

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

July 9, 2014

Presentation of the 2016 303(d) Listing Methodology Document

Issue: The proposed 2016 303(d) 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.

Background: The Department has a public participation process for revision of the LMD that generally runs concurrently with the public notice for the 303(d) List. All comments received on the proposed 2016 LMD are documented in the minutes from public meetings, through letter, or email correspondence.

The LMD was originally posted for public comment from October 15, 2013, through January 31, 2014, in conjunction with the proposed 2014 303(d) list of impaired waters. A public hearing on the proposed 2016 LMD was held on January 22, 2014, at the Lewis and Clark State Office Building, Jefferson City, MO.

Public meetings on the proposed 2016 LMD were held concurrently with the proposed 2014 303(d) list of impaired waters. A summary of the meeting discussions are posted to the Department's 303(d) website:

- November 11, 2013 - Proposed 303(d) and 2016 LMD Public Availability Session
- December 11, 2013 - Proposed 303(d) and 2016 LMD Public Availability Session

Comments and Department Responses to the Initial Proposed 2016 LMD

Six written comments were received. A summary of the comments and Department responses are provided in the Commission meeting packet and posted to the Department's 303(d) website.

Biological Workgroup Meeting

Due to stakeholder concerns and comments submitted during the public comment period and made at Commission meetings and hearings, the Department hosted a meeting of the Biological Assessment Workgroup on February 26, 2014, to address remaining stakeholder concerns. A summary of the agenda items, an overview of meeting discussions, and how or where items were addressed in the revised LMD are provided in the commission meeting packet and posted to the Department's 303(d) website.

Biological Workgroup Meeting Comments and Department Responses

An updated, revised 2016 LMD was provided to the Biological workgroup for review and comments. Three written comments were received. A summary of the comments and Department responses are provided in the Commission meeting packet and posted to the Department's 303(d) website.

Changes from 2014 LMD

There were several major updates from the approved 2014 Listing Methodology Document. The major updates were made to add clarity to the biological assessment processes for fish and aquatic macroinvertebrates, use of the weight of evidence approach, handling habitat assessments, the use of candidate reference streams and how they are chosen, and improving transparency of raw data and quality control. There are also several places in the document where language has been added or modified, but only for the purpose of clarification, and do not represent any modification of the assessment process.

A copy of the updated revised 2016 LMD is provided in the Commission meeting packet and is posted to the Department's 303(d) website.

Recommended Action: The Department recommends the Commission approve the document entitled "Missouri 2016 303(d) Listing Methodology, Final July 9, 2014", as is or with any changes deemed necessary by the Commission.

List of Attachments:

- Attachment One. Public Hearing of 303(d) Impaired Waters Listing and 2016 Listing Methodology Document, January 22, 2014.
- Attachment Two. Proposed 2016 Listing Methodology Document Public Comments.
- Attachment Three. Proposed 2016 Listing Methodology Document Responses to Public Comments.
- Attachment Four. Biological Assessment Workgroup Agenda Topics and Discussion Summary, February 26, 2014.
- Attachment Five. Revised Proposed 2016 Listing Methodology Document Biological Assessment Workgroup Comments and Responses, April 30, 2014.
- Attachment Six. Methodology for the Development of the 2016 Section 303(d) List in Missouri, Final July 9, 2014.



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ORIGINAL

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

**PUBLIC HEARING
OF
303(d) IMPAIRED WATERS LISTING
And
2016 LISTING METHODOLOGY DOCUMENT**

HEARING HELD ON JANUARY 22, 2014

NATIONWIDE SCHEDULING

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

PUBLIC HEARING
OF
303(d) Impaired Waters Listing and 2016 Listing Methodology
Document

January 22, 2014
Missouri Department of Natural Resources
Lewis and Clark State Office Building
1101 Riverside Drive
Jefferson City, MO 65102

THE COURT REPORTER:
Jenna Petree, CCR #1347
MIDWEST LITIGATION SERVICES
401 Locust Street
Columbia, MO 65201
573-449-0561

1 MR. MADRAS: Good morning. I would like to
2 welcome everyone to the public hearing on the 2014 303(d)
3 impaired waters list. I'm John Madras of the Water
4 Protection Program and I would like to welcome everyone who
5 is here to testify and speak their thoughts today. First I
6 would like to introduce Marshall Wilson, our hearing
7 officer who is with us today and we'll go from there.
8 Marshall, if you could proceed.

9 MR. MARSHALL: Good morning. The Department
10 will now begin the public hearing on the proposed 2014
11 impaired waters list and the 2015 listing methodology
12 document. My name, as John said, is Marshall Wilson and I
13 have been assigned with the task of conducting this hearing.

14 This hearing is being conducted pursuant to
15 Section 644.036.5 of the Revised Statutes of Missouri. The
16 purpose of this public hearing is to provide the Department
17 an opportunity to present testimony and to provide the
18 public the opportunity to comment on the proposed list and
19 the listing methodology.

20 This public hearing is not a forum for debate
21 or resolution issues. The Department asks that those
22 commenting be concise and not repeat the comments that have
23 already been made by others. We will first hear testimony
24 from the Department. Following the Department's testimony
25 the public will have the opportunity to comment. We ask

1 that all individuals present fill out an attendance card so
2 that our records are complete. If you wish to present
3 testimony, please indicate that on your attendance card.
4 When you come forward to present testimony please speak
5 into the microphone and begin by identifying yourself for
6 the court reporter.

7 Following the public hearing today, the
8 Missouri Clean Water Commission will review the testimony
9 submitted and make appropriate modifications to the
10 proposed 2014 impaired waters list and the 2016 listing
11 methodology documents. The Commission plans to take final
12 action at the April 2, 2014 meeting.

13 The court reporter will now swear in anyone
14 wishing to testify at this public hearing today. Will all
15 those planning to comment, please stand.

16 The following witness were sworn: Trish
17 Rielly, Trent Stover, Robert Brundage, Leslie Holloway, of
18 lawful age have been produced and sworn and testified as
19 follows:

20 MR. MARSHALL: All right. I believe Ms. Rielly
21 from the Department will start us off.

22 MS. RIELLY: Good morning. I would like to
23 thank you everyone for setting up this hearing. My name is
24 Trish Rielly, I'm the supervisor with the monitoring and
25 assessment unit within the Water Protection Program and

1 today I will provide information on the proposed 2014
2 303(d) list of impaired waters and then the 2016 listing
3 methodology that are currently posted on the Department's
4 website for public comment.

5 So first I would like to provide some
6 information on the 2014 303(d) list of impaired waters and
7 those waters proposed for delisting. So a little bit of
8 background, the federal Water Pollution Control Act,
9 Section 303(d) requires states to biannually or once every
10 two years submit to the US EPA Protection Agency, a list of
11 impaired waters for which adequate pollution controls have
12 not yet been required. The Commission approved the 2014
13 listing methodology back in May 2, of 2012, which was
14 followed to assess the waters on the proposed 2013 303(d)
15 list that's being discussed today. The list was placed on
16 public notice on October 15 and will continue through
17 January 31 of 2014.

18 The Department has held to two public
19 availability meetings to discuss the draft 303(3) list.
20 These meetings were held on November 13 of 2013 and
21 December 11 of 2013. A list of attendees and summary of
22 meetings can be found on the Department's website. As of
23 January 21 of 2014, the Department has received and
24 responded to five written comments on the proposed 303(d)
25 list. I would like to provide a summary of the 2014 303(d)

1 list of impaired waters.

2 The proposed list being presented today is
3 composed of 386 water body pollutant pairs. And 56 of
4 those are new to the 2014 proposed list and the remaining
5 320 listings are carried over from the EPA approved 2012
6 303(d) list. The six most common pollutant categories on
7 the list are bacteria, which there is a 112 listings; heavy
8 metals and water sediment, there are 90 listings; dissolved
9 oxygen, 65 listings; mercury and fish tissue, 42 listings;
10 biological impairments based on bio-monitoring, 19
11 listings; and chloride, 17 listings. The five most common
12 pollutant sources were: mining and smelting, which were 91;
13 unknown, 79; rural nonpoint source, 62; atmospheric
14 deposition, 43; and urban runoff, 36.

15 The summary of the proposed waters for
16 delisting, there is a total of 31 water body pollutant
17 pairs from the 2012 list are being proposed for delisting.
18 Of the 31 proposed for delisting, ten now meet water
19 quality standards. Eleven are due to new assessment
20 methods, two now either have an approved TMDL or permanent
21 in lieu of a TMDL, and five are due to being originally
22 listed in error, and three due to changes in definition of
23 the pollutant or re-sedimentation of the water body. So
24 that's a summary of the 2014 303(d) list, the proposed
25 303(d) list. Now I'm going to talk about the proposed 2016

1 listing methodology.

2 A little bit of background, the listing
3 methodology is a document that describes how the Department
4 will use water quality data to determine if waters of the
5 state are impaired. The Department meet with staff and
6 stakeholders and other interested members of the public and
7 we meet once every two years to revise the document as
8 needed. The proposed 2016 listing methodology was placed
9 on public notice of October 15, 2013 and runs concurrently
10 with the public notice for the 303(d) list. The Department
11 held two public availability meetings again in concurrent
12 with the 303(d) list and those again were held on November
13 13 of 2013, December 11 of 2013 and again the list of a
14 attendees and summary of the public availability meeting
15 discussions are -- can be found on the Department's
16 website.

17 So as of January 21, 2014, the Department has
18 responded to one written comment on the proposed listing
19 methodology. The summary of the changes that have
20 occurred, a majority of the revisions made to the 2014
21 listing methodology that was approved by the Commission in
22 May of 2012 related to the addition of clarifying
23 statements or information related to biological assessments
24 and then minor corrections to some of the tables within
25 that document.

1 The updates to the biological assessment
2 included the recommendations provided by the biological
3 assessment group to consult with the Missouri Department of
4 Conservation on the evaluation on habitat scores and other
5 considerations when looking at streams with low fish
6 community scores. We also included an appendix
7 describing -- included in the appendix describing for using
8 fish community data for listing and assessment purposes.
9 And then we added clarifying -- to clarify that fish
10 community data will only be assessed on third to fifth
11 order streams and then added clarification regarding the
12 weighted evidence approach.

13 Minor corrections or clarifications included
14 the expansion of the statistical functions using Microsoft
15 Excel, the processes followed for sediment quote
16 calculations, correcting information in tables that were
17 inadvertently missed during previous methodology revisions
18 and then there were several places in the document where
19 language has been added or modified, but only for purposes
20 of clarification and it did not represent any modification
21 of the assessment process.

22 We recommend -- or actually the purpose of
23 today's hearing is to introduce both the 2014 303.(d) list
24 of impaired waters and the draft of the 2016 listing
25 methodology and to allow the public to provide comments.

1 The Department requests the Commission's approval of the
2 document in the April Commission meeting. And then in
3 closing I would just like to note what information is
4 available on the Department website.

5 We have the proposed 2013 303(d) list and the
6 assessment worksheets, a list of the waters on the 2012 303
7 (d) list that are proposed for removal from the 2014 list,
8 along with the corresponding assessment worksheets. The
9 proposed 2016 listing methodology document is available
10 online and within that document we have noted where all the
11 corrections or updates have been made and those are made in
12 the comment section of the document. And then also summary
13 of the public availability meeting discussions that were
14 held on November 13 and December 11 of 2013 are also posted
15 on the website.

16 And then we encourage the public to provide
17 written comments on the proposed 303(d) list and the
18 listing methodology, which we'll receive through January 31
19 of 2014. All public comments along with the Department's
20 responses will become part of the Public Administrative
21 record and will be made available on the Department's
22 website in the future. Thank you very much.

23 MR. MARSHALL: Thank you, Ms. Rielly. All
24 right. Our first public comment will be Leslie Holloway.
25 Ms. Holloway, if you would identify yourself for the

1 reporter please.

2 MS. HOLLOWAY: Leslie Holloway representing
3 Missouri Farm Bureau. My comments today are primarily on
4 the listing methodology document. And I was able to attend
5 one of the public stakeholder meetings that the Department
6 held. I was involved with the biological data work group
7 that was convened to consider several issues in conjunction
8 with the listing methodology. And I would like to today go
9 through a few of specifics to the revised proposed listing
10 methodology document where my particular interest lie and
11 will be part of my written comment submitted to the
12 Department at a later date.

