesis: Amount of color is no greater in a test stream than in a control stream. As stated, this is a one-sided test, meaning that we are only interested in determining whether or not the color level in the test stream is greater than in a control stream. If the null hypothesis had been "amount of color is different in the test and control streams," we would have been interested in determining if the amount of color was either less than or greater than the control stream, a two-sided test.

Significance Level: $\alpha=0.10$

Data Set: Platinum-Cobalt color units data for the test stream and a control stream samples collected at each stream on same date.

Test Stream	70	45	35	45	60	60	80
Control Stream	50	40	20	40	30	40	75
Difference (T-C)	20	5	15	5	30	20	5

Statistics for the Difference: Mean = 14.28, standard deviation = 9.76, $n = 7$

Calculated "t" value = (square root of n)(mean)/standard deviation = 3.86

Tabular "t" value is taken from a table of the "t" distribution for 2 alpha (0.20) and n-1 degrees of freedom. Tabular "t" = 1.44.

Since calculated “t” value is greater than tabular t value, reject the null hypothesis and conclude that the test stream is impaired by color.

Statistical Procedure for Mercury in Fish Tissue

Data Set: data in $\mu\text{g/Kg}$ 130, 230, 450. Mean = 270, Standard Deviation = 163.7
The 60% Lower Confidence Limit Interval = the sample mean minus the quantity:
 $((0.253)(163.7)/\text{square root } 3) = 23.9$. Thus the 60% LCL Confidence Interval is 246.088
 $\mu\text{g/Kg}$.

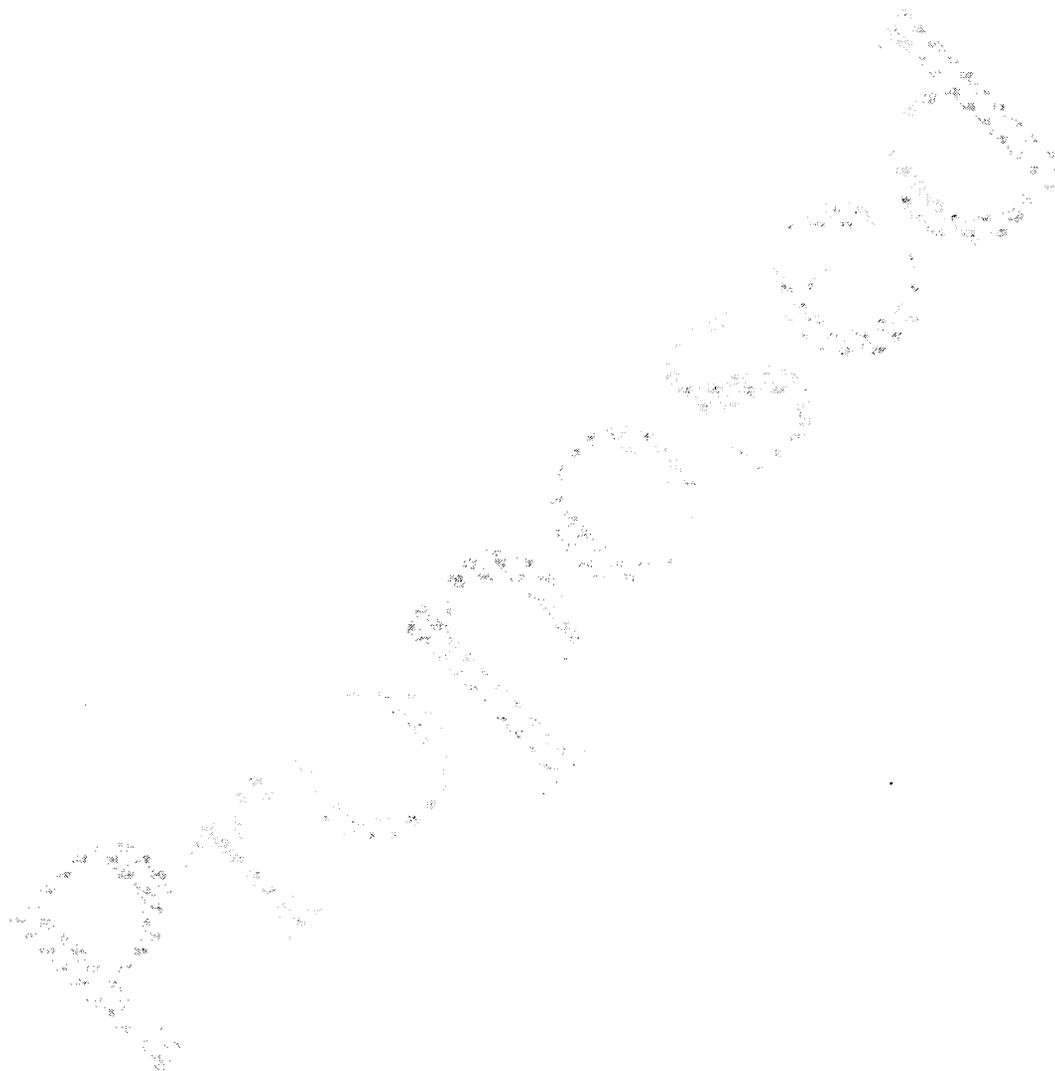
The criterion value is 300 $\mu\text{g/Kg}$. Therefore, since the 60% LCL Confidence Interval is less than the criterion value, the water is judged to be unimpaired by mercury in fish tissue, and the water body is placed in either Category 2B or 3B.

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pp.



Appendix A

Excerpt from *Guidance for 2006 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d), 305(b) and 314 of the Clean Water Act*. July 29, 2005. USEPA pp. 39-41.

The document can be read in its entirety from the US. EPA web site:
<http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/upload/2006irg-report.pdf>

G. How should statistical approaches be used in attainment determinations?

The state's methodology should provide a rationale for any statistical interpretation of data for the purpose of making an assessment determination.

Description of statistical methods to be employed in various circumstances

The methodology should provide a clear explanation of which analytic tools the state uses and under which circumstances. EPA recommends that the methodology explain issues such as the selection of key sample statistics (arithmetic mean concentration, median concentration, or a percentile), null and alternative hypotheses, confidence intervals, and Type I and Type II error thresholds. The choice of a statistic tool should be based on the known or expected distribution of the concentration of the pollutant in the segment (e.g., normal or log normal) in both time and space.

Past EPA guidance (1997 305(b) and 2000 CALM) recommended making non-attainment decisions, for "conventional pollutants"²⁰ — TSS, pH, BOD, fecal coliform bacteria, and oil and grease¹³ — when more than "10% of measurements exceed the water quality criterion." (However, EPA guidance has not encouraged use of the "10% rule" with other pollutants, including toxics.) Use of this rule when addressing conventional pollutants, is appropriate if its application is consistent with the manner in which applicable WQC are expressed. An example of a WQC for which an assessment based on the ten percent rule would be appropriate is the EPA acute WQC for fecal coliform bacteria, applicable to protection of water contact recreational use. This 1976-issued WQC was expressed as, "...no more than ten percent of the samples exceeding 400 CFU per 100 ml, during a 30-day period." Here, the assessment methodology is clearly reflective of the WQC.

On the other hand, use of the ten percent rule for interpreting water quality data is usually not consistent with WQC expressed either as: 1) instantaneous maxima not to be surpassed at any time, or 2) average concentrations over specified times. In the case of "instantaneous maxima (or minima) never to occur" criteria use of the ten percent rule typically leads to the belief that segment conditions are equal or better than specified by the WQC, when they in fact are considerably worse. (That is,

²⁰ There are a variety of definitions for the term "conventional pollutants." Wherever this term is referred to in this guidance, it means "a pollutant other than a toxic pollutant."

pollutant concentrations are above the criterion-concentration a far greater proportion of the time than specified by the WQC.) Conversely, use of this decision rule in concert with WQC expressed as average concentrations over specific times can lead to concluding that segment conditions are worse than WQC, when in fact they are not.

If the state applies different decision rules for different types of pollutants (e.g., toxic, conventional, and non-conventional pollutants) and types of standards (e.g., acute vs. chronic criteria for aquatic life or human health), the state should provide a reasonable rationale supporting the choice of a particular statistical approach to each of its different sets of pollutants and types of standards.

- 1. Elucidation of policy choices embedded in selection of particular statistical approaches and use of certain assumptions EPA strongly encourages states to highlight policy decisions implicit in the statistical analysis that they have chosen to employ in various circumstances. For example, if hypothesis testing is used, the state should make its decision-making rules transparent by explaining why it chose either "meeting WQS" or "not meeting WQS" as the null hypothesis (rebuttable presumption) as a general rule for all waters, a category of waters, or an individual segment. Starting with the assumption that a water is "healthy" when employing hypothesis testing means that a segment will be identified as impaired, and placed in Category 4 or 5, only if substantial amounts of credible evidence exist to refute that presumption. By contrast, making the null hypothesis "WQS not being met" shifts the burden of proof to those who believe the segment is, in fact, meeting WQS.*

Which "null hypothesis" a state selects could likely create contrasting incentives regarding support for additional ambient monitoring among different stakeholders. If the null hypothesis is "meeting standards," there were no previous data on the segment, and no additional existing and readily available data and information are collected, then the "null hypothesis" cannot be rejected, and the segment would not be placed in Category 4 or 5. In this situation, those concerned about possible adverse consequences of having a segment declared "impaired" might have little interest in collection of additional ambient data. Meanwhile, users of the segment would likely want to have the segment monitored, so they can be ensured that it is indeed capable of supporting the uses of concern. On the other hand, if the null hypothesis is changed to "segment not meeting WQS," then those that would prefer that a particular segment not be labeled "impaired" would probably want more data collected, in hopes of proving that the null hypothesis is not true.

Another key policy issue in hypothesis testing is what significance level to use in deciding whether to reject the null hypothesis. Picking a high level of significance for rejecting the null hypothesis means that great emphasis is being placed on avoiding a Type I error (rejecting the null hypothesis, when in fact, the null hypothesis is true). This means that if a 0.10 significance level is chosen, the state wants to keep the chance of making a Type I error at or below ten percent. Hence, if the chosen null hypothesis 2006 IR Guidance

July 2005 41 is "segment meeting WQS," the state is trying to keep the chance of saying a segment is impaired – when in reality it is not – under ten percent.

An additional policy issue is the Type II errors (not rejecting the null hypothesis, when it should have been). The probability of Type II errors depends on several factors. One key factor is the number of samples available. With a fixed number of samples, as the probability of Type I error decreases, the probability of a Type II error increases. States would ideally collect enough samples so the chances of making Type I and Type II errors are simultaneously small. Unfortunately, resources needed to collect such numbers of samples are quite often not available.

The final example of a policy issue that a state should describe is the rationale for concentrating limited resources to support data collection and statistical analysis in segments where there are documented water quality problems or where the combination of nonpoint source loadings and point source discharges would indicate a strong potential for a water quality problem to exist.

EPA recommends that, when picking the decision rules and statistical methods to be utilized when interpreting data and information, states attempt to minimize the chances of making either of the two following errors:

- Concluding the segment is impaired, when in fact it is not, and*
- Deciding not to declare a segment impaired, when it is in fact impaired.*

States should specify in their methodology what significance level they have chosen to use, in various circumstances. The methodology would best describe in "plain English" the likelihood of deciding to list a segment that in reality is not impaired (Type I error if the null hypothesis is "segment not impaired"). Also, EPA encourages states to estimate, in their assessment databases, the probability of making a Type II error (not putting on the 303(d) list a segment that in fact fails to meet WQS), when: 1) commonly-available numbers of grab samples are available, and 2) the degree of variance in pollutant concentrations are at commonly encountered levels. For example, if an assessment is being performed with a WQC expressed as a 30-day average concentration of a certain pollutant, it would be useful to estimate the probability of a Type II error when the number of available samples over a 30 day period is equal to the average number of samples for that pollutant in segments state-wide, or in a given group of segments, assuming a degree of variance in levels of the pollutant often observed over typical 30 day periods.

Appendix B

METHODS FOR ASSESSING COMPLIANCE WITH WATER QUALITY STANDARDS USED FOR 303(d) LISTING PURPOSES: NUMERIC CRITERIA THAT ARE INCLUDED IN STATE WATER QUALITY STANDARDS (10 CSR 20-7.031)

DESIGNATED USES	DATA TYPE	DATA QUALITY CODE	COMPLIANCE WITH WATER QUALITY STANDARDS ¹	Notes
Overall use protection (all designated uses)	No data. Evaluated based on similar land use/ geology as stream with water quality data.	Not applicable	Given same rating as monitored stream with same land use and geology.	Data Type Note: This data type is used only for wide-scale assessments of aquatic biota and aquatic habitat for 305(b) Report purposes. This data type is not used in the development of the 303(d) List.
Any designated uses	No data available or where only effluent data is available. Results of dilution calculations or water quality modeling	Not applicable	Where models or other dilution calculations indicate noncompliance with allowable pollutant levels and frequencies noted in this table, waters may be added to Category 3B and considered high priority for water quality monitoring.	
Protection of Aquatic Life	Dissolved oxygen, water temperature, pH, total dissolved gases, oil and grease.	1-4	<u>Full:</u> No more than 10% of all samples exceed criterion. <u>Non-Attainment:</u> Requirements for full attainment not met.	Compliance with Water Quality Standards Note: Some sampling periods are wholly or predominantly during the critical period of the year when criteria violations occur. Where the monitoring program presents good evidence of a demarcation between seasons where criteria exceedences occur and seasons when they do not, the 10% exceedence rate will be based on an annual estimate of the frequency of exceedence. Continuous (e.g. sonde) data with a quality rating of excellent or good will be used for assessments. Chronic pH will be used in the 2018 LMD only if these criteria appear in the Code of State Regulations, and approved by the U.S. Environmental Protection Agency.

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DESIGNATED USES	DATA TYPE	DATA QUALITY CODE	COMPLIANCE WITH WATER QUALITY STANDARDS ¹	Notes
Losing Streams	<i>E. coli</i> bacteria	1-4	<p><u>Full</u>: No more than 10% of all samples exceed criterion.</p> <p><u>Non-Attainment</u>: Requirements for full attainment not met. The criterion for <i>E. coli</i> is 126 counts/100ml. 10 CSR 20-7.031 (4)(C)</p>	
Protection of Aquatic Life	Toxic chemicals	1-4	<p><u>Full</u>: No more than one acute toxic event in three years that results in a documented die-off of aquatic life such as fish, mussels, and crayfish (does not include die-offs due to natural origin). No more than one exceedence of acute or chronic criterion in the last three years for which data is available.</p> <p><u>Non-Attainment</u>: Requirements for full attainment not met.</p>	<p>Compliance with Water Quality Standards Note: For hardness based metals with eight or fewer samples, the hardness value associated with the sample will be used to calculate the acute or chronic thresholds.</p> <p>For hardness based metals with more than eight samples, the reference percentile hardness provided in state water quality standards will be used to calculate the acute and chronic thresholds.</p>
Protection of Aquatic Life	Nutrients in Lakes (total phosphorus, total nitrogen, plus chlorophyll)	1-4	<p><u>Full</u>: Nutrient levels do not exceed water quality standards following procedures stated in Appendix D.</p> <p><u>Non-Attainment</u>: Requirements for full attainment not met.</p>	<p>Compliance with Water Quality Standards Note: Nutrient criteria will be used in the 2018 LMD only if these criteria appear in the Code of State Regulations, and approved by the U.S. Environmental Protection Agency.</p>
Human Health - Fish Consumption	Chemicals (water)	1-4	<p><u>Full</u>: Water quality does not exceed water quality standards following procedures stated in Appendix D.</p> <p><u>Non-Attainment</u>: Requirements for full attainment not met.</p>	

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DESIGNATED USES	DATA TYPE	DATA QUALITY CODE	COMPLIANCE WITH WATER QUALITY STANDARDS ¹	Notes
Drinking Water Supply -Raw Water.	Chemical (toxics)	1-4	<u>Full</u> : Water Quality Standards not exceeded following procedures stated in Appendix D. <u>Non-Attainment</u> : Requirements for full attainment not met.	Designated Use Note: Raw water is water from a stream, lake or groundwater prior to treatment in a drinking water treatment plant.
Drinking Water Supply- Raw Water	Chemical (sulfate, chloride, fluoride)	1-4	<u>Full</u> : Water quality standards not exceeded following procedures stated in Appendix D. <u>Non-Attainment</u> : Requirements for full attainment not met.	
Drinking Water Supply-Finished Water	Chemical (toxics)	1-4	<u>Full</u> : No Maximum Contaminant Level (MCL) violations based on Safe Drinking Water Act data evaluation procedures. <u>Non-Attainment</u> : Requirements for full attainment not met.	Compliance with Water Quality Standards Note: Finished water data will not be used for analytes where water quality problems may be caused by the drinking water treatment process such as the formation of Trihalomethanes (THMs) or problems that may be caused by the distribution system (bacteria, lead, copper).
Whole-Body-Contact Recreation and Secondary Contact Recreation	Fecal coliform or <i>E. coli</i> count	2-4	Where there are at least five samples per year taken during the recreational season: <u>Full</u> : Water quality standards not exceeded as a geometric mean, in any of the last three years for which data is available, for samples collected during seasons for which bacteria criteria apply. <u>Non-Attainment</u> : Requirements for full attainment not met.	Compliance with Water Quality Standards Note: A geometric mean of 206 cfu/100 ml for <i>E. coli</i> will be used as a criterion value for Category B Recreational Waters. Because Missouri's Fecal Coliform Standard ended December 31, 2008, any waters appearing on the 2008 303(d) List as a result of the Fecal Coliform Standard will be retained on the list with the pollutant listed as "bacteria" until sufficient <i>E. coli</i> sampling has determined the status of the water.

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DESIGNATED USES	DATA TYPE	DATA QUALITY CODE	COMPLIANCE WITH WATER QUALITY STANDARDS¹	Notes
Irrigation, Livestock and Wildlife Water	Chemical	1-4	<p><u>Full</u>: Water quality standards not exceeded following procedures stated in Appendix D.</p> <p><u>Non-Attainment</u>: Requirements for full attainment not met.</p>	

¹ See section on Statistical Considerations, Appendix C & D.

Appendix C

METHODS FOR ASSESSING COMPLIANCE WITH WATER QUALITY STANDARDS USED FOR 303(d) LISTING PURPOSES: NARRATIVE CRITERIA BASED ON NUMERIC THRESHOLDS NOT CONTAINED IN STATE WATER QUALITY STANDARDS (10 CSR 20-7.031)

BENEFICIAL USES	DATA TYPE	DATA QUALITY CODE	COMPLIANCE WITH WATER QUALITY STANDARDS ⁱⁱ	Notes
Overall use protection (all beneficial uses)	Narrative criteria for which quantifiable measurements can be made.	1-4	<p><u>Full</u>: Stream condition typical of reference or appropriate control streams in this region of the state.</p> <p><u>Non-Attainment</u>: The weight of evidence, based on the narrative criteria in 10 CSR 20-7.031(3), demonstrates the observed condition exceeds a numeric threshold necessary for the attainment of a beneficial use.</p> <p>For example: Color: Color as measured by the Platinum-Cobalt visual method (SM 2120 B) in a water body is statistically significantly higher than a control water.</p> <p><u>Objectionable Bottom Deposits</u>: The bottom that is covered by sewage sludge, trash, or other materials reaching the water due to anthropogenic sources exceeds the amount in reference or control streams by more than 20 percent.</p> <p>Note: Waters in mixing zones and unclassified waters that support aquatic life on an intermittent basis shall be subject to acute toxicity criteria for protection of aquatic life. Waters in the initial Zone of Dilution shall not be subject to acute toxicity criteria.</p>	

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METHODS FOR ASSESSING COMPLIANCE WITH WATER QUALITY STANDARDS USED FOR 303(d) LISTING PURPOSES: NARRATIVE CRITERIA BASED ON NUMERIC THRESHOLDS NOT CONTAINED IN STATE WATER QUALITY STANDARDS (10 CSR 20-7.031)

BENEFICIAL USES	DATA TYPE	DATA QUALITY CODE	COMPLIANCE WITH WATER QUALITY STANDARDS ⁱⁱ	Notes
Protection of Aquatic Life	Toxic Chemicals	1-4	<p><u>Full</u>: No more than one acute toxic event in three years (does not include die-offs of aquatic life due to natural origin). No more than one exceedence of acute or chronic criterion in three years for all toxics.</p> <p><u>Non-Attainment</u>: Requirements for full attainment not met.</p>	<p>Compliance with Water Quality Standards Note: The test result must be representative of water quality for the entire time period for which acute or chronic criteria apply. For ammonia the chronic exposure period is 30 days, for all other toxics 96 hours. The acute exposure period for all toxics is 24 hours, except for ammonia which has a one hour exposure period. The department will review all appropriate data, including hydrographic data, to ensure only representative data are used. Except on large rivers where storm water flows may persist at relatively unvarying levels for several days, grab samples collected during storm water flows will not be used for assessing chronic toxicity criteria.</p> <p>Compliance with Water Quality Standards Note: In the case of toxic chemicals occurring in benthic sediment rather than in water, the numeric thresholds used to determine the need for further evaluation will be the Probable Effect Concentrations proposed in "Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems" by MacDonald, D.D. <i>et al.</i> Arch. Environ. Contam. Toxicol. 39,20-31 (2000). These Probable Effect Concentrations are as follows: 33 mg/kg As; 4.98 mg/kg Cd; 111 mg/kg Cr; 149 mg/kg Cu; 48.6 mg/kg Ni; 128 mg/kg Pb; 459 mg/kg Zn; 561 µg/kg naphthalene; 1170 µg/kg phenanthrene; 1520 µg/kg pyrene; 1050 µg/kg benzo(a)anthracene, 1290 µg/kg chrysene; 1450 µg/kg benzo(a)pyrene; 22,800 µg/kg total polyaromatic hydrocarbons; 676 µg/kg total PCBs; chlordane 17.6 ug/kg; Sum DDE 31.3 ug/kg; lindane (gamma-BHC) 4.99 ug/kg. Where multiple sediment contaminants exist, the Probable Effect Concentrations Quotient shall not exceed 0.75. See Appendix D and Section II. D for more information on the Probable Effect Concentrations Quotient.</p>