13 On page 15 under, "Other Quality
14 Assurance/Quality Control" -- excuse me -- "Other Data
15 Quality Considerations," the data age section. This is an
16 issue that I have raised previously before the Clean Water
17 Commission and in written comments and that will be
18 something that I will ask for the Department to review
19 further with stakeholders. On page 16 the, data type and
20 amount and information content had had some discussions
21 previously with staff who were very willing to sit down and
22 review those and would like to have further discussion on
23 how that is addressed formerly in the listing methodology.
24 Specifically about the amount of samples upon which some of
25 the impairment listings are based.

1 On page 17, how water quality data is
2 evaluated to determine whether or not waters are impaired
3 for 303(d) listing purposes. The language in that section
4 relative to weight, specifically the sentence that reads,
5 "Examples of other relevant data might include biological
6 data on fish or aquatic invertebrate animals." And the new
7 language reading which will be giving greater weight on the
8 other types. The sentence continues to read, "or toxicity
9 testing of water sediments."

10 On page 25, getting into the tables towards
11 the end of the document, "Protection of aquatic life." The
12 discussion of the aquatic invertebrates, DNR protocol and
13 the NBC ram protocol have been part of subjects of
14 extensive discussions with the biological data work group
15 and it is unclear yet to me and to others who participated
16 in the work group how some of the decisions were reached.
17 And it's difficult to interpret exactly what these tables
18 are, how these tables will be translated into listing
19 waters. So again, we'll be asking for additional
20 stakeholder discussion with the biological data work group
21 and those same comments apply to Tables B1 and B2 relative
22 to biological monitoring.

23 So in summary, generally we have commented on
24 more than one occasion and are reiterating our comments
25 that there is increased reliance on Missouri Department of

1 Conservation data and we would urge caution in the use of
2 that data which has not been formatted or collected
3 specifically for the purpose of water quality regulation
4 but rather for the purposes the Department of Conservation
5 is charged with in protecting wildlife, forestry and fish
6 resources, which we believe in some cases may coincide with
7 what the 303(d) listing is all about and in other cases may
8 not. But we don't think that it's clear yet exactly how
9 some of those thresholds are being determined. So we are
10 asking DNR to reconvene the biological data work group in
11 advance of the Commission taking action on the listing
12 methodology document. I appreciate the opportunity to
13 testify.

14 MR. MARSHALL: Thank you, ma'am. All right.
15 Next would be Mr. Brundage. Good morning, Robert. Please
16 identify yourself for the record.

17 MR. BRUNDAGE: Robert Brundage, I'm with the
18 law firm of Newman, Comley and Ruth here in Jefferson City.
19 Thank you for the opportunity to testify. Mr. Wilson, no
20 offense to you, sir, however when I same came here today. I
21 was curious if the Clean Water Commission was going to be
22 here today and I did not understand or appreciate that the
23 history of having this public hearing in front of the Clean
24 Water Commission has changed. I would hope that there
25 would be an opportunity to speak to the Clean Water

1 Commission face-to-face. Again, no offense to you, sir.

2 MR. MARSHALL: None taken.

3 MR. BRUNDAGE: So I guess that was one of my
4 comments here today that I would hope there would be an
5 opportunity to testify in front of the Clean Water
6 Commission because these are extremely important decisions.

7 Like Leslie Holloway, I too was --
8 participated in many of the biological subcommittee
9 meetings, if that's what we're going to call that group.
10 At the conclusion of those meetings, there was some areas
11 of consensus and some areas where there was no consensus.
12 I was never exactly clear how some of those areas or how
13 the conclusion of those meetings were all rolled into the
14 new listing methodology document. I guess you have to just
15 read it and try to piece it back together and I haven't
16 completely done that yet, but I guess I'll try to do so
17 before the end of the comment period.

18 I, like Leslie Holloway, I would appreciate
19 the opportunity to have another meeting of that biological
20 committee to kind of review some of those things and also
21 to review some of the areas of testimony that I have today
22 and some the comments that I made during the two public
23 availability sessions that I attended.

24 Another overarching comment that I made during
25 the public availability session was concerning the.

1 Department of Natural Resources increasing reliance upon
2 the data and expertise of the Missouri Department of
3 Conservation. My comment was that the Clean Water
4 Commission and the DNR staff, they have the authority over
5 the 303(d) listing process and they should be ones to make
6 all the decisions. They should not defer completely to the
7 Missouri Department of Conversation and say they have the
8 expertise, whatever they say goes. That's kind of the
9 direction we are going on some of this information and I
10 think the Department of Natural Resources needs to do their
11 own independent review of those areas and have their own
12 staff take ownership of all these issues to decrease the
13 reliance on the conservation department.

14 I want to offer some comments on the use of
15 macro-invertebrate data on page 25 of the draft listing
16 methodology. There is the reference to biological aquatic
17 invertebrates under the DNR protocol and I wanted to
18 discuss the issue of comparing appropriate reference
19 streams or local control streams. The document says that,
20 "The results must be statistically similar to
21 representative reference or control stream." Okay. So
22 what is that? There is a footnote, footnote 18 talks
23 about, "The test streams that are significantly smaller
24 than bio-reference streams." I won't read the rest of it
25 but the term significantly smaller and I think it should be

1 written a different way and there should be a different
2 standard. There shouldn't be any significant difference
3 between the type of streams. There should be significantly
4 similar or -- and I will borrow some other words from the
5 listing methodology previously on page 19 under the
6 definition of Overall Use Protection. It talks about
7 evaluating data based on "similar land use/geology with the
8 stream of the water quality data." So I think there should
9 be similar land uses, there should be similar geology,
10 there should be similar watershed size and there should be
11 similar habitat. We need to make sure we are comparing
12 apples to apples when we have this kind of data because
13 habitat has a -- well it's either habitat issues or it's
14 water quality issues that affect macro-invertebrates. If
15 we don't have and we don't compare the exact same type of
16 habitat and streams, then there is a possibility there
17 would be some listing that are not appropriate one way or
18 the other.

19 In the same band on habitat on page 15 in the
20 narrative of the methodology, there is a discussion that --
21 bear with me. "For the interpretation of biological data
22 where habitat assessments data indicates a habitat scores
23 are less than 75 percent of referenced or appropriate
24 stream scores -- controlled stream scores." So the DNR
25 will use macro-invertebrate data if the subject stream has

1 habitat and is at least 75 percent of the reference stream
2 of the control stream. And I inquired to the Department of
3 where that number came from and in reviewing that, it
4 appeared that the NCSI score of 16 and the research to come
5 up with that score was not exactly the same study to come
6 up with the 75 percent figure. And looking at that
7 research, I think the 75 percent number is probably too
8 low. What it should be I'm not exactly sure but it could
9 be, and possibly should be, more like 90 percent. That
10 needs to be studied further to tie those numbers together.

11 Some of the research or discussion from the
12 Department said, "Although there is a likely variability in
13 habitat quality versus biological condition, we do not have
14 sufficient information at this time to justify departure
15 from the 75 percent number." Well, if you don't have
16 justification to depart from it, you don't have
17 justification for that 75 percent number in the first
18 place. So I think that needs to be looked at and that
19 number possibly needs to be adjusted.

20 The reason I'm bouncing back and forth between
21 documents is because during the public comment period the
22 Department revised the listing methodology and I guess I
23 became aware of that during the second public availability
24 session and so I'm trying to go off of the new document at
25 this point in time.

1 In table 1.2 on page 25, again on
2 macro-invertebrate samples, it talks about for seven or
3 fewer samples. So the Department looks at this data in one
4 way for seven or fewer samples or for eight or more
5 samples. I guess that would apply that if there was a
6 single sample that didn't meet the NCSI of 16, I suppose
7 the Department could 303(d) list based on a single sample.
8 And that is obviously and I would hope everyone agree that
9 is not enough data to 303(d) list a stream. So that issue
10 should be addressed somewhere in the document. In case I
11 haven't found it, it should be addressed somewhere.

12 The other thing is it talks about if there are
13 seven or fewer samples, then it says 75 percent of the
14 stream condition and their scores must be 16 or greater.
15 But if there is more than seven then 75 percent -- let me
16 make sure I try to get this right, bear with me. Well, I
17 think I will defer my comment on that and make sure that I
18 I'm accurate in what I say. I will include that in my
19 written comments.

20 Next thing I want to talk about is the fish
21 IDI and go back to the issue of habitat. That was one of
22 the issues of discussion during the last year or so in the
23 biological subcommittee. And on page 24 if I get this
24 right -- nope page 26 now. Footnote 20, I believe. It
25 talks about if habitat is a "likely problem." And the next

1 footnote 21, talks about habitat is determined to be a
2 significant possible cause for impairment. So the words
3 likely problem or significant possible cause are not
4 adequately defined. And I think that's kind one of the
5 crux of the issues is that during the biological committee
6 meetings, one of my comments was is that when the fish IDI
7 was developed it was not developed for the purpose of
8 making stream impairment decisions. And that there was not
9 a -- when that fish IDI index was tested scientifically, it
10 was not tested against streams that were only impaired by
11 poor water quality. There were streams in there that had
12 poor habitat too. So I know the Department has done some
13 additional work on that, but I don't know if it's really
14 made its way into these footnotes appropriately because if
15 habitat is a likely problem or a significant possible
16 cause, what is that and how is that defined. It's unclear
17 to me at this point in time.

18 Something else I'm going to include in my
19 written comments is concerning the sediment data for
20 probable effects concentration. I corresponded with Trish
21 Rielly and some of the staff that she works with about some
22 of the data and the Department has revised one of the data
23 sheets for a subject stream that I was looking at. I will
24 probably look at some other streams. I guess one of the
25 reasons that the data sheet was revised is because the data

1 was not exactly -- it was not transparent or clear how some
2 of the calculations were made to come of the numbers and
3 the averaging. So how things were averaged, how duplicates
4 were used was not exactly clear and I think the listing
5 methodology document could be clarified in that regard so
6 everyone will understand how all that data is going to be
7 interpreted.

8 The other thing is some of the data that's
9 based upon these decisions was not all available and I did
10 an open records request to request that information, so
11 there should be probably more data included in these data
12 sheets and then a better explanation of how it's used and
13 how the calculations are made.

14 Kind of that same vain on quality
15 assurance/quality control data. Several years ago there
16 was a discussion in front of the Clean Water Commission
17 that I was involved with that it seemed that the Department
18 doesn't archive the quality assurance/quality control data
19 that supports the data in which 303(d) listing is made.
20 It's apparently looked at at the time the data results are
21 reported and that is not maintained or archived or kept
22 with the actual data. So at a later date if nobody -- if
23 no third parties or people in the public looked at the data
24 at the time, if you wait long enough it's not going to be
25 available for you to look at later on. So there is no way

1 for you to corroborate whether the data was reliable in the
2 first place. I think the Department should consider some
3 means to be able to keep it archived all of the QA/QC data
4 together with the data results.

5 Finally on the 303(d) list, there is several
6 listings for new listings for lakes that were apparently
7 impaired by nutrients. During the last several years when
8 the lake nutrient criteria had going through the rule
9 making process and gone to EPA and EPA rejected a majority
10 of the nutrient criteria of the lakes, one of my comments
11 was is that remaining criteria were not really in hindsight
12 based upon or tied to the beneficial uses. And that I
13 suggested to the Department and the Clean Water Commission
14 should rescind temporarily the lake nutrient criteria that
15 were approved by EPA. The Department at the time chose not
16 to do so and now we have going forward with this 303(d)
17 list, listings for lakes that are impaired by nutrients
18 based upon nutrient criteria that in hindsight are flawed.
19 And I would hope that the Department would withdraw those
20 proposed listing before the Clean Water Commission votes on
21 those and that they wait until the entire package of new
22 lake nutrient criteria are adopted by the Clean Water
23 Commission and approved by the EPA before proceeding to
24 list any more lakes on the 303(d) list based on nutrient
25 impairments. That concludes my remarks.

1 MR. MARSHALL: Thank you, sir. Our next
2 comments will come from Trent Stover. Mr. Stover, if you
3 would identify yourself for the record.