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METHODS FOR ASSESSING COMPLIANCE WITH WATER QUALITY STANDARDS USED FOR 303(d) LISTING PURPOSES: NARRATIVE CRITERIA BASED ON NUMERIC THRESHOLDS NOT CONTAINED IN STATE WATER QUALITY STANDARDS (10 CSR 20-7.031)

BENEFICIAL USES	DATA TYPE	DATA QUALITY CODE	COMPLIANCE WITH WATER QUALITY STANDARDS ⁱⁱ	Notes
Protection of Aquatic Life	Biological: Aquatic Macro-invertebrates sampled using DNR Protocol.	3-4	<p>Full: For seven or fewer samples and following DNR wadeable streams macroinvertebrate sampling and evaluation protocols, 75% of the stream condition index scores must be 16 or greater. Fauna achieving these scores are considered to be very similar to regional reference streams. For greater than seven samples or for other sampling and evaluation protocols, results must be statistically similar to representative reference or control stream.</p> <p>Non-Attainment: For seven or fewer samples and following DNR wadeable streams macroinvertebrate sampling and evaluation protocols, 75% of the stream condition index scores must be 14 or lower. Fauna achieving these scores are considered to be substantially different from regional reference streams. For more than seven samples or for other sampling and evaluation protocols, results must be statistically dissimilar to control or representative reference streams.</p>	<p>Data Type Note: DNR invert protocol will not be used for assessment in the Mississippi Alluvial Basin (bootheel area) due to lack of reference streams for comparison.</p> <p>Data Type Note: See Section II.D. for additional criteria used to assess biological data.</p> <p>Compliance with Water Quality Standards Note: See Appendix D. For test streams that are smaller than bioreference streams (Table I of Water Quality Standards) where both bioreference streams and small control streams are used to assess the biological integrity of the test stream, the assessment of the data should display and take into account both types of control streams.</p>
Protection of Aquatic Life	Biological: MDC Fish Community (RAM) Protocol (Ozark Plateau only)	3-4	<p>Full: For seven or fewer samples and following MDC RAM fish community protocols, 75% of the fIBI scores must be 36 or greater. Fauna achieving these scores are considered to be very similar to regional reference streams. For greater than seven samples or for other sampling</p>	<p>Data Type Note: See Section II.D. for additional criteria used to assess biological data.</p> <p>Compliance with Water Quality Standards Note: MDC fIBI scores are from “Biological Criteria for Streams and Fish Communities in Missouri” by Doisy et al. (2008). If habitat limitations (as measured by either the QCPH1 index or other appropriate methods) are judged to contribute to low fish</p>

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BENEFICIAL USES	DATA TYPE	DATA QUALITY CODE	COMPLIANCE WITH WATER QUALITY STANDARDS ⁱⁱ	Notes
			<p>and evaluation protocols, results must be statistically similar to representative reference or control streams.</p> <p><u>Suspected of Impairment:</u> Data not conclusive (Category 2B or 3B). For first and second order streams FBI score < 29.</p> <p><u>Non-Attainment:</u> First and second order streams will not be assessed for non-attainment. When assessing third to fifth order streams with data sets of seven or fewer samples collected by following MDC RAM fish community protocols, 75% of the FBI scores must be lower than 36. Fauna achieving these scores are considered to be substantially different from regional reference streams. For more than seven samples or for other sampling and evaluation protocols, results must be statistically dissimilar to control or representative reference streams.</p>	<p>community scores and this is the only type of data available, the water body will be included in Category 4C, 2B, or 3B. If other types of data exist, the weight of evidence approach will be used as described in this document.</p> <p>Compliance with Water Quality Standards Note: For determining influence of poor habitat on those samples that are deemed as impaired, consultation with MDC RAM staff will be utilized. If, through this consultation, habitat is determined to be a significant possible cause for impairment, the water body will not be rated as impaired, but rather as suspect of impairment (categories 2B or 3B).</p> <p>Compliance with Water Quality Standards Note: See Appendix D. For test streams that are significantly smaller than bioreference streams where both bioreference streams and small candidate reference streams are used to assess the biological integrity of the test stream, the assessment of the data should display and take into account both biocriteria reference streams and candidate reference streams.</p>
Protection of Aquatic Life	Other Biological Data	3-4	<p><u>Full:</u> Results must be statistically similar to representative reference or control streams.</p> <p><u>Non-Attainment:</u> Results must be statistically dissimilar to control or representative reference streams.</p>	<p>Data Type Note: See Section II.D. for additional criteria used to assess biological data</p>

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BENEFICIAL USES	DATA TYPE	DATA QUALITY CODE	COMPLIANCE WITH WATER QUALITY STANDARDS ⁱⁱ	Notes
Protection of Aquatic Life	Toxicity testing of streams or lakes using aquatic organisms	2	<p><u>Full</u>: No more than one test result of statistically significant deviation from controls in acute or chronic test in a three-year period.</p> <p><u>Non-Attainment</u>: Requirements for full attainment not met.</p>	
Human Health - Fish Consumption	Chemicals (tissue)	1-2	<p><u>Full</u>: Contaminant levels in fish tissue levels in fillets, tissue plugs, and eggs do not exceed guidelines.</p> <p><u>Non-Attainment</u>: Requirements for full attainment not met.</p>	<p>Compliance with Water Quality Standards Note: Fish tissue threshold levels are; chlordane 0.1 mg/kg (Crellin, J.R. 1989, "New Trigger Levels for Chlordane in Fish-Revised Memo" Mo. Dept. of Health inter-office memorandum. June 16, 1989); mercury 0.3 mg/kg based on "Water Quality Criterion for Protection of Human Health: Methylmercury" EPA-823-R-01-001. Jan. 2001.</p> <p>http://www.epa.gov/waterscience/criteria/methylmercury/merctitl.pdf; PCBs 0.75 mg/kg, MDHSS Memorandum August 30, 2006 "Development of PCB Risk-based Fish Consumption Limit Tables;" and lead 0.3- mg/kg (World Health Organization 1972. "Evaluation of Certain Food Additives and the Contaminants Mercury, Lead and Cadmium." WHO Technical Report Series No. 505, Sixteenth Report on the Joint FAO/WHO Expert Committee on Food Additives. Geneva 33 pp. Assessment of Mercury will be based on samples solely from the following higher trophic level fish species: Walleye, Sauger, Trout, Black Bass, White Bass, Striped Bass, Northern Pike, Flathead Catfish and Blue Catfish. In a 2012 DHSS memorandum (not yet approved, but are being considered for future LMD revisions) threshold values are proposed to change as follows: chlordane 0.2 mg/kg ; mercury 0.27 mg/kg ; and PCBs = 0.540 ; lead has not changed, but they do add atrazine and PDBEs (Fish Fillet Advisory Concentrations (FFACs) in Missouri).</p>

ⁱⁱ See section on Statistical Considerations and Appendix D.

Appendix D

DESCRIPTION OF ANALYTICAL TOOLS USED FOR DETERMINING THE STATUS OF MISSOURI WATERS (11" X 14" FOLD OUT)

Designated Use	Analytes	Analytical Tool	Determining when waters are impaired			Determining when waters are no longer impaired			Notes
			Decision Rule/ Hypothesis	Criterion Used with the Decision Rule ⁱⁱⁱ	Significance Level (α)	Decision Rule/ Hypothesis	Criterion Used with the Decision Rule	Significance Level (α)	
Narrative Criteria	Color	Hypothesis Test: Two Sample, one tailed t-Test	Null Hypothesis: There is no difference in color between test stream and control stream.	Reject Null Hypothesis if calculated "t" value exceeds tabular "t" value for test alpha	0.1	Same Hypothesis	Same Criterion	0.4	
	Bottom deposits	Hypothesis Test, Two Sample, one tailed "t" Test	Null Hypothesis: Solids of anthropogenic origin cover less than 20% of stream bottom where velocity is less than 0.5 feet/second.	Reject Null Hypothesis if 60% Lower Confidence Limit (LCL) of mean percent fine sediment deposition (pfsd) in stream is greater than the sum of the pfsd in the control and 20 % more of the stream bottom. i.e., where the pfsd is expressed as a decimal, test stream pfsd > (control stream pfsd)+(0.20)	0.4	Same Hypothesis	Same Criterion	Same Significance Level	Criterion Note: If data is non-normal a nonparametric test will be used as a comparison of medians. The same 20% difference still applies. With current software the Mann-Whitney test is used.

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Designated Use	Analytes	Analytical Tool	Determining when waters are impaired			Determining when waters are no longer impaired			Notes
			Decision Rule/ Hypothesis	Criterion Used with the Decision Rule ⁱⁱⁱ	Significance Level (α)	Decision Rule/ Hypothesis	Criterion Used with the Decision Rule	Significance Level (α)	
Aquatic Life	Biological monitoring (Narrative)	For DNR Invert protocol: Sample sizes of 7 or less, 75% of samples must score 14 or lower.	Using DNR Invert. Protocol: Null Hypothesis: Frequency of full sustaining scores for test stream is the same as for biological criteria reference streams.	Reject Null Hypothesis if frequency of fully sustaining scores on test stream is significantly less than for biological criteria reference streams.	Not Applicable	Same Hypothesis	Same Criterion	Same Significance Level	
		For RAM Fish IBI protocol: Sample sizes of 7 or less, 75% of samples must score less than 36.							
		For DNR Invert protocol and sample size of 8 or more: Binomial Probability	A direct comparison of frequencies between test and biological criteria reference streams will be made.	Rate as impaired if biological criteria reference stream frequency of fully biologically supporting scores is greater than five percent more than test stream.	0.1	Same Hypothesis	Same Criterion	0.4	Criterion Note: For inverts, the reference number will change depending on which EDU the stream is in (X%-5%), for RAM samples the reference number will always be 70 (75%-5%).
		For RAM Fish IBI protocol and sample size of 8 or more: Binomial Probability.							
For other biological data an appropriate parametric or	Null Hypothesis, Community metric(s) in	Reject Null Hypothesis if metric scores for test stream are	0.1	Same Hypothesis	Same Criterion	0.4			

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Designated Use	Analytes	Analytical Tool	Determining when waters are impaired			Determining when waters are no longer impaired			Notes
			Decision Rule/ Hypothesis	Criterion Used with the Decision Rule ⁱⁱⁱ	Significance Level (α)	Decision Rule/ Hypothesis	Criterion Used with the Decision Rule	Significance Level (α)	
Aquatic Life (cont.)		nonparametric test will be used.	test stream is the same as for a reference stream or control streams.	significantly less than reference or control streams.					
			Other biological monitoring to be determined by type of data.	Dependent upon available information.	Dependent upon available information.	Same Hypothesis	Same Criterion	Same Significance Level	
	Toxic chemicals in water: (Numeric)	Not applicable	No more than one toxic event, toxicity test failure or exceedence of acute or chronic criterion in 3 years.	Not applicable	Not applicable	Same Hypothesis	Same Criterion	Same Significance Level	
	Toxic chemicals in sediments: (Narrative)	Comparison of geometric mean to PEC value, or calculation of a PECQ value.	Waters are judged to be impaired if parameter geomean exceeds PEC, or site PECQ is exceeded.	For metals use 150% PEC threshold. The PECQ threshold value is 0.75.	Not applicable	Water is judged to be unimpaired if parameter geomean is equal to or less than PEC, or site PECQ equaled or not exceeded.	For metals use 150% of PEC threshold. The PECQ threshold value is 0.75.	Not applicable	Compliance with Water Quality Standards Note: In the case of toxic chemicals occurring in benthic sediment rather than in water, the numeric thresholds used to determine the need for further evaluation will be the Probable Effect Concentrations proposed in "Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems" by MacDonald, D.D. <i>et al.</i> Arch. Environ. Contam. Toxicol. 39,20-31 (2000). These Probable Effect Concentrations are as follows:

Appendix D

DESCRIPTION OF ANALYTICAL TOOLS USED FOR DETERMINING THE STATUS OF MISSOURI WATERS (11" X 14" FOLD OUT)

Designated Use	Analytes	Analytical Tool	Determining when waters are impaired			Determining when waters are no longer impaired			Notes
			Decision Rule/ Hypothesis	Criterion Used with the Decision Rule ⁱⁱⁱ	Significance Level (α)	Decision Rule/ Hypothesis	Criterion Used with the Decision Rule	Significance Level (α)	
Aquatic Life (cont.)									33 mg/kg As; 4.98 mg/kg Cd; 111 mg/kg Cr; 149 mg/kg Cu; 48.6 mg/kg Ni; 128 mg/kg Pb; 459 mg/kg Zn; 561 µg/kg naphthalene; 1170 µg/kg phenanthrene; 1520 µg/kg pyrene; 1050 µg/kg benzo(a)anthracene, 1290 µg/kg chrysene; 1450 µg/kg benzo(a)pyrene; 22,800 µg/kg total polyaromatic hydrocarbons; 676 µg/kg total PCBs; chlordan 17.6 ug/kg; Sum DDE 31.3 ug/kg; lindane (gamma-BHC) 4.99 ug/kg. Where multiple sediment contaminants exist, the Probable Effect Concentrations Quotient shall not exceed 0.75. See Appendix D and Section II. D for more information on the Probable Effect Concentrations Quotient.
	Temperature, pH, total dissolved gases, oil and grease, dissolved oxygen (Numeric)	Binomial probability	Null Hypothesis: No more than 10% of samples exceed the water quality criterion.	Reject Null Hypothesis if the Type I error rate is less than 0.1.	Not applicable	Same Hypothesis	Same Criterion	Same Significance Level	
Losing Streams	<i>E. coli</i>	Binomial probability	Null Hypothesis: No more than 10% of samples exceed the water quality criterion.	Reject Null Hypothesis if the Type I error rate is less than 0.1.	0.1	Same Hypothesis	Same Criterion	Same Significance Level	

11/15/2017

Appendix D

DESCRIPTION OF ANALYTICAL TOOLS USED FOR DETERMINING THE STATUS OF MISSOURI WATERS (11" X 14" FOLD OUT)

Designated Use	Analytes	Analytical Tool	Determining when waters are impaired			Determining when waters are no longer impaired			Notes
			Decision Rule/ Hypothesis	Criterion Used with the Decision Rule ⁱⁱⁱ	Significance Level (α)	Decision Rule/ Hypothesis	Criterion Used with the Decision Rule	Significance Level (α)	
Human Health – Fish Consumption	Toxic chemicals in water (Numeric)	Hypothesis test: 1-sided confidence limit	Null Hypothesis: Levels of contaminants in water do not exceed criterion.	Reject Null Hypothesis if the 60% LCL is greater than the criterion value.	0.4	Same Hypothesis	Reject Null Hypothesis if the 60% UCL is greater than the criterion value.	Same Significance Level	
	Toxic chemicals in tissue (Narrative)	Four or more samples: Hypothesis test 1-sided confidence limit	Null Hypothesis: Levels in fillet samples or fish eggs do not exceed criterion.	Reject Null Hypothesis if the 60% LCL is greater than the criterion value.	0.4	Same Hypothesis	Reject null hypothesis if the 60% UCL is greater than the criterion value.	Same Significance Level	
Drinking Water Supply (Raw)	Toxic chemicals (Numeric)	Hypothesis test: 1-sided confidence limit	Null Hypothesis: Levels of contaminants do not exceed criterion.	Reject Null Hypothesis if the 60% LCL is greater than the criterion value.	0.4	Same Hypothesis	Reject null hypothesis if the 60% UCL is greater than the criterion value.	Same Significance Level	
	Non-toxic chemicals (Numeric)	Hypothesis test: 1-sided confidence limit	Null Hypothesis: Levels of contaminants do not exceed criterion.	Reject Null Hypothesis: if the 60% LCL is greater than the criterion value.	0.4	Same Hypothesis	Reject null hypothesis if the 60% UCL is greater than the criterion value.	Same Significance Level	
Drinking Water Supply (Finished)	Toxic chemicals	Methods stipulated by Safe Drinking Water Act.	Methods stipulated by Safe Drinking Water Act.	Methods stipulated by Safe Drinking Water Act.	Methods stipulated by Safe Drinking Water Act.	Same Hypothesis	Same Criterion	Same Significance Level	

Appendix D

DESCRIPTION OF ANALYTICAL TOOLS USED FOR DETERMINING THE STATUS OF MISSOURI WATERS (11" X 14" FOLD OUT)

Designated Use	Analytes	Analytical Tool	Determining when waters are impaired			Determining when waters are no longer impaired			Notes
			Decision Rule/ Hypothesis	Criterion Used with the Decision Rule ⁱⁱⁱ	Significance Level (α)	Decision Rule/ Hypothesis	Criterion Used with the Decision Rule	Significance Level (α)	
Whole Body Contact and Secondary	Bacteria (Numeric)	Geometric mean	Null Hypothesis: Levels of contaminants do not exceed criterion.	Reject Null Hypothesis: if the geometric mean is greater than the criterion value.	Not Applicable	Same Hypothesis	Same Criterion	Not applicable	
Irrigation & Livestock Water	Toxic chemicals (Numeric)	Hypothesis test 1-Sided confidence limit	Null Hypothesis: Levels of contaminants do not exceed criterion.	Reject Null Hypothesis if the 60% LCL is greater than the criterion value.	0.4	Same Hypothesis	Reject null hypothesis if the 60% UCL is greater than the criterion value.	Same Significance Level	
Protection of Aquatic Life	Nutrients in lakes (Numeric)	Hypothesis test	Null hypothesis: Criteria are not exceeded.	Reject Null Hypothesis if 60% LCL value is greater than criterion value.	0.4	Same Hypothesis	Same Criterion	Same Significance Level	Hypothesis Test Note: State nutrient criteria require at least four samples per year taken near the outflow point of the lake (or reservoir) between May 1 and August 31 for at least four different, not necessarily consecutive, years.

ⁱⁱⁱ Where hypothesis testing is used for media other than fish tissue, for data sets with five samples or fewer, a 75 percent confidence interval around the appropriate central tendencies will be used to determine use attainment status. Use attainment will be determined as follows: (1) If the criterion value is above this interval (all values within the interval are in conformance with the criterion), rate as unimpaired; (2) If the criterion value falls within this interval, rate as unimpaired and place in Category 2B or 3B; (3) If the criterion value is below this interval (all values within the interval are not in conformance with the criterion), rate as impaired. For fish tissue, this procedure will be used with the following changes: (1) it will apply only to sample sizes of less than four and, (2) a 50% confidence interval will be used in place of the 75% confidence interval.



**Draft 2018 Listing Methodology Document
PUBLIC COMMENTS**

**Public Notice
October 1, 2015 – January 31, 2016**

**Missouri Department of Natural Resources
Water Protection Program
PO Box 176
Jefferson City, MO 65102-0176
800-361-4827 / 573-751-1300**

Rielly, Trish

From: Perkins, Bruce <Perkins.Bruce@epa.gov>
Sent: Monday, November 30, 2015 8:01 AM
To: Rielly, Trish
Subject: Comments on the 2016 MO draft 303(d) list

Trish,

Here are the EPA's comments on your draft list. Also one on the 2018 methodology. Let me know if you have any questions.

EPA comments on the draft 2016 Missouri Section 303(d) List

The following comments are presented alphabetically by the water body name as it is expressed in the public notice draft version.

Barker Creek Tributary (WBID 4083) - This water body is proposed to be newly listed for impairment due to an excursion of the EPA-approved Missouri water quality criterion for dissolved oxygen. In review of the state supplied assessment spreadsheet, it was noted that the assessment also recommended impairment by chloride plus sulfate and pH. However, the draft list does not include those two impairments.

Bee Fork (WBID 2760) – This water is proposed to be listed for contaminated sediments (Lead). This water was previously listed for lead in water and the supplied assessment spreadsheet also identifies lead in water not sediment.

Blackberry Creek (WBID 3184) – This water body is proposed for listing due to an impairment cause of Total Dissolved Solids. It was previously listed for excursion of the chloride plus sulfate criterion. The EPA-approved Missouri water quality standards do not have a criterion for total dissolved solids but do for chloride plus sulfate, under section 303(d) a state's waters are assessed against the state's EPA-approved water quality standards. In this case a listing for total dissolved solids could be an assessment of the state's narrative criteria, however, the state must still assess against the criterion of chloride plus sulfate. In its action on the 2014 Missouri section 303(d) List, the EPA added this water body to the list for chloride plus sulfate.

Brush Creek (WBID 1371) -This water body is proposed to continue to be listed for the cause of dissolved oxygen. For the 2016 cycle an additional cause of total suspended solids has been added. In a review of the provided assessment spreadsheet it is noted that the assessment does not indicate an impairment for total suspended solids. The sheet explicitly states there are low levels of total suspended solids.