4 MR. STOVER: Good morning. I'm Trent Stover
5 with HDR Engineering in our Columbia, Missouri office. I'm
6 also here to make comments on behalf of the City of
7 Springfield, Missouri as well. And I echo several of the
8 comments that Leslie and Robert made. One, to start with
9 the public notice process. There has been revisions and
10 unfortunately I wasn't able to attend some of the other
11 stakeholders meetings, I apologize for that. But there has
12 been a bit of fluidity I guess during this public notice
13 process. Some of that has caused apparent inconsistency
14 within the document which makes it difficult to comment
15 upon. So we'll bring forward the comments that we think
16 are appropriate and speak to those, but I do urge the
17 Department to convene a public meeting and a stakeholders
18 group to discuss some of those comments prior to moving
19 this forward for decision at the Clean Water Commission
20 meeting.

21 In particular some of the inconsistencies that
22 I believe that I saw and again it would be worth sitting
23 down but there appears to be some inconsistency between
24 Tables 1.2, B1 and B2, which are some different tables that
25 apply to either listings or delisting of specific water

1 bodies. For example, there was some changes to the sample
2 size requirements for the macro-invertebrate data analysis
3 and it appears that some of those were inconsistently
4 applied between B1 and B2. B1 doesn't necessarily
5 address -- to me it doesn't appear to address how to deal
6 with sample sizes less than eight for example as well. So,
7 there is some clarification that probably needs to be made
8 within those tables.

9 With respect to data availability and use, the
10 303(d) listing methodology has had for several years some
11 criteria based on data age, in particular I believe it's
12 seven years of data that are set older than seven years
13 have to be evaluated to insure that they're representative
14 of current conditions. In looking at some of the listing
15 data sheets from 2014 data, I haven't seen where there is
16 any of the documentation on whether those data are still
17 representative based on the requirements of the listing
18 methodology.

19 Again, I agree with Robert the data quality
20 information should be supplied with any of the 303.(d)
21 listings. I will also note that the association of the
22 Missouri Clean Water Agency and specifically to data
23 availability and use will be providing comments with
24 respect to the sample size compared to the 10 percent rule
25 for 303(d) listings and that more than 10 samples should be

1 used in comparison of the 10 percent rule. So small data
2 sets should not be used against those rules and should
3 probably lead to a Category 3 listing or a Category 3
4 designation rather than jumping to Category V until
5 additional data are collected. The requirements that
6 trigger with the development of TMDL etc. and some of the
7 permeating complications that can incur warrant I think the
8 greater use of Category 3 so that we ensure the state
9 resources are adequately assigned where there is true water
10 quality problems and so additional data should be collected
11 in some of these waters that might may be more
12 questionable.

13 Now, with respect to the biological data or
14 impairment decisions, we strongly support the Department's
15 further occlusion of habitat consideration into the
16 evaluation process. The Department along with MDC have
17 done some more work with the habitat thresholds that should
18 be used to determine whether water should go into Category
19 4c or habitat impairments versus Category 5, which include
20 impairments. You know, I specifically haven't had a change
21 to read through all the documentation on those thresholds
22 but I support having a threshold in place that is
23 reproducible and so forth. But it would be nice if we
24 could get together again to discuss how the habitat
25 threshold was developed and so forth.

1 There has been a longstanding requirement or
2 process to evaluate habitat for macro-invertebrates and it
3 appears -- and I make be wrong with the older 303(d)
4 list -- but it appears that it actually had a delisting
5 based on habitat and assigned it over to Category 4c,
6 particularly for Troublesome Creek. But I'm unaware of
7 whether those assessments have been performed on all of the
8 rest of the Category 5 waters to see whether those are
9 justified. And maybe that's been done, but it's not within
10 the data sheets with the 2014 303(d) list and so forth.
11 And I urge also the Department to go back and look at
12 Category 3 and Category 4 waters that were originally
13 listed for macro-invertebrate impairment and see whether
14 those were assigned to the right category rather than maybe
15 to a 4c or a 3 or maybe not even impaired at all.

16 With respect to that, the macro-invertebrate
17 habitat evaluations rely upon the environmental service
18 programs, habitat protocols. I suggest that while that's a
19 good reproducible habitat evaluation, it doesn't
20 necessarily apply all the way into the in stream habitat.
21 So at times the impairment decisions were made on waters
22 that maybe didn't have the three habitats that were
23 available for macro-invertebrate sampling. Maybe it would
24 be based on two of those habitats because there was one of
25 those habitats was not available for sampling. That would

1 greatly skew your score, potentially with respect to
2 diversity and total tax time and so forth. So that should
3 be another consideration in addition to the shaft process.
4 And that would also indicate a Category 4c listing
5 potentially rather than a Category 5.

6 I did like the MDC's I guess in the
7 Department's recommendation on not considering losing
8 stream characteristics with respect to fish data
9 assessments. And I would urge the Department to also
10 evaluate whether that should be a consideration for
11 macro-invertebrate evaluation as well.

12 And lastly again, with respect to habitat
13 scores, those should be included within the 303(d) listing
14 documentation for all of the list of waters not just the
15 ones that are delisted for that situation.

16 Now, with fish data comparisons still within
17 the biological impairment portion, I appreciate the thought
18 and the process that's gone in with the Department of
19 Conservation and DNR to evaluate when those fish metrics
20 should be applicable to the water body and when they should
21 not. One of those cases is in first and second order
22 streams when those plateau and then evaluation of only
23 third to fifth order streams. Now, with that I understand
24 those developments and so forth. I would urge that we use
25 the proposed valley segment type classification to dial

1 this in a little bit better or make it more clear when
2 those apply and when those do not. And it appears to me
3 the first and second order streams are likely the head
4 water classifications that the Department recently adopted
5 into the water quality standards classifications and I'm
6 not sure about the third to fifth, but that's probably the
7 creek classification. So I would suggest that we modify it
8 so that when the public and EPA, DNR, MDC or whoever is
9 evaluating the applicability to those biological criteria
10 that apply, that we can look at it with respect to the GIS
11 system and the classifications that the Department has been
12 working on very hard.

13 With respect to that classification as well
14 with macro-invertebrates data analysis, I appreciate the
15 Department's evaluation. It looks like there was a couple
16 of delisting that were made because of the size of the
17 stream and so forth and with respect to whether it's
18 appropriate to compare to the regional bio-criteria or
19 reference streams. I would urge you to go further. The
20 original proposed rule in the water quality standards
21 package had within the definition of bio-criteria that it
22 would apply to the valley segment types and the
23 classification system that was developed by the Department.
24 I would urge that the macro-invertebrate analysis be first
25 reviewed in accordance with those classifications so head

1 water streams are compared to head water control or
2 reference streams and that should be the first step. And
3 then there should be an assessment from there on whether or
4 not the next order is representative. There was a -- when
5 the final rule was adopted, that specificity in the
6 bio-criteria you portion was removed and my understanding
7 was that was primarily to allow the Department to use data
8 that were maybe within the next larger classification type.
9 And if that's the case, then we should take it within the
10 303(d) listing methodology and try to make that more
11 specific.

12 Lastly with respect to the biological data
13 evaluations in the other category, the other biological
14 data. I think it should be clarified with respect to fish
15 and macro-invertebrates that we're relying on the
16 Department's protocols rather than some other type of
17 analysis after the investment that our state has made into
18 those metrics and many times those are multi-metrics. And
19 with respect to the biologic -- I'm sorry -- the
20 macro-invertebrate criteria and they were multi-metric for
21 a purpose and I would hate to see lack of definition in
22 that section be used to support a listing based on one of
23 those single metrics. Potentially -- although and in
24 addition I would think other biological input should be
25 considered again with respect to our multi-metric. It may

1 be a similar case where we went and evaluated some of these
2 others and so forth that it would be similar to, you know,
3 just relying on EPT for macro-invertebrates or something
4 like that with respect to another type of organism. And I
5 would suggest if there are other organisms that are
6 considered for analysis the weight that the 303(d) list
7 carries on, I would suggest that the Department rely on
8 Category 3 more often and then collect additional data for
9 analysis that again the state has developed resources in
10 with respect to macro-invertebrates and fish in particular.
11 And then if there is conflicting biological data that one
12 type of -- let's say the macro-invertebrates pass and the
13 fish fail -- that should lead to Category 3 designation
14 rather than necessarily going into Category 5 so that we
15 can have additional evaluation.

16 Now moving onto bacteria. One small issue
17 with respect to the E-Coli criteria. Right now that's
18 assigned to -- that's a groundwater criteria. You know, I
19 understand sort of what the thought process was with that
20 but that really technically is just applied to losing
21 streams not to the groundwater. So I think it should be
22 clarified that's only related to losing streams rather than
23 groundwater protection since it's not listed for that in
24 the Missouri Water Quality Standards.

25 Now with respect to the narrative criteria

1 translation. I know there is a lot of the biologic of
2 information that suggest -- and I appreciate the Department
3 working some more on the weighted evidence approach that
4 was sort of thrown into the listing methodology probably
5 six years or so. And I think there is some additional
6 detail that could be put together and particularly in
7 considerations on bio-availability of certain parameters
8 and so forth. So we'll provide some comments with respect
9 to that.

10 With respect to the probable effect
11 concentrations and quotations, I agree with Robert that
12 this should be better clarified, particularly in averaging
13 procedures. Typically a lot of these sediment
14 concentrations and so forth follow a log normal
15 distribution. The protocol isn't specific or the listing
16 methodology isn't specific on what types of means to use,
17 but I would suggest that should follow the distribution of
18 the data. And in most times I believe it's most
19 appropriate to use geometric means rather for the probable
20 effect not concentrations. The document should also
21 probably consider the averaging that occurs over a reach,
22 let's say. So if there is multiple sets that are collected
23 in reach, I believe it would be most appropriate to combine
24 all of those into the averaging process as well rather than
25 picking specific creek points within a specific reach

1 segment. And with a lot of these sediment data come along
2 with inherently quality assurance considerations. And so
3 there is a lot of scatter in a lot of these sediment data
4 and so the quality assurance data should be available for
5 those data sets.

6 And another issue with those is the way that
7 we manage non-detects. And then also levels below the
8 recording limits and that should be clarified. And I would
9 suggest that zero pollutant is used below those protection
10 limits because in some of these cases, the protection limit
11 is greater than the criteria. And so if you use either the
12 detection limit or even after the detection limit,
13 sometimes you trigger a false positive impairment decision
14 based on the way that you just manage the non-detect
15 values.

16 With respect to -- I'll wrap it up here
17 shortly. With respect to the statistical analysis and the
18 bars for delisting considerations included within the table
19 B-2. I need to look at it in more detail but it appears
20 there is a handful of delisting considerations that either
21 carry greater weight of evidence to trigger a delisting
22 than a 303(d) listing and I believe that's likely
23 appropriate for human health considerations. But with
24 respect to I believe nutrients and the biological data have
25 a higher bar for delisting. The state really needs to look

1 at that because that could trigger an inordinate number of
2 samplings to come back with a non-impairment and meeting
3 the criteria before a delisting can occur. And many times
4 that original listing was developed on a relatively small
5 data set. So I think we need to take a hard look at
6 considering for system of these parameters an equal bar for
7 listing and delisting.

8 Lastly once a listing is made I think there
9 should be some additional clarification on prioritization
10 of TMDL. In particular with listings that have criteria
11 and beneficial uses that -- pardon me -- that are in
12 upcoming rule changes. Those should be considered lower in
13 priority. I would suggest that for parameters such as
14 chloride. I would hope at some point we are going to
15 reevaluate dissolved oxygen criteria. Ms. Rielly said we
16 have a number of dissolved oxygen 303(d) listings and I
17 think the state realize that the current statewide criteria
18 is problematic and therefore the TMDL development should be
19 prioritized for those. I would say that's the same for
20 lake nutrients as well.

21 And as we made comments during the last water
22 quality standards package, the losing stream criteria that
23 I mentioned earlier is one of those that really needs to be
24 evaluated with respect to its appropriateness. So I would
25 also suggest the state assign those 303(d) listings low

1 priority for TMDL development. So with that I appreciate
2 your time and opportunity to comment.

3 MR. MARSHALL: Thank you, Mr. Stover. All
4 right. Is there anyone else present this morning that
5 would like to offer testimony or comments on these record?
6 Seeing none. The Department will receive written testimony
7 on the proposed 2014 impaired waters list and the 2016
8 listing methodology document until 5:00 p.m. on January 31,
9 2014. You may submit this written testimony to Ms. Trish
10 Rielly, Water Protection Program, Missouri DNR Water
11 Protection Program at P.O. Box 176 Jefferson City, Missouri
12 65102 or by e-mail to Ms. Rielly at trish.rielly@dnr.mo.gov
13 or by fax to (573)526-6802 prior to that 5:00 on January 31
14 deadline. On behalf of the Department I thank everyone who
15 has participated in this process and this hearing is now
16 closed. Thank you.