Brush Creek (WBID 3986) – The assessments sheet has errors. The calculations are not in the same column as the data being assessed. The state did not use the same data that was used by the EPA to list this water for PAHs in sediment. New data for this water body available at the KCwaters web site (the source was identified to the state during the 2014 listing cycle and therefore should be considered readily available) was not used in the 2016 cycle assessment.

Center Creek (WBID 3203) – This water body is proposed for delisting of lead contaminated sediments due to a change in the states methodology for assessing potentially toxic sediments. While the geometric mean of all sediment samples now falls below the narrative threshold, all samples collected from mile 1 through 11.6 are greater than the threshold. This indicates that the new methodology results in an overall average of nontoxic sediments, while all samples from the area located within historic mining areas still indicate potential toxicity based on the methodology. As such, the ten mile portion of this assessment unit with toxic sediments greater than the state's narrative threshold is masked and not acknowledged by this proposal.

Flat River Creek (WBID 2168) – This water body is proposed to have the cause lead in fish tissue added for the 2016 listing cycle. A review of the EPA-approved TMDL for this water body (Big River TMDL approved 3/24/2010) shows the TMDL targets specifically identified lead in fish tissue. As such, that TMDL applies to this cause and the water body / pollutant combination already has a TMDL. Additionally, the cadmium impairment has been shifted from water to sediment while the assessment spreadsheet indicates that the impairment remains in water and not sediment.

Joplin Creek (WBID 5006) - This water body is proposed for listing with causes of lead and cadmium. In review of the assessment spreadsheet no lead impairment is shown. The assessment identifies cadmium and zinc as impairments for

this water body. However, there is only one excursion of zinc criteria shown in the sheet. One excursion does not require the state to identify an impairment, the assessment target is typically more than one excursion in three years on average.

Mississippi River (WBID 1707, 1707.03) – This water body is proposed to continue its listing for *Escherichia coli*. The water body identification number is not consistent between the 2014 list and the 2016 proposal.

Peruque Creek (WBID 0216) – This water body is proposed for delisting based on a lack of fish kills since 2010. There is no information presented that the fish population has recovered so that there are any fish in the assessment unit. As such a delisting may be premature if the fish community is absent. Time itself is not considered “good cause” for delisting an assessment unit.

Turkey Creek (WBID 3217) – This water body is proposed for delisting of the cause lead contaminated sediment. The portion of the assessment unit between Hwy 66 and Hwy 249 are consistently above the target for listing with one exception. In addition, contaminated sediments using the new averaging methodology continue for cadmium and zinc. These multiple lines of evidence suggest continued impairment of this assessment unit. A proposal to delist this water body pollutant combination was disapproved by the EPA for Missouri’s 2014 cycle list and it was listed by the EPA.

Willow Branch (WBID 3280) – This water body is proposed for delisting of the causes cadmium and lead contaminated sediments based on a new listing methodology. The listing is retained for zinc contaminated sediments. Similar to Turkey Creek (see above) this water body exhibits sediment concentrations of cadmium and lead in portions of the assessment unit that consistently exceed the concentration targets for listing. By taking the geometric mean of all samples this condition is masked.

Wilsons Creek (WBID 2375) – The data presented for delisting of PAH contaminated sediments in this water body do not agree with the data collected by the EPA. It seems there have been mix ups in the location of some of the samples as data is attributed to sites on dates where no samples were collected at those sites. If the state would like, the EPA could resupply the original data for reassessment.

General Comment

Please provide an edited Table H with the extent of assessed water bodies for those previously only identified as 8-20-13 MUDD V1.0.

Comment on 2018 listing methodology.

Hardness is defined in the state’s EPA-approved WQS. A state’s 303(d) list is based on water quality standards and is reviewed by the EPA based on standards.

Bruce Perkins
Regional Integrated Report Coordinator
US EPA Region 7
Water Wetlands and Pesticides Division
Water Quality Management Branch
11201 Renner Blvd.
Lenexa, KS 66219
(913) 551 7067

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STEPHEN G. NEWMAN
JOHN A. RUTH
NICOLE L. SUBLETT
ALICIA EMBLEY TURNER

January 29, 2016

Missouri Department of Natural Resources
Attn.: Trish Rielly
Water Protection Program
P.O. Box 176, Jefferson City, MO 65102
trish.rielly@dnr.mo.gov

Re: Comment on Proposed 2018 Listing Methodology

Dear Trish:

I am writing on behalf of Simmons Foods, Inc. to provide comment on those sections of the proposed 2018 Listing Methodology that relate to the biological assessment of small streams. As reported in the methodology, when the MSCI is calculated according to the Wadeable/Perennial Reference Stream criteria, 70% of the Class U are unclassified streams. There is a 70% failure rate for unclassified candidate reference streams.

For a fair comparison to be made, small streams being assessed should be of the similar size to candidate reference streams. Candidate reference streams should have the same valley segment type, the same flow excluding artificial flows from effluent and similar land use. Small, effluent-dominated streams do not have the same morphology as streams with the same natural flow but which have much larger watersheds. Therefore, small effluent-dominated streams should not be compared to candidate reference streams with the same flow from natural sources but which have different stream morphology and larger watersheds.

With these thoughts in mind, I suggest to the 2018 Listing Methodology as described in the following paragraphs.

Comment No. 1:

Aquatic Macroinvertebrate Community Data

The department conducts aquatic biological assessments to determine macroinvertebrate community health as a function of water quality and habitat. The health of a macroinvertebrate community is directly related to water quality and habitat. Almost all macroinvertebrate evaluation consists of comparing the health of the community of the "target" to healthy macroinvertebrate communities from reference streams of the same general size and usually in the same Ecological Drainage Unit (EDU).

Assessing Small Streams

ATTORNEYS AT LAW

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* * *

For test streams that are smaller than wadeable perennial reference streams, MDNR also samples five candidate reference streams (small control streams) of same or similar size, flow under natural conditions (excluding effluent) and Valley Segment Type (VST) in the same EDU with the same or similar land use twice during the same year the test stream is sampled (additional information about the selection small control streams is provided below). Although in most cases the MDNR samples small candidate reference streams concurrently with test streams, existing data may be used if a robust candidate reference stream data set exists for the EDU.

Selecting Small Candidate Reference Streams

Accurately assessing streams that are smaller than reference streams begins with properly selecting small candidate reference streams. Candidate reference streams are smaller than WPRS streams and have been identified as “best available” reference stream segments in the same EDU as the test stream according to watershed, riparian and in-channel conditions. The selection of candidate reference streams is consistent with framework provided by Hughes *et al.* (1986) with added requirements that candidate reference streams must be from the same EDU and have the same or similar values for VST parameters. If candidate reference streams perform well when compared to WPRS, then test streams of similar size and VST are expected to do so as well. VST parameters important for selection are based on temperature, stream size, natural flow (excluding effluent), geology, land use, and relative gradient, with emphasis placed on the first three parameters.

Comment No. 2.

Page 21 of the Listing Methodology discusses full attainment for determining non-attainment of aquatic life based on seven or fewer macroinvertebrate samples or more than eight samples. I inquired with you the minimum number of samples required before an attainment determination will be made by the department. The department responded by saying the data must meet the data qualifications of either a data code three or four.

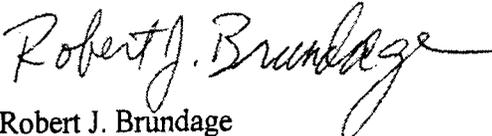
I am aware the department’s aquatic macroinvertebrates monitoring protocol provides that samples are collected during the fall and spring. However, I am concerned the sample size for Data code three should require both spring and fall samples. I suggest Data code three be revised as follows:

Data code three - where a minimum of one quantitative biological monitoring study of at least one aquatic assemblage (fish, macroinvertebrates, or algae) at multiple sites (spring and fall samples), or multiple samples at a single site when data from that site is supported by biological monitoring at an appropriate control site.

Thank you for the opportunity to comment. Should you wish to discuss these comments further, feel free to contact me.

Sincerely,

NEWMAN, COMLEY & RUTH P.C.

By: 
Robert J. Brundage



ASSOCIATION OF MISSOURI CLEANWATER AGENCIES

Comments on Draft 2018 Impaired Waters Listing Methodology

January 6, 2015

Thank you for this opportunity to provide input regarding the 2018 proposed 303(d) listing methodology. We are impressed with the technical robustness of much of the proposed methodology. However, we believe there remain several areas that could be enhanced that will facilitate our shared goal of yielding scientifically accurate water body assessments.

Sampling for acute toxic pollutant parameters: The methodology should specify that two grab samples for acute pollutant parameters will be taken within one hour, 15 minutes apart. This is critical to minimize errors in grab sampling as well as the impact of data outliers. Sampling personnel are already at the stream sampling locations and staying here for 15 minutes is not a major staffing issue. The regulatory implications of incorrect impaired waters listings readily justify taking two samples 15 minutes apart for acute toxic pollutant parameters.

Determination of applicable hardness for hardness dependent water quality criteria: The methodology provides that when there are fewer than eight samples DNR will use the 25th percentile hardness (soon to change to median hardness once that change in the pending triennial review of WQS is adopted) to calculate the applicable instream water quality standard. This approach is okay for chronic criteria but incorrect for acute criteria. For acute samples DNR should use the actual hardness associated with each sample, regardless of number of samples available.

Evaluating Chronic Criteria: Chronic criteria are expressed as 4-day average criteria. The methodology does not explain how available data are manipulated to calculate the highest four-day average value. It would be incorrect for DNR to compare a single grab sample result to a 4-day chronic standard. Instead, DNR should either sample daily for four consecutive days or take all annual data and then calculate the highest 4-day average (to an appropriate level of confidence).

Data Quality. We are under the impression that USGS grades its data (excellent, good, fair, or poor). If that is correct, where data are evaluated by USGS as being either "poor" or "fair", we do not believe such data should be used to make an impaired waters determination. Instead, follow up monitoring should be performed until valid data (good or excellent) are collected. If DNR currently considers the USGS data qualifiers, it should explain how it does so.

1-in-3 Samples for Toxics. We disagree with the proposed approach of listing a water as being impaired for toxics if more than one sample in any three year period exceeds the applicable criterion. While such an approach may make sense for a significant toxicity event such as a fish kill (the three year period giving the aquatic community time to recover) it does not make sense

for isolated, non-significant excursions. Moreover, it places too much significance on a single grab sample or two samples in a three year period. Consider, two samples slightly above the copper criterion out of 50 samples. The two would lead to an impaired waters determination. We think the 10 percent approach should also be applied to toxics in lieu of the 1-in-3 policy with the proviso that DNR will designate a water as being impaired if there are two documented significant toxicity events (fish kill or sampling results exceeding the applicable criterion by 100 percent) in any three year period.

Application of the Stable Flow Provision. DNR reports that it applies a "stable flow" qualifier for determining whether toxics data are representative and should be used for impaired waters determinations. We recommend that the final methodology specify that DNR will document its evaluation of stable flow conditions for all data for each water that it proposes and adds to the impaired waters list.

###

January 29, 2016

Ms. Trish Rielly
Water Protection Program
Missouri Department of Natural Resources
P.O. Box 176
Jefferson City, MO 65102

Subject: Public Comments Regarding the Proposed 2018 Section 303(d) Listing Methodology Document

Ms. Rielly:

The City of Springfield, Missouri (City) submits the following comments regarding the proposed Methodology for the Development of the 2018 Section 303(d) List in Missouri (2018 LMD) placed on public notice by the Missouri Department of Natural Resources (MDNR or Department) on October 1, 2015.

The City supports the addition of subcategory 5-alternative

The City strongly supports MDNR's addition of subcategory 5-alternative (5-alt) to the LMD. The inclusion of category 5-alt provides additional needed flexibility where TMDLs may not be appropriate, particularly in the case of urban stream impairments where watershed management efforts are much more effective. The City interprets the inclusion of subcategory 5-alt as a willingness by MDNR to strongly consider prioritizing alternative restoration approaches over development of a TMDL.

Methodology does not explain how excursions from the one-in-three year frequency will be determined

For the protection of aquatic life, the LMD currently limits exceedances of acute or chronic criteria to no more than once in the last three years for toxic chemicals. The problem with this requirement arises from comparing discrete grab samples to a 4-day average criterion. Counting an individual sample as a criterion excursion places too much significance on single data points and increases the likelihood of false positives (i.e., concluding the segment is impaired when in fact it is not) as sample frequency increases. To address this issue, the City recommends applying the 10% exceedance rule currently applied to conventional pollutants. Alternatively, the Department could specify sampling on four consecutive days or calculate a statistically representative 4-day average. For example, data could be segregated by each of the preceding three years and the 95th percentile 4-day average could be used for comparison to the criterion.

Office of the Director
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Requiring the use of reference percentile hardness values is inappropriate

The draft LMD now requires the use of “reference” percentile hardness values for hardness based metals where there are more than eight samples. The Department clarified that “reference” points back to Missouri’s water quality standards (10 CSR 20-7.031) rather than reference or control stream conditions. It is unclear why a percentile hardness value would ever be preferred over paired-hardness data, if available. While use of a reference percentile hardness value is appropriate for permit effluent limit calculations, which represents predicted circumstances, paired hardness data should be preferred for determination of standards attainment as it best represents actual toxicity. Therefore, the City requests that the Department remove this requirement. Additionally, the City requests that the LMD specify the following in reference to compliance with any hardness based metals criteria (e.g., numeric criteria that are included in state standards (p. 47) and narrative criteria based on numeric thresholds not contained in state standards (p. 51): “For determination of standards attainment, where available, paired metal/hardness data may be used. Where paired data are not available, the reference percentile hardness provided in state water quality standards will be used to calculate the acute and chronic criteria.” With respect to assessing chronic criteria, hardness data from paired metal/hardness data could be appropriately averaged if the Department adopts a statistically representative 4-day average approach as suggested in the previous comment.

Additional refinements to the Weight of Evidence approach

In May 2014 the City raised concerns about relying on Probable Effect Concentrations (PECs) for impairment decisions without additional lines of evidence. The City noted that the true impact of sediment pollutant concentrations (i.e., the primary measure of sediment toxicity) is complicated by the actual bioavailability of contaminants, which can vary based upon site conditions. To address this concern in the 2016 LMD, the City requested MDNR make the following revision (in bold) to the LMD (currently found on Page 18 of the 2018 LMD):

*This weight of evidence analysis will include the use of other types of environmental data when it is available or collection of additional data to make the most informed use attainment decision. Examples of other relevant environmental data might include **physical and chemical data to better understand potential toxicity (e.g., carbon-normalized equilibrium sediment benchmarks (ESBs) for non-ionizable organic chemicals (NIOCs), porewater concentrations and simultaneously extracted metals/acid-volatile sulfide)**, biological data on fish [Fish Index of Biotic Integrity (fIBI)] or fish tissue, or toxicity testing of water or sediments.*

At the time this request, MDNR chose to postpone making the proposed revision as noted in the April 30, 2014 response document:

Additional discussions may be necessary with sediment toxicity experts prior to incorporating specific types of data for determination of toxicity. The Department would like to explore these suggestions further for potential incorporation into the 2018 LMD.

The City continues to recommend that MDNR adopt the proposed revision and strongly encourages MDNR to explore the issue of sediment toxicity and bioavailability. The City notes that the USEPA has

ESB guidance documents for PAHs, nonionic organics, dieldrin, and endrin, and metals. The City would also welcome the opportunity to provide additional guidance as MDNR explores this issue.

Consistent with the City's previous recommendations and concerns stated above, we also suggest the following refinements (in bold) on Page 19 to clarify that Category 2B or 3B applies where multiple lines of evidence are not available and additional data are needed.

*When the weight of evidence analysis suggests, but does not provide strong scientifically valid evidence of impairment **supported by multiple lines of evidence**, the department will place the water body in question in Categories 2B or 3B.*

Additionally, the City recommends MDNR provide additional clarity that PECs are not independently applicable numeric water quality criteria. Pursuant to §303(c) of the CWA, numeric water quality standards/criteria must be promulgated then reviewed and updated on a regular basis through the rule making process. To date, sediment toxicity numeric criteria have not been addressed in Missouri's WQS. Therefore, numeric translators of narrative criteria (e.g., PECs) may not be used as the sole source for impairment. This is partially addressed in the Appendix D table note on Page 57, which states "the numeric thresholds used to determine the ***need for further evaluation*** (emphasis added) will be the Probable Effect Concentration . . .". However, the intent of the Appendix D table should be clarified by revising the PEC references to read, "For metals ***and organics*** use 150% of the PEC threshold." Similarly, the City suggests additional clarity is needed and offers the following revisions to the text on Pages 32-33.

*For toxic chemicals occurring in benthic sediments, data interpretation will include calculation of a geometric mean for specific toxins from an adequate number of samples, and comparing that value to a corresponding Probable Effect Concentration (PEC) given by MacDonald et al. (2000). The PEC is the level of pollutant above which harmful effects on the aquatic community are likely to be observed. – MacDonald (2000) gave an estimate of accuracy for the ability of individual PECs to predict toxicity. For all metals ~~except arsenic~~ ***and organic contaminants (e.g., polycyclic aromatic hydrocarbons, etc.)***, pollutant geometric means will be compared to 150% of the recommended PEC values. ***This comparison should only be used to assess the need for further evaluation and/or as part of a weight of evidence approach.*** This comparison should also meet confidence requirements applied elsewhere in this document. When multiple contaminants occur in sediment, toxicity may occur even though the level of each individual pollutant does not reach toxic levels. The method of estimating the synergistic effects of multiple pollutants in sediments is described below.*

The City appreciates the opportunity to provide public comment and looks forward to your thoughtful consideration of these comments. Please feel free to contact me at anytime to discuss any of these issues.

Sincerely,

A handwritten signature in black ink, appearing to read "Errin Kemper", with a long horizontal flourish extending to the right.

Errin Kemper, P.E.
Assistant Director – Environmental Services
Springfield Missouri

CC:

Steve Meyer, P.E. – Director
Jan Y. Millington – Assistant City Attorney
Paul Calamita – Aqualaw
Trent Stober, P.E. - HDR



**Draft 2018 Listing Methodology Document
RESPONSES TO PUBLIC COMMENTS**

**Public Notice
October 1, 2015 – January 31, 2016**

**Missouri Department of Natural Resources
Water Protection Program
PO Box 176
Jefferson City, MO 65102-0176
800-361-4827 / 573-751-1300**

INTRODUCTION

Pursuant to 40 CFR 130.7, States, Territories and authorized Tribes must submit biennially to the U.S. Environmental Protection Agency (EPA) a list of water-quality limited (impaired) segments, pollutants causing impairment, and the priority ranking of waters targeted for Total Maximum Daily Load (TMDL) development. Federal regulation at 40 CFR 130.7 also requires States, Territories, and authorized Tribes to submit to EPA a written methodology describing the state's approach in considering and evaluating existing and readily available data used to develop its 303(d) List of impaired waters. The listing methodology must be submitted to EPA each year the Section 303(d) List is due. While EPA does not approve or disapprove the listing methodology, the agency considers the methodology during its review of the state's 303(d) impaired waters list and the determination to list or not to list waters.

The Missouri Department of Natural Resources (department) placed the draft 2018 Listing Methodology Document (LMD) on public notice from Nov. 1, 2015 to Jan. 31, 2016. All original comments received during this public notice period are available online on the department's website at <http://dnr.mo.gov/env/wpp/waterquality/303d/303d.htm>. Comments were received from the following groups or individuals:

Association of Missouri Cleanwater Agencies
City of Springfield
Newman, Comley and Ruth, P.C. Law Firm
U.S. Environmental Protection Agency

This document summarizes and paraphrases the comments received, provides the department's responses to those comments, and notes any changes made to the final draft 2018 LMD resulting from these comments.

Association of Missouri Cleanwater Agencies Comments

Several comments were submitted by the Association of Missouri Cleanwater Agencies (Association). Those comments are summarized below in the order they were presented in the comment letter.

The Association commented that when sampling for acute pollutant parameters, the methodology should specify that two grab samples for acute pollutant parameters will be taken within one hour, 15 minutes apart to minimize errors in grab sampling as well as the impact of data outliers. The Association states that regulatory implications of making an incorrect determination readily justifies taking two samples 15 minutes apart for acute toxic pollutant parameters and that doing so would not be a major staffing issue.

Department Response

Water quality pollutant parameters that have acute water quality criteria for the protection of aquatic life designated use include ammonia, chlorine, cyanide, chloride, metals, and two organic compounds. In the absence of a known chemical spill, or presence of a fish kill or other aquatic life kill, it would be difficult for the department to determine if a toxic event is occurring at the time of a sampling event. A determination of a toxic event would not be known until laboratory chemical analyses have been completed. Due to the infrequent nature of toxic events, the general assumption that toxic events are not occurring under ambient, base flow conditions is reasonable. Should the department determine that a toxic event occurred during the sampling period, this information would be noted in the assessment worksheet and the data used or censored according to the LMD.

It is important to note that field sampling and quality assurance/quality control protocols require assessment sampling to be conducted during representative stream conditions. The majority of monitoring used for assessment purposes is designed to characterize a water body under representative ambient conditions by collecting multiple samples at multiple stream locations (spatially) and over time (temporally). Depending upon the purpose of the water quality study, samples may also be collected multiple times per day to document diurnal fluctuations. Because multiple samples are collected within a day, year or over multiple years, adding an additional sampling requirement to collect two samples within a 15 minute period per hour is not necessary and would not add significant resolution to the data. Additionally, the fiscal impact of an additional sample in terms of both staff time and analytical costs has not been estimated. While the Association asserts such costs may not be “major”, resource costs and allocations could be significant given the number and type of sampling the department conducts for assessment purposes. No changes were made to the draft LMD as a result of this comment.