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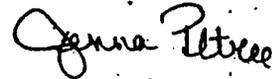
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COUNTY OF COLE)

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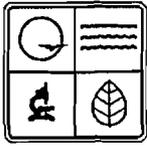
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**Missouri
Department of
Natural Resources**

**Proposed 2016 Listing Methodology Document
PUBLIC COMMENTS**

**Public Notice
October 15, 2013 – January 31, 2014**

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



**Metropolitan St. Louis
Sewer District**

2350 Market Street
St. Louis, MO 63103

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FEB 04 2014

WATER PROTECTION PROGRAM

January 31, 2014

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

RE: Public Comments for the proposed Methodology for the Development of the 2016 Section 303(d) List in Missouri

Ms. Reilly:

The Metropolitan St. Louis Sewer District (MSD) is offering this letter into the public record during the public notice period associated with the Missouri Department of Natural Resources' (MDNR or Department) proposed Methodology for the Development of the 2016 Section 303(d) List in Missouri (listing methodology document, or LMD). MSD very much appreciates the Department's consideration of public comments, as the listing and delisting decisions that result from applying the LMD protocols significantly influence operations, management, and capital improvements planning efforts for private, municipal, and state environmental programs across Missouri. The professionalism and technical expertise of you and your supporting scientists is well-recognized. For this reason, we hope you will consider these comments on their technical merit, regulatory basis, and in accordance with a science-based policy approach and direct your staff to work with stakeholders to make sure critical comments (such as burden of proof to list/delist) are adequately addressed.

In general, we are concerned that the 2016 LMD public notice process was very disjointed and resulted in a document that is inconsistent and confusing. Many of the inconsistencies are likely due to the fact that the original draft public notice document was revised during the public notice period after the Department held the first of two public information sessions. Although we appreciate that the Department hosted these sessions, we believe revising the LMD during the public notice period complicated the process and added to the document's inconsistencies. These inconsistencies impact our ability to make specific, informed comments on important sections of the LMD. For example, several narrative descriptions and statistical analyses presented in Tables 1.1, 1.2, B-1, and B-2 are incomplete or provide conflicting information. Because these tables form the basis for listing and delisting decisions, it is important that they accurately define the rationale and methods that will be used. More specific comments regarding these and other issues are included below.

MSD also remains concerned about several issues that were identified during the 2012 public notice period but not addressed in the final 2014 LMD. Because the issues were not addressed, they remain outstanding in the draft 2016 LMD. These issues include, but are not limited to, using a greater burden of proof to delist a waterbody than to list it for some parameters, applying environmental indicators that are listed as criteria or requirements in the water quality standards (e.g., applying E. coli requirements as groundwater criteria), clarifying how the Department will interpret "other biological data," determining appropriate sample sizes and data age, and defining methods for choosing appropriately-sized reference or control streams. We discussed some of these issues in our 2012 comment letter, which is attached for your reference. We have also included comments on these issues in this letter.

Comment 1. The methods used to list a water as impaired should be the same as those used to delist the same water.

As we noted in our 2012 comments, the LMD prescribes a greater burden of proof to delist waters than to list them for some parameters by changing the statistical significance (biological data, color) or confidence levels (some toxics) associated with the recommended tests. Appendix B includes a description of the analytical tools that will be used to determine if a waterbody is impaired (Table B-1) or if a waterbody that was previously determined to be impaired is now unimpaired (Table B-2). As the Department explains (pages 40-41) in the section "Rationale for the Burden of Proof," the major difference between Tables B-1 and B-2 is that the burden of proof for delisting is greater than for initial listing. This is accomplished by changing the significance level of statistical tests in Table B-2 for several data types. The Department justifies this approach with the following explanation (page 41, emphasis added):

"However, if the department retained these same test significance levels in determining when an impaired water had been restored to an unimpaired status (Table B-2) **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 was 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 with only a 12 percent probability of being unimpaired is **clearly a poor decision.**"

In the example given by the Department, it is not apparent what undesirable environmental effects would occur from implementing a 0.1 significance level for listing purposes that would suddenly not occur when delisting. By changing the significance level and acceptable Type 1 error after a stream is judged to be impaired, the Department is effectively making the policy decision that it should be more difficult to remove an impairment (e.g., increasing the statistical rejection region). The rationale for changing the burden of proof is not clear as waterbodies that are very close to the water quality standard (slightly above or below) are not likely to represent a fundamentally different biological or chemical condition. The issue is further complicated by the fact that for some parameters, such as lake nutrients and bacteria, the burden of proof is indeed the same for listing and delisting.

As the Department is aware, these statistical decisions have major ramifications on future planning, monitoring, and TMDL development efforts and incorrect decisions can lead to unnecessary financial and resource burdens to both the state and permittees, with little to no defined environmental benefit. To illustrate the point, consider a theoretical stream from which three of 10 macroinvertebrate samples had a Missouri Stream Condition Index (MSCI) score of less than the required 16. Assuming reference streams met the MSCI threshold 90% of the time, the stream would be listed as impaired using the binomial probability approach because the calculated type 1 error rate of 0.07 is less than the required level of significance (0.1). Because the burden of proof changes once a stream is listed (required significance of 0.4) under the current protocols, 13 additional, consecutive samples that score above a 16 would have to be collected for the stream to be delisted ($p = 0.408$). However, if the burden of proof were not changed, only two additional, consecutive samples ($p = 0.111$) that score a 16 would have to be collected to delist the stream.

Theoretical Stream Listing/Delisting Example for 10 Biological Samples*			
LMD Requirement	Required Alpha to List/Delist	# of Exceedances that Would Trigger Initial Listing	# of Additional Samples Needed w/out an Exceedance to Delist
Differing Burden of Proof (Existing LMD)	0.1/0.4	3/10	<u>13</u>
Similar Burden of Proof	0.1/0.1	3/10	<u>2</u>

*Assumes reference streams score 16 or higher in 90% of samples.

It is apparent that increasing the burden of proof for delisting decisions is an onerous and unnecessary requirement which has no ecological basis. Furthermore, increasing the burden of proof almost ensures that waters will be listed for a longer period of time than what otherwise may be necessary; considering that macroinvertebrates are generally only collected once during the spring and fall, the theoretical stream above would be listed as impaired for at least another 6.5 years, assuming 13 more samples with a MSCI score above 16 were collected.

We continue to request that methods and decision criteria used to list a stream also be used to delist a stream. We recognize that some may believe that this request constrains the Department's ability to exercise best professional judgment in some situations, however additional data can always be collected for streams that are of questionable quality.

Comment 2. The Department should improve the consistency of language within and between Tables 1.1, 1.2, B-1, and B-2.

In the draft LMD, there are a number of instances where language presented in Tables 1.1, 1.2, B-1, and B-2 is inconsistent both within and between the tables. The tables also reference each other quite a bit. These inconsistencies and references make it difficult to understand MDNR's proposed method and provide substantive comments, and will cause significant confusion in future listing and delisting decisions if left unchanged.

For example, in Table B-1 two analytical tools each (binomial probability and direct comparison) are presented for both macroinvertebrates and fish with eight or more samples. It is not clear if this was done on purpose or is a typographical error, but it gives the impression that two different methods could or would be used to evaluate impairment. Then in Table B-2, the same biological monitoring analytical tool section differentiates between waters with between 8 to 30 and more than 30 samples, instead of only 8 or more as indicated in Table B-1, and then follows with "Same as Table B-1." For this section, it is not clear what should and should not be the same between the two tables. This is an example of just one of many confusing items in the tables.

MSD requests that MDNR reevaluate the information in the tables to ensure that language and tools are consistent and clear. One approach that may be helpful is to combine the tables so that information regarding data requirements, listing thresholds, and analytical tools to list and delist are presented together in a single table for each beneficial use/analyte combination. This would greatly facilitate understanding, review, and implementation of the methodology.

Comment 3. A complete fact sheet should be provided for each listing and delisting decision.

While we appreciate the time and effort MDNR invests in preparing the Excel worksheets that are made available during the public notice period, we note that critical information that may help to interpret listing decisions is often missing. This includes, but is not limited to, information related to quality assurance, detection limits, habitat scores and quality (including the number of habitats sampled), and the environmental conditions before or during sample collection.

We would therefore request that the Department provide a complete fact sheet for each waterbody proposed for assignment to Categories 2B, 3B, 4C, or 5, as well as those proposed for delisting. At a minimum, the fact sheet should include a summary of all relevant information, explain the scope and basis for the decision, provide the raw data (including the information mentioned above), the proposed listing category, and demonstrate how the data meet thresholds outlined in the LMD. We believe that these fact sheets would help improve transparency and incorporate sound science into the 303(d) process.

Comment 4. Waterbodies currently listed as impaired for water quality criteria or beneficial uses that are expected to change in the near future should be considered a low priority for TMDL development.

A number of new water quality standards regulations were adopted following the recent triennial review. These new regulations represent a significant change in how water quality standards will be administered in the state. Additionally, several existing water quality criteria may be changing in the near future. Stakeholders have requested that MDNR evaluate the implementation issues related to these changes and if necessary, modify the regulations during the next one to three triennial reviews to address any uncertainties. MSD is concerned that these new and changing regulations introduce significant uncertainty into the water quality standards and assessment process. Based on our understanding of potential water quality standards changes, we request that MDNR identify existing impairments for chloride, ammonia, losing stream bacteria, recreational bacteria, dissolved oxygen, and nutrients as low TMDL priorities. This would allow MDNR to concentrate resources on waters where impairment thresholds are more certain. We would request that MDNR include this consideration in Section II.E.3 of the LMD.

Comment 5. Data age, quality, and minimum sample sizes should be addressed when making impairment decisions.

The LMD states (page 15) that when data older than seven years are used to make a listing decision, the Department will provide a written justification for using those data. To our knowledge, very few listing decisions that incorporate older data have explored whether or not those data should be used. The LMD also states (page 16) that only Data Code Two or above are generally used for making listing decisions; however, data quality or codes is rarely discussed or apparent in the listing worksheets. We note that data age and quality are critical issues that must be considered to make a fully informed listing decision. Therefore, MSD requests that the Department provide data age and quality information in listing fact sheets discussed in Comment 3 above. If this information is not available or suggests the data are not representative, the Department should consider waters with suspected impairments as Category 2B or 3B until sufficient data are collected.

Another data concern we have is related to the minimum number of samples needed to make a listing determination. In 2012, we also raised this issue specifically with respect to fish community data. Other than the five minimum samples required for assessing compliance with recreational uses, this issue is not addressed in the LMD. As the Department is aware, environmental data, and particularly biological data, can be highly variable and may introduce significant uncertainty into conclusions regarding impairment status. We therefore request that the Department set appropriate minimum sample sizes for all data types that will be used to make listing decisions.

Comment 6. The *E. coli* value listed in Table 1.1 is not a groundwater protection criterion.

The proposed LMD identifies *E. coli* bacteria as a criterion to assess attainment of groundwater protection uses (page 19). We recognize this likely represents the Department's intent to address the *E. coli* losing stream criterion of 126 cfu/100 mL found at 10 CSR 20-7.031(4)(C). However, we note that Missouri's water quality standards do not include a groundwater protection beneficial use for bacteria. We request the Department either better define the linkage between the *E. coli* decision threshold and groundwater protection use or remove the threshold altogether. If this is retained in the LMD, bacteria TMDLs for losing streams should be a low priority until the appropriateness of this "criterion" can be further analyzed.

Comment 7. Environmental indicators used to detect beneficial use impairment on a statewide basis should be limited to criteria or requirements listed in Missouri's Water Quality Standards.

As we noted in our 2012 comments, there are several environmental indicators used to detect impairment that are not approved water quality standards. Examples of these unapproved standards include total cobalt color, biocriteria (e.g., benthic macroinvertebrates, fish, and "other biological data"), sediment quality guidelines, and others. The net result of this approach is issuance of water quality-based permit limits in TMDL watersheds that are not based on approved water quality standards. We understand that setting TMDL-specific water quality targets may be needed for unique situations and waterways. However, it appears that unapproved standards could be used throughout the state and applied to multiple waterways which will unnecessarily commit departmental and permittee resources on problematic TMDLs. Therefore, we request that the LMD should state that unapproved standards cannot be used to place waters in Category 5. In this request, we note that fiscal impacts associated with implementation of unapproved standards have not been quantified.