The Association commented the methodology states that when there are fewer than eight samples the department will use the 25th percentile hardness to calculate the applicable instream water quality standard. When determining hardness for hardness dependent water quality criteria for acute samples, the department should use the actual hardness associated with each sample, regardless of the number of samples available.

Department Response

The Association’s comment does not accurately reflect the text where hardness is referenced in Appendix C of the draft 2018 LMD placed on public notice. The draft 2018 LMD currently states that when determining hardness-based metals criteria (acute or chronic) with eight or fewer samples, the hardness value associated with the sample will be used. This current language is consistent with how the Association states the methodology should read and no change is necessary. No changes were made to the draft LMD as a result of this comment.

Summary of draft 2018 LMD comments

When determining hardness-based metals criteria with more than eight samples, the department will use the 25th percentile hardness to calculate the applicable instream water quality standards as required by 10 CSR 20-7.031(1)(BB).

The Association also commented that chronic criteria are expressed as 4-day average criteria. The methodology does not explain how available data are manipulated to calculate the highest four day average value. It would be incorrect for the department to compare a single grab sample to a 4-day chronic standard. Instead, the department should either sample for four consecutive days or take all annual data to calculate the highest 4-day average.

Department Response

When examining existing and readily available data for assessment purposes, the department verifies that flow conditions at the time of water quality sampling were stable and representative of ambient conditions. If stream flow data are available to support that stable conditions were maintained over a 4-day period, it is reasonable to assume that pollutant loading also remained constant over the same 4-day period when the sampling event occurred. This method of assessment is consistent with EPA Integrated Reporting (IR) Guidance and allows for use of the highest quality data available (<http://www.epa.gov/tmdl/integrated-reporting-guidance>). No changes were made to the draft LMD as a result of this comment.

The Association stated that the U.S. Geological Survey (USGS) grades its data (excellent, good, fair, or poor). Where data are evaluated by USGS as being either poor or fair, the data should not be used to make an impairment determination. Instead follow-up monitoring should be performed until valid data (good or excellent) are collected.

Department Response

The department is aware the USGS graded their continuous monitoring (e.g. sonde) data as excellent, good, fair, or poor and appreciates the comment requesting additional information to be added to the LMD. A clarifying note will be added to specify the department will only use those data rated as excellent and good for assessment purposes.

The Association disagrees with the one-in-three year proposed approach of listing a water as being impaired for toxics. Where it may make sense for a significant toxicity event such as a fish kill, it does not make sense for isolated, non-significant excursions. It places too much significance on a single grab sample or two samples in a three year period. An example of 2 out of 50 samples for copper would cause an impaired water determination. The 10 percent approach should also be applied to toxics in lieu of the one-in-three policy with the proviso that the department will designate a water as being impaired if there are two documented significant

toxicity events (fish kill or sampling results exceeding the applicable criterion by 100 percent) in any three year period. A similar comment was provided by the City of Springfield.

Department Response

The one-in-three year assessment method is consistent with EPA IR Guidance and state implementation of water quality standards. As stated in the guidance, “For toxic (priority pollutants) and protection of freshwater aquatic life, EPA IR guidance recommends use of a one-in-three year maximum allowable excursion recurrence frequency.” The guidance also recommends making non-attainment decisions for “conventional pollutants” and has not encouraged the use of the 10 percent rule with other pollutants, including toxics. Development and implementation of acute and chronic water quality criteria are based on the concept that toxicity criteria contain components of magnitude, duration and frequency protective of aquatic life. The not to exceed more than “once every three years” frequency can be found in both criteria development guidelines (e.g., *Guidelines for Deriving Numerical National Water Quality Criteria for the Protection Of Aquatic Organisms and Their Uses*, (p.34, PB85-227049) and *Water Quality Standards Handbook*, (Chapter 3, p.4, EPA 823-B-94-005a) as well as criteria implementation guidance (e.g., *Technical Support Document for Water Quality-based Toxics Control*, p. 36, EPA 505-2-90-001). Water quality assessments using the once every three year return interval frequency ensures consistency with toxicity criteria development and water quality standards implementation. It also ensures that aquatic communities impacted by pollutants are identified and provided opportunity for ecological recovery from toxic stressors in an expeditious manner. No changes were made to the draft LMD as a result of this comment.

The Association commented that the department applies a “stable flow” qualifier for determining whether toxics data are representative and should be used for impaired waters determinations. It is recommended that the final methodology specify the department will document its evaluation of stable conditions for all data for each water it proposes and adds to the impaired waters list.

Department Response

Specific reference to the “stable flow” qualifier is currently provided on the department’s assessment worksheets. When assessing for chronic toxicity, the department considers the position of stream flow on the hydrographic curve in relation to when a sample was collected. Therefore, access to daily stream flow data for the water body is necessary to provide a reliable estimate of the stream flow two days prior, the day of, and the day following the sample collection date. An assessment determination for chronic toxicity cannot be determined in the absence of stream flow data. No changes were made to the draft LMD as a result of this comment.

City of Springfield comments on the 2018 LMD

The City of Springfield (City) strongly supports the department's additions to the subcategory 5-alt alternative (5-alt) to the LMD. The inclusion of the 5-alt provides additional needed flexibility where Total Maximum Daily Loads (TMDLs) may not be appropriate, particularly in the case of urban stream impairments where watershed management efforts are much more effective. The City interprets the inclusion of subcategory 5-alt as a willingness by the department to strongly consider prioritizing alternative restoration approaches over development of a TMDL.

Department Response

The department appreciates the support and agrees the new category will provide additional flexibility in the assessment and restoration process. No changes were made to the draft LMD as a result of this comment.

The City provided a one-in-three year toxic event comment that was similar to the comment provided by the Association of Missouri Cleanwater Agencies.

Department Response

As stated in the response to the Association, the one-in-three year assessment method is consistent with EPA IR guidance and state implementation of water quality standards. As stated in the EPA IR guidance "For toxic (priority pollutants) and protection of freshwater aquatic life, EPA guidance recommends use of a one-in-three year maximum allowable excursion recurrence frequency." Additional rationale and information can be found in the department's response to the Association. No changes were made to the draft LMD as a result of this comment.

It is unclear why a percentile hardness value would be preferred over paired-hardness data, if available. While use of a reference percentile hardness value is appropriate for permit effluent limit calculations, paired hardness data should be preferred for determination of standards attainment as it best represents actual toxicity. The City requests the department to remove this requirement, and that the LMD specify the reference to compliance with any hardness based metals criteria (e.g. numeric criteria that are included in the state standards and narrative criteria based on numeric thresholds not contained in the state standards).

Department Response

The assessment method described in the draft 2018 LMD is consistent with the Water Quality Standards regulation at 10 CSR 20-7.031(1)(BB) in the determination of compliance with hardness-dependent metals criteria for the protection of aquatic life designated use. Any change to derivation of hardness, and its use within the assessment process, would first require a rule

change to the definition of hardness in the Missouri Water Quality Standards prior to a change in the LMD. No changes were made to the draft LMD as a result of this comment.

The City raised concerns about relying on the probable effect concentration (PECs) for impairment decisions without lines of evidence. The City noted that the true impact of sediment pollutant concentrations is complicated by the actual bioavailability of contaminants, which can vary based upon site conditions. To address the concerns in the 2016 LMD, the City requested the department make wording revisions to the LMD to include specific types of chemical analyses (e.g. carbon-normalization equilibrium sediment benchmarks for non-ionizable organic chemicals, porewater concentrations and simultaneously extracted metals/acid-volatile sulfide) to be conducted to better understand the potential toxicity to aquatic life and would add multiple lines of evidence before making a listing decision.

Department Response

The current assessment procedure of assessing pollutants in sediments at 150 percent of the PEC (instead of 100 percent) provides a reliable basis for assessing sediment quality conditions in freshwater ecosystems and the effects on benthic macroinvertebrate species. These assessments, and the effects and impacts of sediment toxicity that are detected, assist the department in implementing general criteria protections for aquatic life with respect to protection of benthic habitat. The department is not opposed to considering other chemical analyses, and is willing to convene stakeholder meetings of interested parties and the public to discuss future enhancements to the assessment procedure. During the public comment period, the City provided several articles for the department to review. The department is currently reviewing these documents and will convene sediment stakeholder workgroup meetings following review of the available science. In addition to enhancing sediment toxicity assessments for aquatic life protection, the department would be willing to review and investigate the potential for bioaccumulation in aquatic organisms and subsequent food chain transfers to humans or wildlife toward protection of the human health designated use. The department appreciates the City's comment and looks forward to working stakeholders to refine sediment toxicity assessment procedures. No changes were made to the draft LMD as a result of this comment, but future stakeholder meetings will be held to mature the methodology.

The City also recommends the department adds clarity that PECs are not independently applicable numeric water quality criteria. Numeric translators of narrative criteria (e.g. PECs) may not be used as the sole source of impairment. This is partially addressed in the LMD, but additional clarity is needed. The City provided suggested wording additions.

Department Response

The department has included the assessment of pollutants in sediments for potential toxicity since the 2008 listing cycle. The sediment PEC thresholds are used as a numeric translator to

determine if the general criteria for the protection of aquatic life as stated in Missouri Water Quality Standards are being met. At the suggestion of stakeholders, the weight of evidence approach was added during updates to the listing methodology since the 2010 listing cycle. Overall, the sediment PEC thresholds are still subject to the “weight of evidence” analysis, where it could be overturned by convincing evidence of another kind, such as aquatic life survey that shows full attainment. As currently stated, when data (e.g. chemical and biological) are available the department will include this information as part of the weight of evidence analysis. No changes were made to the draft LMD as a result of this comment.

Newman, Comley and Ruth comments on the 2018 LMD

A comment was submitted on behalf of Simmons Foods, Inc. The comment was in relation to the biological assessment of small streams. Specific wording was provided for inclusion within the draft 2018 LMD to state “For streams smaller than wadeable perennial reference streams, that candidate reference streams (small control streams) of similar size, flow under natural conditions (excluding effluent) and valley segment type (VST) in the ecological drainage unit (EDU) with the same or similar land use twice during the same year the test stream is sampled.”

The following section of the draft 2018 LMD was referenced “When the Missouri Stream Condition Index (MSCI) is calculated according to the wadeable/perennial reference streams, 70% of the Class U are unclassified streams. There is a 70% failure rate for unclassified candidate reference streams.” For a fair comparison to be made, small streams being assessed should be of similar size to candidate reference streams. Candidate reference streams should have the same valley segment type, the same flow excluding artificial flow from effluent and similar land use. Small, effluent dominated streams do not have the same morphology as streams with the same natural flow, but which have much larger watersheds. Therefore, small effluent-dominated streams should not be compared to candidate reference streams with the same flow from natural sources, but which have different stream morphology and larger watersheds.