Comment 8. Including considerations for habitat limitations have strengthened the LMD protocols but these protocols may need to be refined.

MSD supports the Department's willingness to further consider habitat as a limiting factor when evaluating biological community data. Minimum habitat requirements for macroinvertebrates have been in the LMD for some time (bottom of page 17) and the new inclusion of Appendix E for fish community data is necessary, as habitat is a critical element that must be evaluated to better understand biological results. However, to our knowledge, habitat data are rarely evaluated or presented in the listing worksheets even though it is required in the LMD. With respect to macroinvertebrates, we would expect that Stream Habitat Assessment Project Procedure (SHAPP) scores and information related to the number and quality of individual habitats sampled would be relevant to the evaluation.

We believe that as long as habitat-related listing decisions are appropriately documented and available for review and comment, they play an important role in evaluating impairment status. Therefore, we suggest that MDNR review all waters currently in Category 4A or 5 as the result of a biological impairment to determine if those waters are habitat-limited. If they are, they should be moved to Category 4C as outlined in the existing LMD procedures.

With respect to Appendix E, we have several questions about how the habitat metrics and 0.39 threshold were chosen. For example, the QCPH1 index was selected as being the best overall indicator of habitat condition, but little justification was presented to support that assertion. Further, it appears that MDNR and MDC only evaluated the QCPH1 with respect to unimpaired stream communities, and did not test it against impaired streams. As a result, it is unclear how well the metric or 0.39 threshold can differentiate between impaired and unimpaired streams. Until these and other questions are better understood, the 2016 LMD should, in addition to the 0.39 QCPH1 threshold, allow for consideration of other habitat measures. This could be addressed by revising Appendix E to include the original workgroup recommendation:

When fish IBI scores indicate waterbody impairment as determined by the LMD rules, DNR assessment staff will consult with MDC on the habitat scores associated with these samples. Based on the results of this consultation, if DNR concludes that:

- *the majority of the low scores also have physical habitat scores that are suspect but do not clearly indicate either good habitat or poor habitat, the fish community will be assessed as "suspect" and in the absence of other data indicating impairment, the water body will be placed in category 2B or 3B.*
- *the majority of the low scores have physical habitat scores that indicate poor habitat condition, the fish community will be assessed as impaired by habitat and in the absence of other data requiring 303(d) listing, the water body would be placed in category 4C.*
- *the majority of the low scores have physical habitat scores that indicate good habitat condition, the water body will be assessed as having a fish community impaired by a stressor other than habitat and placed in category 5, the state 303(d) List unless a TMDL that addresses these stressors has been approved, in which case, the water body will be placed in category 4A.*

We also suggest revising footnote 20 to improve consistency with Appendix E as follows:

²⁰IBI scores are from “Biological Criteria for Streams and Fish Communities in Missouri” 2008. Doisy, et al. for MDC. If **habitat limitations (as measured by either the QCPH1 score or other appropriate metrics) habitat is are judged to contribute to low fish community scores, likely a problem, the waterbody won’t be listed as Category 5 based on this data. It still could be will be included in Category 4C, 2B, or 3B.**

Comment 9. The Department should specify the methods for choosing appropriate reference or control streams for biological data comparisons. Also, MDNR should generally limit biological data comparisons to streams that have the same Valley Segment Type (VST) code.

In footnote 18 the Department states, “For test streams that are significantly smaller than bioreference streams 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.” We fully support MDNR’s stance that biological data should be considered with respect to stream size. However, the Department should be more specific with respect to what it considers a significant difference in size, as well as the methods that should be used to choose appropriate comparison streams.

In our past comments, we have suggested that the Department use an approach¹ that relies on watershed area and streamflow as a guide for choosing comparison streams. However, recent revisions to Missouri’s water quality standards integrate the Missouri Resource Assessment Partnership’s (MoRAP) VST mapping layer into the state waterbody classification system. Because the VST layer is already attributed according to categories of stream size, flow, gradient, temperature, and geology², it should be used as a guide for choosing comparison streams. This would be advantageous because it would standardize the selection process and improve consistency with the water quality standards.

When accurately defined, reference or control streams are the most accurate way to characterize attainable conditions for a stream or region. Because the VST classification layer already groups waterbodies with similar important characteristics, it would seem reasonable that the VSTs should also serve as the basis for defining attainable conditions for similar-sized streams. In other words, biological data collected from a test stream should only be measured against comparison streams from the same VST code, as these streams would be the best available representatives of biological potential in the region.

MSD requests that MDNR specify that 1) the VST layer will be used as the basis for choosing biological comparison streams, and 2) biological data comparisons will generally be limited to streams that have the same VST code.

¹ Hughes, R., D. Larsen, and J. Omernik. 1986. Regional Reference Sites: a Method for Assessing Stream Potentials. *Environmental Management* 5:629-635.

² Sowa, S., D. Diamond, R. Abbitt, G. Annis, T. Gordon, M. Morey, G. Sorensen, and D. True. 2004. The Aquatic Component of Gap Analysis: A Missouri Prototype. Final Report Issued to The United States Department of Defense Legacy Program. Missouri Resource Assessment Partnership, University of Missouri-Columbia. Columbia.

Comment 10. The Department should clarify how it intends to apply and interpret “other biological data” when listing or de-listing waterbody segments.

In Table 1.2 of the draft LMD, “other biological data” is listed as an acceptable data type that may be used to determine impairment status. Although we acknowledge that a variety of biological data may be useful in assessing the status of an aquatic community, we are concerned that data requirements and procedures for applying “other biological data” are not mentioned in the LMD. Specifically, we are concerned that 1) it is not clear if the same data type must be used to de-list a stream as to list it, and 2) the use of “other biological data” may inadvertently lower the burden of proof than would otherwise be required to make a listing decision (e.g., using a single metric rather than a multi-metric index such as the MSCI score). We request that the “other biological data” allowance be removed until approvable data collection, analysis, and application methods can be developed and presented in the appropriate public participation process. Should the Department choose to retain the “other biological data” allowance in the LMD, we request that the LMD be revised to include language that clarifies these uncertainties.

Comment 11. The weight of evidence approach used to translate narrative criteria should be more clearly explained.

On page 17 of the LMD, MDNR discusses that a “weight of evidence” analysis will be used when analyzing compliance with numeric thresholds used to translate narrative water quality criteria. These numeric thresholds include parameters listed in Table 1.2 and sediment toxicity listed in Table B-1. While we recognize the Department’s need to exercise best professional judgment in some circumstances, we request that MDNR more clearly explain the process that will be used to conduct a weight of evidence analysis. More specifically, we believe the Department should better outline the data types, sample sizes, relative data weightings, and decision-making processes; we note that the revised redline version of the draft LMD also included a comment (see Comment RAV20 on page 17) that the reference to “other [data] types” needed clarification.

We are also concerned that there may be considerable uncertainty in listing decisions made based on a single numeric translator. For example, for sediment toxicity the LMD uses Probable Effects Concentrations (PECs) to estimate toxicity thresholds. As the Department knows, actual sediment toxicity is ultimately based on bioavailability, which varies with site-specific conditions. Without additional lines of evidence, PECs alone may not be adequate indicators of biological health. Another numeric translator of concern is the “other biological data” category. Although we acknowledge that biological data other than macroinvertebrate MSCI or fish IBI scores may be useful, this category is very vague - data requirements and procedures for applying it are not mentioned in the LMD. For the reasons discussed in Comment #10 above, we would question its (“other biological data”) reliability as an impairment indicator if it were the only line of evidence used.

Therefore, we request the Department more clearly explain the weight of evidence approach and specify that where multiple lines of evidence are not available, MDNR will assign waters to Category 2B or 3B until additional data are available to make an informed impairment decision.

Comment 12. Revise the section on “Threatened Waters” to more accurately reflect EPA guidance.

Currently, the LMD is not specific when addressing how MDNR will evaluate threatened waters (pages 6 and 17). We request that the sections that discuss threatened waters be revised to more accurately reflect EPA’s 2006 Assessment and Reporting Guidance document referenced on page 4 of the LMD. The guidance states (emphasis added):

EPA recommends that states consider as threatened those segments that are currently attaining WQS, but are projected as the result of applying a valid statistical methodology to exceed WQS by the next listing cycle (every two years). For example, segments should be listed if the analysis of existing data and information demonstrates a declining trend in the segment’s WQS, and the projected trend will result in a failure to meet that standard by the date of the next list (i.e., 2008 for purposes of the 2006 assessment cycle). The state assessment and listing methodology should describe how the state identifies threatened segments.

We suggest revising the section on page 6 as outlined below. Language regarding threatened waters on page 17 should also be updated, as appropriate. In accordance with the guidance, we also request that MDNR define the statistical methods and thresholds that will be used to conduct time trend analyses.

When a ~~statistically-valid time trend analysis indicates that a water that would otherwise be currently in Categories 1, 2, or 3 has a time trend analysis~~ for one or more discrete water quality pollutants ~~that indicates the water is currently maintaining all beneficial uses but will not continue to meet these~~ maintain designated beneficial uses before the next listing cycle, it will be considered a “threatened water.” A threatened water will be treated as an impaired water and placed in the appropriate Category (4A, 4B, or 5).

Comment 13. The Department should add language to Section II.B. that allows the use of site-specific calculations, as opposed to default assumptions, when evaluating compliance for some parameters.

Oftentimes, the Department relies on default data assumptions when evaluating water quality standards compliance for parameters that vary seasonally or with environmental conditions. Default assumptions for pH, hardness, and water temperature assumptions are generally the most common. MDNR should amend Section II.B., and any other relevant section, to both identify any default data assumptions that will be used to make listing decisions and indicate that site-specific data may be used in place of these default assumptions.

Comment 14. Typographical errors.

- Remove the word “All” in the heading for Section II.B. To be consistent with the text that indicates “[t]hese sources presently include, but are not limited to...”, the word “all” should be removed from the heading.
- The word “inverts” should be replaced with “macroinvertebrates” throughout the document.
- Section I.B.21. refers to data sources 22-25 but there is no data source 24 or 25 listed.

Thank you for the opportunity to comment on the proposed methodology. We look forward to working with MDNR to develop an LMD document that is transparent, objective, and repeatable. Please contact John Lodderhose, Assistant Director of Engineering, at (314) 436-8714 or jlodderhose@stlmsd.com if you have any questions or would like to discuss these issues further.

Sincerely,



Susan M. Myers
General Counsel

cc: Jay Hoskins
John Lodderhose
Rich Unverferth
Kristol Whatley



Metropolitan St. Louis
Sewer District
2350 Market Street
St. Louis, MO 63103

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WATER PROTECTION DIVISION

March 15, 2012

Mr. John Ford
Water Quality Monitoring and Assessment Section
Missouri Department of Natural Resources
P.O. Box 176
Jefferson City, Missouri 65102

RE: *Public Comments for Missouri's 2014 Listing Methodology Document*

Dear Mr. Ford:

This comment letter is offered into the public record during the public notice period associated with Missouri's proposed 2014 Listing Methodology Document (LMD). With this letter, the Metropolitan St. Louis Sewer District (MSD) requests the Missouri Department of Natural Resources (Department) to remove or better support several proposed changes to the LMD.

Comment 1. The weight of available evidence and methods used to list a waterway as impaired should be equal and comparable to information needed to de-list the same waterway.

The proposed LMD includes several new methods or rationale for placing a waterbody on the 303(d) list. These newly proposed methods include use of 'other biological data', fish IBI data provided by the Missouri Department of Conservation, and sediment quality guidelines – among others. Should these newly proposed methods be adopted into the LMD, we believe the same decision criteria used to list a waterway as impaired also be applied when evaluating the waterway for delisting. This request is in many ways intuitive, and speaks directly to the scientific weight of evidence principle. Clearly, a situation to be avoided is Hinkson Creek, where a macroinvertebrate bio-criteria excursion frequency of 0% (i.e., 100% achievement) initially placed in the Total Maximum Daily Load study contradicts the allowable excursion frequency (i.e., approximately 25%) in the bio-criteria protocol. Another example would be where a crayfish or mussel study (e.g., 'other biologic data') is used to list a stream, but application of Missouri's macroinvertebrate protocol is needed to delist that same stream. As we are sure the Department is aware, each aquatic indicator assemblage (e.g., benthic macroinvertebrates, fish, plankton, etc.) features unique and differing sensitivities to pollution or stress. Consequently, an impairment detected by a crayfish or mussel study may, or may not be, reflected in macroinvertebrate scores. Thus, we request that methods and decision criteria used to list a stream also be used to delist a stream. We recognize this request apparently constrains the Department to exercise best professional judgment in some situations, but believe any methodological procedure should feature comparable listing and delisting decision criteria.

Comment 2. Any environmental indicator used to detect beneficial use impairment on a statewide basis should be published in Missouri's Water Quality Standards.

In our review of the LMD, we note that several environmental indicators used to detect impairment are not approved water quality standards. Examples of these unapproved standards include cobalt color criteria, bio-criteria (e.g., benthic macroinvertebrates, fish, and 'other biological data'), sediment quality guidelines, and others. The net result of this approach is issuance of water quality-based permit limits in TMDL watersheds that are not based on approved water quality standards. We understand that setting TMDL-specific water quality targets is needed for unique situations and waterways. However, it appears that unapproved standards could be used throughout the state and applied to multiple waterways. Therefore, we request that these unapproved standards be formally incorporated into Missouri's Water Quality Standards prior to use as listing decision thresholds. In this request, we note that fiscal impacts associated with implementation of unapproved standards have not been characterized.

Comment 3. Technical rationale for reducing the fish tissue sample size from three to one should be provided.

The proposed LMD includes a reduction in fish tissue sample size from three to one (Page 3). Understanding that all environmental parameters have variability, it is not clear why multiple samples are no longer required to describe fish tissue data. Representing fish tissue regimes with a single point-in-time sample appears to conflict with the multi-year averaging period that applies to human health criteria. A LMD approach that better aligns with the human health averaging period would include multiple samples collected over multiple years. Therefore, we request that the Department use the same fish tissue sample size requirement as specified in the 2012 LMD.

Comment 4. Fish IBI data reported by the Department appear to be highly variable. A longer averaging period or larger minimum sample size should be considered.

Some fish IBI data presented in spreadsheets provided as part of the 2012 303(d) listing process are highly variable. For example, three reported IBI scores collected over a five-year period from two locations in Dry Creek (WBID 3418) ranged from 15 (impaired) to 37 (unimpaired). At Fox Creek (WBID 1842), IBI scores were even more variable; three IBI scores ranged from 11 (impaired) to 37 (unimpaired) at one site over a one-month sampling period.

These results suggest that IBI scores for a waterbody are spatially and temporally variable, and could introduce significant uncertainty into the Department's conclusions regarding impairment status for waterbodies in the Ozarks. We request that the Department consider this variability by setting an appropriate minimum sample size and averaging period requirement for Ozark fish IBI data in the LMD before they can be used to assess impairment decisions.

Comment 5. For biological data comparisons, the Department should specify the allowable watershed area and annual stream flow differences between test streams and control or reference streams when evaluating biological data.

In Table 1.2, footnote 15 on page 21 the Department states, "For test streams that are significantly smaller than bio-reference streams where both bio-reference 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."

We fully support the Department's stance that biological data should be considered with respect to stream size however, we would ask that the Department be more specific in what it considers to be a significant difference in size. We suggest the Department adopt the approach used by Hughes et. al (1986, citation below). In their methodology, they suggest only using comparison streams with a watershed area and mean annual discharge that are within an order of magnitude of the control stream. This specification is generally used in many state bio-criteria programs and provides a more objective, defensible method for determining data applicability.

We also request that the Department expand the stream size requirement in footnote 15 to apply to all types of biological data. As the LMD is currently written, it appears as if the Department intends only to use comparable sized-streams when evaluating macroinvertebrate data.

Hughes, R., D. Larsen, and J. Omernik. 1986. Regional Reference Sites: a Method for Assessing Stream Potentials. Environmental Management 5:629-635.

Comment 6: The Department should apply the same significance levels when evaluating the attainment status of impaired and unimpaired waters.

In Appendix B, the Department includes a description of the analytical tools that will be used to determine if a waterbody is impaired (Table B-1) or if a waterbody that was previously determined to be impaired is now unimpaired (Table B-2). As the Department explains (page 32) in the section "Rationale for the Burden of Proof," the major difference between Tables B-1 and B-2 is that the burden of proof for demonstrating attainment is higher than for demonstrating impairment. This is accomplished by changing the significance level of statistical tests in Table B-2 for several data types. The Department justifies this approach with the following explanation (page 32, emphasis added):

"However, if the department retained these same test significance levels in determining when an impaired water had been restored to an unimpaired status (Table B-2) **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 was 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 with only a 12 percent probability of being unimpaired is clearly a poor decision."

It is clear that the Department believes that it is inappropriate to apply the same probability thresholds when going from impaired to unimpaired but the rationale for doing so is not clear. In the example given by the Department, it is not apparent what undesirable results or poor decision will occur if the significance level is held constant at 0.1. By increasing the significance level and acceptable Type 1 error after a stream is judged to be impaired, the Department is effectively making the policy decision that it should be more difficult to get a stream de-listed than listed (e.g., increasing the statistical rejection region and burden of proof). The rationale for changing the burden of proof is not clear as waterbodies that are very close to the water quality standard (slightly above or below) are not likely to represent a fundamentally different biologic condition. Therefore, we respectfully request that the Department maintain consistent significance levels (0.1 for most tests) between Tables B-1 and B-2.

Thank you for the opportunity to comment on the proposed 2014 Listing Methodology Document. Please contact John Lodderhose at 314-436-8714 if you have any questions or require additional information.

Sincerely,


Susan M. Myers
General Counsel

SMM/lad

cc: John Lodderhose, MSD

City of St. Joseph

1100 Frederick Avenue, St. Joseph, Missouri 64501

January 31, 2014

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FEB 04 2014

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

WATER PROTECTION PROGRAM

Subject: Public Comments Regarding the Proposed Methodology for the Development of the 2016 Section 303(d) List in Missouri Document

Ms. Reilly:

The City of St. Joseph, Missouri (City) submits these comments regarding the proposed Methodology for the Development of the 2016 Section 303(d) List in Missouri placed on public notice by the Missouri Department of Natural Resources (MDNR or Department) on October 15, 2013. This listing methodology document (LMD) is extremely important as it lays out the process for making impairment decisions. If these processes inappropriately lead to false impairment decisions, ensuing regulatory actions will lead to unwarranted resources spent by MDNR, the US Environmental Protection Agency (USEPA), regulated point sources, and the public. Alternatively, appropriate water quality protections are not afforded if Missouri's methodology does not sufficiently identify truly impaired waters. Therefore, it is paramount that MDNR develop and apply sound methods to make impairment decisions.

Modifications to the proposed 2016 LMD during the public notice process makes public comment difficult and likely led to inconsistencies.

MDNR posted a revised proposed 2016 LMD to the Department's website during the public comment period. We are unaware of the posting date, although the revised LMD filename suggests that it was posted on or after November 26, 2013. MDNR documents indicate that the revisions were made to improve the LMD based upon comments received during the November 14, 2013 public availability session and incorporate recent habitat data analyses. These revisions have led to inconsistencies between Tables 1.2, B-1, and B-2, which are critical tables that define the methods to make impairment decisions. In particular, the biological data analysis methods are inconsistent with respect to sample size and statistical significance levels. These inconsistencies make meaningful public comment difficult. If Tables B-1 and B-2 are accurately displayed, we assert that delisting decisions based on biological data

should use equivalent significance levels as listing decisions. The apparently proposed higher confidence level for delisting waters using macroinvertebrate or fish data poses an extremely high bar given the typically small datasets that form the basis for these listing decisions.

Data used to make impairment decisions should be well documented and data use restrictions should be consistently applied.

MDNR appropriately characterizes the need for high quality and representative data in making impairment decisions. However, MDNR does not typically provide data quality information with individual data during public notice of impairment decisions. We assert that this information is critical for the public's ability to review impairment decisions and to document MDNR's process in screening data of insufficient quality. In addition, the LMD places a data age restriction of seven years unless MDNR demonstrates that older data are still representative of current conditions. Given the investments that are being made into point and nonpoint source reductions, data older than seven years old should typically be considered suspect with respect to representativeness of current conditions. Therefore, MDNR should provide sound justification when using data older than seven years. Data quality information should also be provided in all impairment decision worksheets. Lastly, MDNR should not use small datasets to make impairment decisions. For example, no fewer than 10 samples should be used to judge datasets against the "10% rule". Given the financial impacts to MDNR, USEPA, and the public, additional data should be collected to make more informed impairment decisions when datasets are limited in size. If data quality information is not available, representativeness is questionable, or datasets are limited in size, MDNR should place waters with suspected impairments into Category 2B or 3B until sufficient data are available to make informed decisions.

Habitat impacts should be carefully considered when making impairment decisions based upon biological data.

We strongly support MDNR's inclusion of habitat considerations when assessing biological data and making impairment decisions based upon these data. MDNR includes habitat threshold values when assessing both macroinvertebrate and fish communities; however, these habitat assessment measurements differ between these two communities. We urge that MDNR, the Missouri Department of Conservation (MDC), and other resource professionals work together to develop a single habitat assessment procedure and metrics, if possible. A single habitat protocol would greatly improve data collection efficiency and ability to assess both fish and macroinvertebrate data with a single habitat metric.

MDNR and MDC chose a habitat metric (QCPH1) and threshold value (0.39) to determine if habitat limitations lead to fish community impairments. We appreciate the efforts of these agencies to develop this threshold; however, this metric and threshold value was first assigned in the LMD with the revision released during the public notice period. Therefore, additional documentation and stakeholder input should be gathered prior to making impairment decisions based upon fish community data.

The LMD specifies that macroinvertebrate communities are considered impaired due to habitat if habitat scores are less than 75% of reference stream habitat scores. This provision is consistent with

previous listing cycle LMDs. While the scoring system is not defined, we believe that MDNR uses the Stream Habitat Assessment Project Procedure (SHAPP) to make these decisions. MDNR has made at least one recommendation to categorize a macroinvertebrate community as habitat impaired (Troublesome Creek). We support this decision; however, we are unaware of habitat assessment documentation in other 303(d) listing decisions. We also believe that additional habitat assessments are relevant in implementing the Missouri macroinvertebrate protocol for listing decisions. In particular, macroinvertebrate data should not be used for impairment decisions if a sample habitat is not present or very limited for sample collection. For example, MDNR should not make a listing decision on macroinvertebrate data if rootmat substrate is not available or disproportionately small in the study stream compared to reference or control streams. We also contend that natural losing stream conditions may also reduce macroinvertebrate communities and should be taken into account as MDNR does with fish communities. Therefore, we assert that MDNR should include habitat assessment information related to the number and quality of individual habitats sampled in all listing decision documentation. We also urge MDNR to review possible habitat limitations for all current Categories 4A and 5 waters listed as impaired due to macroinvertebrate scores.

Fish data comparisons should be made only where science supports and consistent with Missouri's new stream classification system.

We support MDNR's assertion that fish community Index of Biotic Integrity (IBI) comparisons should only occur in ecoregions and stream sizes where adequate relationships between IBI scores and impairment exist. Currently, the IBI metric only applies to third through fifth order streams in the Ozark Plateau. MDNR should redefine this limitation in terms of the new stream classification system included within 10 CSR 20-7.031, which will be effective by the time of the 2016 303(d) list. These stream orders would likely only apply to creeks and possibly small rivers in the Missouri Resource Assessment Partnership's (MoRAP) Valley Segment Type (VST) mapping layer, adopted by reference in Missouri's water quality standards. We urge MDNR to begin using this classification system within the 2016 LMD to provide greater transparency and consistency in the assessment process.

Macroinvertebrate data analyses should be made with comparable reference or control streams.

The proposed 2016 LMD includes revisions to better define the importance of using only comparable reference or control streams when analyzing macroinvertebrate communities. However, we are aware of only two delistings from the proposed 2014 303(d) list attributed to reference and study stream comparability issues. We urge MDNR to provide greater specificity to ensure only comparable reference or control streams are used. Specifically, we believe that MDNR should only compare study and reference or control streams that have identical VST size classification unless there is a compelling reason to broaden the comparison. For example, it may be appropriate to compare biological data from the downstream portion of a headwater segment to the upstream portion of a creek segment. In addition to stream size, MDNR should also limit comparisons to streams with similar VST attributes (i.e., flow, gradient, temperature, and geology). After making these refinements to the process of ensuring comparability between study and reference or control streams, MDNR should reevaluate all previous listing decisions of waters in Categories 4 and 5 to determine if these were influenced by comparability issues.