Department Response

The department agrees and recognizes that small streams should be assessed to streams of similar size and characteristics. Because of this recognition, the department had developed a 13-step process for selecting candidate reference streams. During revisions to the 2014 LMD, the stepwise process was added and incorporated into the assessment process. Candidate reference streams represent the best available stream conditions within the same EDU as the test stream. It is important to note that streams and their watersheds are unique, and no two systems will be completely identical to one another. That said, the stepwise process for selecting candidate reference streams provides a systematic means for selecting small streams that have similar characteristics. No changes were made to the draft LMD as a result of this comment.

The department would like to note that there are many effluent dominated and dependent stream systems located throughout the state. Effluent dominated or dependent systems provide

Summary of draft 2018 LMD comments

permanent and stable stream flow, and aquatic habitats throughout the year. These conditions provide an environment for aquatic life to become established and maintained. Previously, many small streams were protected under the state's general water quality criteria provided in Missouri Water Quality Standards regulation. However, under the revised stream classification system, many of these small streams are now protected under both numeric and general water quality criteria regardless if they are natural or effluent dominated systems.

An additional comment was submitted by Newman, Comley and Ruth in relation to the LMD discussing full attainment for determining non-attainment of aquatic life based upon seven or fewer macroinvertebrate samples or more than eight samples. An inquiry was made regarding the minimum number of samples required, where the department responded by stating the data must meet the data qualifications of either a data code three or four. Suggested wording was provided to revise data code three to require both spring and fall samples.

Department Response

The department agrees, and has added the suggested wording to the 2018 LMD to clarify the minimum number of samples necessary to make a biological assessment for aquatic macroinvertebrate data under data code three.

EPA Comment on 2018 LMD

Hardness is defined in the state's EPA-approved water quality standards. A state's 303(d) list is based on water quality standards and is reviewed by the EPA based on standards.

Department Response

The department assesses hardness based parameters at the 25th percentile when a minimum of eight (8) hardness samples are available. The department believes this minimum provides confidence in the accuracy of the data result. No changes were made to the draft LMD as a result of this comment.

1 BEFORE THE MISSOURI DEPARTMENT OF NATURAL RESOURCES
 MISSOURI CLEAN WATER COMMISSION

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PUBLIC HEARING

Draft 2018 303(d) Listing Methodology Document

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January 6, 2016

Lewis and Clark State Office Building

9

1101 Riverside Drive

Jefferson City, MO 65102

10

11 Before:

12 Todd Parnell - Chair

Buddy Bennett - Vice Chair

13 John Cowherd - Commissioner

Samuel Leake - Commissioner

14 Ashley McCarty - Commissioner

Wallis Warren - Commission

15

16 THE COURT REPORTER:

17 Jenna Petree

MIDWEST LITIGATION SERVICES

18 2511 Broadway Bluffs

Columbia, MO 65201

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1 PROCEEDINGS

2 We'll move into Agenda Item 2, which is the
3 draft 2018 303(d) Listing Methodology document of the
4 public hearing. The opening statement is that the
5 Commission will begin the public hearing on the proposed
6 2018 Listing Methodology Document. The purpose of this
7 public hearing is to provide the Department an opportunity
8 to present testimony and to provide both the Department and
9 the public the opportunity to comment on proposed listing
10 methodology.

11 This public hearing is not a forum for debate
12 or resolution of issues. The Commission asked that those
13 commenting limit their testimony to five minutes, not
14 repeat the comments that others have already made. The
15 Commission will first hear testimony from the Department.
16 Following the Department's testimony, the Commission will
17 give the public an opportunity to comment. We ask that all
18 individuals present fill out an attendance card so that our
19 records are complete. If you wish to present verbal
20 testimony, please indicate that on your attendance card.
21 When you come forward to present testimony, please speak
22 into the microphone and begin by identifying yourself to
23 the court reporter.

24 Following the public hearing today, the
25 Commission will review the testimony presented and make

1 appropriate modifications to the proposed documents. The
2 Commission plans to take final action at the April 1, 2016
3 meeting.

4 The court reporter will now swear in anyone
5 wishing to testify at this public hearing before the Clean
6 Water Commission today. All those wishing to comment,
7 please stand.

8 The following individuals, TRISH RIELLY, LESLIE HOLLOWAY,
9 JAY HOSKINS, ROBERT BRUNDAGE were duly sworn and provided
10 the following testimony:

11 CHAIRMAN PARNELL: Thank you. All right.
12 Trish, you're back up.

13 MS. RIELLY: Good morning again. Again, my
14 name is Trish Rielly. I'm currently the supervisor of the
15 Monitoring and Assessment Unit within the Watershed
16 Protection Section of the Water Protection Program. Today
17 I will be providing information on the draft 2018 Listing
18 Methodology that is currently posted on the Department's
19 website for public comment.

20 As background, the Listing Methodology is a
21 document that describes how the Department will use water
22 quality data to determine if waters of the state are
23 impaired. Department staff meet with stackholders and
24 other interested members of the public once every two years
25 to revise this document as needed.

1 The proposed 2018 Listing Methodology was
2 placed on public notice on October 1, 2015, which runs
3 concurrently with the public notice of the draft 2016
4 303(d) List, and continues through January 31 of 2016.

5 The Department held two public availability
6 meetings held November 3rd and December 1st of 2015, and a
7 biological workgroup meeting was held November 8th of 2015.
8 A list of attendees and a summary of the meeting
9 discussions can be found on the Department's website.

10 To date, the Department has received one
11 written comment on the draft listing methodology. This
12 comment was received from the USEPA Region 7. Again, all
13 written comments will be continued to be received through
14 the end of this month, January 31, 2016. All public
15 comments, along with the Department's responses, will
16 become part of the public administrative record and posted
17 to the Department's website.

18 Going over a summary of changes from the 2016
19 Listing Methodology. I need to note on the draft 2018
20 Listing Methodology that was posted on the web page, there
21 is a numbering -- a page numbering error. The document is
22 actually 60 pages in length instead of 62 pages. The word
23 processing software automatically counted other pages, such
24 as the title page and the table of contents in the total
25 count. This will be corrected in the final version that

1 will eventually be posted.

2 A majority of the revisions that were made to
3 the 2016 Listing Methodology that was approved by the
4 Commission in July of 2014 related to reformatting the
5 document, in addition to clarifying -- the addition of
6 clarifying statements or information relating to a
7 biological assessments. Minor comments were also made to
8 the tables. Specific updates: There were several places
9 in the document where language was added or modified, but
10 only for the purpose of clarification and did not represent
11 any modification of the assessment process. The document
12 was reformatted to consolidate similar information within
13 the appropriate sections of the document. For example,
14 Appendix D and E of the 2016 Listing Methodology were moved
15 to Section II D on page 18 of the draft 2018 Listing
16 Methodology. While Tables B-1 and B-2 in the 2016 Listing
17 Methodology were combined to create a foldout table as
18 Appendix D in the draft 2018 methodology -- Listing
19 Methodology. The designated use for Human Health for fish
20 consumption was added to Appendix B table in the draft
21 Listing Methodology. Missouri's data solicitation process
22 was added under the Identification of All Existing and
23 Readily Available Water Quality Data Sources section.
24 Clarification was added that chronic pH will be used in the
25 2018 Listing Methodology only if the criteria appears in

1 the Code of State Regulations and is approved by USEPA.
2 And then clarification was added explaining how the
3 assessment of hardness based metals will be conducted when
4 samples are fewer or greater than eight samples.

5 Again, the recommendation -- the purpose of
6 today's hearing was to introduce the draft 2018 Listing
7 Methodology and to allow the public to provide comments.
8 The Department will request the Commission's approval at
9 the April Commission meeting. Information that's available
10 on the Department's website includes: The draft 2018
11 303(d) Listing Methodology Document where all the additions
12 and/or updates that were made to this document are noted in
13 comments within that document; meeting discussion summaries
14 of the Public Availability Meetings that were held on
15 November 3rd and December 1st of 2015 in the biological
16 workgroup meeting that was held in 2008. Did I say 2008?
17 I didn't mean 2008, I meant November 8th. That's all I
18 have.

19 CHAIRMAN PARNELL: Any questions
20 Commissioners? Thank you, Trish. Leslie, you're back up
21 again. Missouri Farm Bureau.

22 MS. RIELLY: Thank you, Mr. Chairman. I
23 really don't have anything to add to the comments that I
24 already made, but I would just call your attention to the
25 summary of the public meeting discuss, which I thought was

1 pretty thorough. Thank you.

2 CHAIRMAN PARNELL: Thank you. Mr. Brundage,
3 MCR.

4 MR. BRUNDAGE: Good morning, Commissioners.
5 I'm going to submit some written comments on this before
6 the deadline. But I have participated in the process all
7 along and made several comments and attended the
8 bio-assessment meeting. I want point out for the record
9 that I appreciate that this Commission is holding this
10 hearing today. If you recall, I don't know, a year and
11 half ago or whatever it was, the Commission chose not to
12 personally hear the comments of stakeholders and now you
13 have. There are fewer issues this time around, but still
14 they are important nonetheless. One of the comments that I
15 will be making and one of the things that I have been
16 discussing with the Department is how you assess the really
17 small streams when most of the criteria have been developed
18 for the larger streams and bio that lives in those streams.
19 So, that continues to be an important issue. The last time
20 around I made comments to you on your approval date and I
21 think the Department is in the process of addressing some
22 of those, so those will be coming up to you. So other than
23 that, I don't have any other comments today, but it's good
24 to be here and good to see you all and happy new year.

25 CHAIRMAN PARNELL: Any questions? Thank you.

1 Closing statement, the Commission will accept comments on
2 the proposed document until 5 -- Oh, I'm sorry. Were you
3 sworn in?

4 MR. HOSKINS: Yes. My name is Jay Hoskins.
5 I'm with the Metropolitan St. Louis Sewer District. I was
6 asked to deliver comments from the Association of Missouri
7 Clean Water Agencies for the public record and Chew and
8 Parnell on behalf of Amsung. Thank you.

9 CHAIRMAN PARNELL: Any others? The Commission
10 will accept comments on the proposed document until 5:00
11 p.m. January 31, 2016. Comments can be submitted to the
12 Department's Water Protection Program by mail to the
13 Department's Water Protection Program, Attention: Trish
14 Rielly, PO Box 176, Jefferson City, Missouri 65102-0176;
15 e-mail directly to trish.rielly@dnr.mo.gov; hand-deliver to
16 the receptionist at the Lewis and Clark State Office
17 Building 1101 Riverside, Jefferson City, mark comments with
18 "Attention To Trish Rielly, Water Protection Program." On
19 behalf of the Commission, I thank everybody who has
20 participated in this process. This hearing is now closed
21 as well.

22 (Hearing concluded at 10:35 a.m.)

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