Impairment decisions based upon "other" biological data evaluations should be done very carefully.

Macroinvertebrate and fish communities should serve as the primary biological endpoints for assessment of narrative criteria given the amount of effort expended to develop an understanding of these communities. In addition, the Missouri Stream Condition Index and fish IBI should be the primary metrics used for these assessments provided the amount of State resources that were invested to develop scientifically sound metrics. Other biological endpoints should be carefully assessed if considered for impairment decisions. In fact, we suggest that in most cases MDNR should assign waters to Categories 2B or 3B if use impairment is suspected based upon other biological endpoints. MDNR should then prioritize macroinvertebrate and fish sampling and use a weight of evidence approach to make an impairment decision.

The proposed 2016 LMD inaccurately assigns the losing stream E. coli criterion to groundwater protection.

The proposed 2016 LMD lists *E. coli* bacteria as a criterion to assess attainment of groundwater protection uses (Tables 1.1, B-1, and B-2). We recognize this likely represents the Department's intent to address the *E. coli* losing stream criterion of 126 cfu/100 mL in 10 CSR 20-7.031. However, Missouri's water quality standards do not include a groundwater protection beneficial use for bacteria. Therefore, these tables should be modified to refer to losing stream protection. In addition, the City again asserts that Missouri's losing stream criterion is not justified by sound science as this value is was meant to be a long-term geometric mean for protection of swimming. We urge MDNR to reevaluate this criterion during the next triennial review of water quality standards.

Additional detail should be provided under the weight of evidence approach.

Missouri's LMDs have included for quite some time a weight of evidence approach for evaluation of numeric translators of narrative criteria. The pertinent section of the 2016 LMD follows.

"The Department will use a weight of evidence analysis for all narrative criteria. For those analytes with numeric thresholds, the threshold values given in Table 1.2 will trigger a weight of evidence analysis to determine the existence or likelihood of use impairment and the appropriateness of proposing a listing based on narrative criteria. This weight of evidence analysis will include the use of other types of environmental data when it is available. Examples of other relevant environmental data might include biological data on fish or aquatic invertebrate animals (which will be given greater weight than the other types) or toxicity testing of water or sediments. When the weight of evidence analysis suggests, but does not provide strong, scientifically defensible evidence of impairment, the Department will place the water body in question in Categories 2B or 3B."

We urge MDNR to provide greater detail into the types of environmental data that may be considered when assessing the weight of evidence. We believe that Missouri should rely on additional measures of potential aquatic life impacts that account for the true toxicity of contaminants in the environment. In the case of sediment toxicity, MDNR should rely on multiple lines of evidence including biological,

chemical, and toxicity data. The proposed LMD includes Probable Effects Concentrations from McDonald (2000) as the primary measures of sediment toxicity. However, the true aquatic life impacts from these constituents is complicated by the actual bioavailability, which can vary significantly based upon site conditions. We suggest that MDNR provide additional detail with respect to the weight of evidence and not rely on a single line of evidence in complicated situations, such as potential sediment toxicity. Where multiple lines of evidence are not available, MDNR should assign waters to Categories 2B or 3B until additional data are available to make a sound impairment decision.

Greater detail should be provided with respect to sediment quality data and analysis.

MDNR relies upon Probable Effect Concentrations (PECs) and Quotients (PEQs) to predict sediment toxicity as outlined by McDonald (2000). While the proposed 2016 LMD provides the magnitude of the PECs, little detail is provided on how to analyze sediment quality data. Sediment datasets typically include multiple spatial and temporal sample results; however, the LMD does not include averaging procedures for these situations. We assert that the type of mean (i.e., arithmetic or geometric) should be based upon the statistical distribution of the dataset. As sediment data are typically log normally distributed, geometric means should typically be used for data analysis. In addition, multiple samples collected within one segment or reach should be averaged into a single data point for temporal comparisons and averaging. Lastly, sediment quality data frequently include numerous values below detection or reporting limits. We assert that these values should be considered "0" as detection or reporting limits can be above the PECs and potentially lead to false positive impairment decisions if the limit or one-half the limit is used for data censoring.

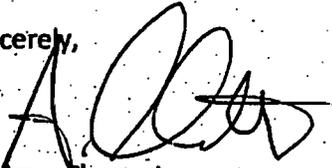
Sediment data quality assurance also needs to be appropriately assessed during the impairment decision-making process as collecting representative samples and laboratory analyses can be difficult. We contend that MDNR should provide all sediment data quality assurance information within impairment decision worksheets.

Total Maximum Daily Loads (TMDLs) for impairments of water quality criteria that MDNR expects to modify in the near to intermediate term should be assigned low priority.

MDNR should prioritize TMDLs carefully to ensure that MDNR, USEPA, and regulated entity resources are used efficiently. Impairments for water quality criteria that MDNR expects to modify in the next one to three triennial reviews of water quality standards should be assigned low priority so that resources are not spent chasing a moving target. Based upon our understanding of potential changes to numeric water quality criteria, impairments for chloride, bacteria for losing streams and whole body contact recreation, dissolved oxygen, and nutrients as low TMDL priority by MDNR.

St. Joseph greatly appreciates this opportunity to provide public comment and 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 'A. Clements', with a stylized flourish at the end.

Andrew Clements
Asst. Director of Public Works
City of Saint Joseph, MO
816-271-4653
aclements@ci.st-joseph.mo.us

January 31, 2014

RECEIVED

FEB 04 2014

WATER PROTECTION PROGRAM

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 Methodology for the Development of the 2016 Section 303(d) List in Missouri Document

Ms. Rielly:

The City of Springfield, Missouri (City) submits these comments regarding the proposed Methodology for the Development of the 2016 Section 303(d) List in Missouri placed on public notice by the Missouri Department of Natural Resources (MDNR or Department) on October 15, 2013. This listing methodology document (LMD) is extremely important as it lays out the process for making impairment decisions. If these processes inappropriately lead to false impairment decisions, ensuing regulatory actions will lead to unwarranted resources spent by MDNR, the US Environmental Protection Agency (USEPA), regulated point sources, and the public. Alternatively, appropriate water quality protections are not afforded if Missouri's methodology does not sufficiently identify truly impaired waters. Therefore, it is paramount that MDNR develop and apply sound methods to make impairment decisions. The City also offers comments regarding the proposed 2014 Section 303(d) List under separate correspondence.

Modifications to the proposed 2016 LMD during the public notice process makes public comment difficult and have likely led to inconsistencies.

MDNR posted a revised proposed 2016 LMD to the Department's website during the public comment period. We are unaware of the posting date, although the revised LMD filename suggests that it was posted on or after November 26, 2013. MDNR documents indicate that the revisions were made to improve the LMD based upon comments received during the November 14, 2013 public availability session and incorporate recent habitat data analyses. These revisions have led to inconsistencies between Tables 1.2, B-1, and B-2, which are critical tables that define the methods to make impairment decisions. In particular, the biological data analysis methods are inconsistent with respect to sample size and statistical significance levels. These inconsistencies make meaningful public comment difficult and dilute the rule making process.

Office of the Director
Busch Municipal Building • 840 Boonville Avenue
Springfield, Missouri 65802 • 417-864-1919 • springfieldmo.gov/recycling


CITY OF
Springfield
ENVIRONMENTAL
SERVICES

The Revisions of Tables 1.2, B-1 and B-2 result in more stringent requirements to delist a stream than to list a stream as impaired.

If Tables B-1 and B-2 are accurately displayed, we assert that delisting decisions based on biological data should use equivalent significance levels as listing decisions. The apparently proposed higher confidence level, for delisting waters using macroinvertebrate or fish data, poses an extremely high bar given the typically small datasets that form the basis for these listing decisions.

Data used to make impairment decisions should be well documented and data use restrictions should be consistently applied.

MDNR appropriately characterizes the need for high quality and representative data in making impairment decisions. However, MDNR does not typically provide data quality information with individual data during public notice of impairment decisions. We assert that this information is critical for the public's ability to review impairment decisions and to document MDNR's process in screening data of insufficient quality.

In addition, the LMD places a data age restriction of seven years unless MDNR demonstrates that older data are still representative of current conditions. Given the investments that are being made into point and nonpoint source reductions, data older than seven years old should be considered suspect with respect to representativeness of current conditions. Therefore, MDNR should not use data older than seven years, unless sound justification for using the older data is provided. Data quality information should also be provided in all impairment decision worksheets.

Listing methodology should specify that listing decisions will only be made when 10 valid samples are available for all pollutants.

Lastly, MDNR should not use small datasets to make impairment decisions. For example, no fewer than 10 samples should be used to judge datasets against the "10% rule". Given the financial impacts to MDNR, USEPA, and the public, additional data should be collected to make more informed impairment decisions when datasets are limited in size. If data quality information is not available, representativeness is questionable, or datasets are limited in size, MDNR should place waters with suspected impairments into Category 2B or 3B until sufficient data are available to make informed decisions.

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We strongly support MDNR's inclusion of habitat considerations when assessing biological data and making impairment decisions based upon these data. MDNR includes habitat threshold values when assessing both macroinvertebrate and fish communities; however, these habitat assessment measurements differ between these two communities. We urge that MDNR, the Missouri Department of Conservation (MDC), and other resource professionals work together to develop a single habitat assessment procedure and metrics. A single habitat protocol would greatly improve data collection efficiency and ability to assess both fish and macroinvertebrate data with a single habitat metric.

MDNR and MDC chose a habitat metric (QCPH1) and threshold value (0.39) to determine if habitat limitations lead to fish community impairments. We appreciate the efforts of these agencies to develop this threshold; however, this metric and threshold value was first assigned in the LMD with the revision released during the public notice period. Therefore, additional documentation and stakeholder input should be gathered prior to making impairment decisions based upon fish community data.

The LMD specifies that macroinvertebrate communities are considered impaired due to habitat if habitat scores are less than 75% of reference stream habitat scores. This provision is consistent with previous listing cycle LMDs. While the scoring system is not defined, we believe that MDNR uses the Stream Habitat Assessment Project Procedure (SHAPP) to make these decisions. MDNR has made at least one recommendation to categorize a macroinvertebrate community as habitat impaired (Troublesome Creek). We support this decision; however, we are unaware of habitat assessment documentation in other 303(d) listing decisions. We also believe that additional habitat assessments are relevant in implementing the Missouri macroinvertebrate protocol for listing decisions. In particular, macroinvertebrate data should not be used for impairment decisions if a sample habitat is not present or very limited for sample collection. For example, MDNR should not make a listing decision on macroinvertebrate data if rootmat substrate is not available or disproportionately small in the study stream compared to reference or control streams. We also contend that natural losing stream conditions may also reduce macroinvertebrate communities and should be taken into account as MDNR does with fish communities.

Therefore, we assert that MDNR should include habitat assessment information related to the number and quality of individual habitats sampled in all listing decision documentation. We also urge MDNR to review possible habitat limitations for all current Categories 4A and 5 waters listed as impaired due to macroinvertebrate scores.

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Specifically, we believe that MDNR should only compare study and reference or control streams that have identical VST size classification and similar watershed size unless there is a compelling reason to broaden the comparison. For example, it may be appropriate to compare biological data from the downstream portion of a headwater segment to the upstream portion of a creek segment. In addition to stream size, MDNR should also limit comparisons to streams with similar VST attributes (i.e., flow, gradient, temperature, and geology). After making these refinements to the process of ensuring comparability between study and reference or control streams, MDNR should reevaluate all previous listing decisions of waters in Categories 4 and 5 to determine if these listings were influenced by comparability issues using inappropriate reference/control streams.

Impairment decisions based upon "other" biological data evaluations should be done very carefully.

Macroinvertebrate and fish communities should serve as the primary biological endpoints for assessment of narrative criteria given the amount of effort expended to develop an understanding of these communities. In addition, the Missouri Stream Condition Index and fish IBI should be the primary metrics used for these assessments considering the amount of State resources that were invested to develop scientifically sound metrics. Other biological endpoints should be carefully assessed if considered for impairment decisions. In fact, we suggest that in most cases MDNR should assign waters to Categories 2B or 3B if use impairment is suspected based upon other biological endpoints. MDNR should then prioritize macroinvertebrate and fish sampling and use a weight of evidence approach to make an impairment decision.

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strong, scientifically defensible evidence of impairment, the Department will place the water body in question in Categories 2B or 3B.”

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Mr. Trish Rielly
January 31, 2014
Page 6

The City of Springfield greatly appreciates this opportunity to provide public comment and your thoughtful consideration of these comments. If you have any questions or comments, please do not hesitate to contact me at (417) 864-1910 or ekemper@springfieldmo.gov.

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



FEB 04 2014

MISSOURI DEPARTMENT OF NATURAL RESOURCES

ASSOCIATION OF MISSOURI CLEANWATER AGENCIES

January 31, 2014

By Electronic Mail (Trish.Rielly@dnr.mo.gov)

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

RE: AMCA Comments on 2014 Water Quality Assessment Methodology & 303(d) List

Dear Ms. Rielly:

The Association of Missouri Cleanwater Agencies ("AMCA") appreciates the opportunity to provide comments on the Department's 2014 draft 303(d) list and listing methodology. AMCA comprises public water, sewer, and storm water utilities statewide serving a significant majority of the sewered population in the state.

The assessment methodology has significant ramifications for the regulated community and the public at large because it determines which waterbodies will be listed as impaired. Such listings trigger regulatory restrictions and burdens which can range from more stringent point source discharge requirements (monitoring and limits) to public and private land use restrictions.

With these implications in mind, we offer the following comments for the Department's consideration:

QAPP Availability and Compliance Certification. We would like a copy of the MO DNR QAPP/Quality Management Plan for 303(d) data. We think DNR's QAPP should be available on the 303(d) web page. We also think that with each 303(d) list, DNR should certify that all the data used for actual 303(d) listings met the requirements in the QAPP.

All Data Used to Support an Actual 303(d) Listing Should Be Available on the Website from the Outset of the Public Comment Period. In order to make the public comment period meaningful, DNR must make the data supporting each listing available to the public. Ideally, all such data would be available on an ongoing basis as it has been validated. This is critical to allow stakeholders a meaningful opportunity to evaluate DNR's available data with an eye toward correcting errors, filling any data gaps or to collect additional data where more data will better help determine the water body's true impairment status.

We also think that DNR's website should indicate the source and quality of all data provided (i.e., the name of the state agency, private party, etc., that collected the data and certification regarding QA/QC procedures).

Finally, underlying information about biological sampling also should be made available, including survey sheets, sampling dates, and any other relevant information (or at least indicate its prompt availability upon request). Additionally, the requisite procedures for biological sampling should be clearly stated, and each survey used for 303(d) purposes should include a certification that the requirements were followed.

Qualified Data Should be Disclosed and Explained. DNR should identify any data which are qualified and the nature of the qualification. Qualified data should not be the sole basis for any listing decision.

DNR Should Explain its Treatment of Non-Quantified Data. We are unclear whether DNR uses any data which are found to be below applicable quantitation levels. We believe that data below PQLs should be assigned values of "0". We would like to know what DNR's procedure is in relation to such data.

DNR Should Prepare a Fact Sheet for Each New 303(d) Listing. For DNR to really make public review and comment meaningful, DNR should prepare an electronic listing fact sheet for each new listing. The fact sheet should include the following:

1. Summary of the waterbody
2. Identify the pollutant(s) of concern
3. Provide a link to the raw data and associated information (QA/QC, etc)
4. Explain how the data meet the listing criteria
5. Other appropriate information

Such fact sheets are entirely warranted for impaired waters listings to readily inform interested stakeholders as to the scope and basis for the listing. While we would like to see such fact sheets for all listed waters, we recognize DNR staff limitations. Accordingly, we propose that DNR start fact sheet development for waters which will be added (and, maybe, subtracted) to

the 2016 list. We believe the preparation of such fact sheets will play a significant role in enhancing the quality of the listing program and the public's ability to provide meaningful input.

Minimum of 10 Samples for Listings Based Upon the 10% Methodology - No Listings Based Upon a Single Sample. We feel very strongly that no listing should be based upon a single data point. DNR should modify its listing methodology to specify that listing decisions will only be made where at least 10 valid samples are available for all pollutants where compliance will be judged by the "no more than 10% of samples exceed the WQS" criterion. This is critical so that a listing will not be made based upon one data point above the criterion. The chances of a false positive or non-representative sampling condition are far too high to make a listing determination based upon a single data point. Waters with one high data result out of fewer than 10 data points should be put in a category for additional data collection during the next listing cycle.

No Listing Based Upon A Single Fish Community or Benthos Sample Unless the Impairment is Severe. We also feel strongly that no stream should be listed as having an impaired fish community or benthos based upon a single stream survey unless the survey results show extreme impairment. In particular, stream surveys showing marginal impairments are not a proper basis to solely support a listing.

DNR Needs to Consistently and Properly Express its One-in-Three-Year Listing Criterion for Toxics. In the section of the list for Protection of aquatic life for toxic chemicals, DNR identifies a secondary listing criterion:

Full Attainment: No more than one acute toxic event in three years that results in a documented fish kill (does not include fish kills due to natural causes). No more than one exceedence of acute or chronic criterion in the last three years for which data is available.

AMCA Comment: The one-in-three year policy is just that, an EPA policy and not a binding rule. Thus, DNR does not need to use it in the listing methodology.¹ Our strong preference is that DNR not use this policy to make listing decisions and, instead rely on the greater than 10 percent provision. Thus, DNR should delete this unnecessary listing criterion.

However, if DNR insists on using this policy, and while reserving our rights to challenge its use, DNR must apply it properly. To that end, DNR proposes to add the underlined language to the first sentence above. AMCA agrees with this important addition. It captures the intent of the policy - namely to allow the aquatic community three years to recover from a catastrophic event without a

¹ EPA's 1-in-3 year criteria exceedance policy is not mandated by the Clean Water Act, nor has it been properly promulgated as a regulation. Therefore, EPA lacks the authority to impose it as a binding legal requirement on the state, and DNR is not obligated to incorporate the 1-in-3 year criterion into the water quality assessment methodology. See *National Mining Association v. Jackson*, Nos. 10-1220, 11-0295, 11-0446, 11-0447, 2012 WL 3090245, at *8 & n.10, 14, 17 __ F. Supp. 2d __ (D.D.C. July 31, 2012).

subsequent toxic instream event/condition. The first sentence - with the underlined addition - gets this right. The second sentence, however, lacks this important qualifier and must be deleted. Otherwise, two samples which slightly exceed the criteria could trigger a completely unnecessary listing - which would be inconsistent with the first sentence. Note that the toxic chemical criteria are very overprotective such that it makes no sense whatsoever to list a stream just because the criteria might have been exceeded twice in a three year period while the total number of high samples does not exceed 10% of the overall sample results.

The 10% listing criterion should control unless there is a document major toxic event (due to other than natural causes) followed by a second toxic event within three years. Then a precautionary listing might be appropriate (again, we reserve the right to challenge this unpromulgated listing criterion).

Same comment in Table 1.2 for narrative criteria for the protection of aquatic life in relation to "toxic chemicals".

We Question the E.Coli Value Stated for Groundwater. Table 1.1 -shows an e.coli criterion of 126 for groundwater . We believe that is the public health recreation number and not a groundwater value. Accordingly, please delete the 126 value from Table 1.1.

Thank you for considering our comments. Please do not hesitate to contact me should you have any questions.

Sincerely,



Paul Calamita
General Counsel

C: AMCA Members
Mr. John Madras

ROBERT J. BRUNDAGE
EDWARD C. CLAUSEN
MARK W. COMLEY
SHARIE L. HAIN
JOSHUA L. HILL
CATHLEEN A. MARTIN



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

January 31, 2014

Via Email Only

Ms. Tricia Rielly, Chief
Monitoring and Assessment Unit
Water Protection Program
Mo. Dept. of Natural Resources
P.O. Box 176
Jefferson City, MO 65102-0176
trish.rielly@dnr.mo.gov

Re: Comments on Draft 2016 Listing Methodology

Dear Trish:

Thank you for the opportunity to provide comments on the draft 2016 Listing Methodology document (LMD) and the draft 2014 303(d) list. These written comments supplement my oral testimony given on January 22, 2014.

Comment No. 1:

The public hearing on the proposed 2016 Listing Methodology was held on January 22, 2014. When I arrived at the hearing, the Clean Water Commission was not present. Reportedly, one or more commissioners directed that the Clean Water Commission should not personally participate in the hearing. This is the first time in memory that the Clean Water Commission has not personally presided over the hearing on the 303(d) list and the LMD. Due to the importance of the 303(d) list and the LMD, I respectfully request the Clean Water Commission reconsider its previous decision and schedule a hearing to hear live testimony on the 303(d) list and the LMD.

Comment No. 2:

After approval of the 2014 LMD, the Department of Natural Resources hosted meetings of the Biological Assessment workgroup to consider changes to the 2014 LMD. That effort culminated in a document emailed to stakeholders on October 30, 2012. This document was titled *Evaluation of Biological Data in the DNR Listing Methodology Document*. I provided written comments and responses to this document dated December 10, 2012. It is unclear how the recommendations and issues for which no consensus was reached were incorporated into the 2016 LMD. The department should provide a written response on how the October 30, 2012 report was incorporated into the 2016 LMD.

Comment No. 3:

On page 17, section D describes how the department will use a “weight of evidence analysis for all narrative criteria.” The LMD refers to the use of “other biological data” in Table 1.2 on page 26. The LMD says the weight of evidence analysis will include the “use of other types of environmental data when it is available. Examples of other relevant environmental data might include biological data on fish or aquatic invertebrate animals (which will be given greater weight than the other types) or toxicity testing of water or sediments.” (Emphasis added.) In addition to macroinvertebrate and fish data, the LMD should identify what “other types” of data could be used and why they are reliable. The department should be cautious in its use of other types of data in addition to macroinvertebrate and fish data.

Comment No. 4:

On page 17, under section D, biological data is used “where habitat assessment data indicates habitat scores are less than 75 percent of reference or appropriate control stream scores. . . .” Common sense dictates that streams with poor habitat will have poor biological scores. I inquired into the source of the 75 percent rule. The MSCI is based upon the “Semi-Quantitative Macroinvertebrate Stream Bioassessment Project Procedure.” The 75 percent habitat threshold was taken from the department’s “Stream Habitat Assessment Project Procedure (SHAPP).” The department reported that the 75 percent habitat threshold and a MSCI score of 16 are “not interchangeable.” Figure 1 depicting Habitat vs. Biological Condition taken from Plafkin *et. al.* (1989) shows non-impaired biological conditions versus habitat quality. This figure suggests that biological conditions become impaired when the habitat quality is 75 percent or less of the highest assessed level or score. However, the “non-impaired” portion of this figure does not correspond into a MCSI of 16. Therefore, the Plafkin study should not be used to set the percent habitat. The department admits that “there is likely to be variability and habitat quality vs. biological condition.” According to the Plafkin figure, the biological condition starts to degrade when habitat reaches 90% of the reference score. Since subject streams are often compared to reference waters which have the very best habitat, I suggest it would be more appropriate to set the habitat score at 90 percent.

Comment No. 5:

On page 25, Table 1.2 references aquatic invertebrate’s protocol. Footnote 18 provides that “test streams that are significantly smaller than bioreference streams 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.” Footnote 19 is nearly identical. When test streams are smaller, much less “significantly smaller,” the department should not compare MSCI scores from these “smaller” test streams to the larger bioreference streams. I suggest this footnote be rewritten to state that test streams should be compared to local streams with similar watershed size, land use and geology. Note that the terms “similar land use/geology” are used in Table 1.1 on page 19. In addition, test streams or subject streams should only be compared to control streams with similar land use, geology, watershed size and stream morphology.

Comment No. 6:

Table 1.2 references MDC fish community protocol data that produces fish IBI scores. Footnotes 20 and 21 refer to habitat. For example, footnote 20 says that “if habitat is a likely problem the water body won’t be listed as Category 5.” (Emphasis added.) Footnote 21 says that if “habitat is determined to be a significant possible cause for impairment, the water body will not be rated as impaired. . . .” (Emphasis added.) The terms “likely problem” and “significant possible cause” are not defined. During the biological assessment workgroup meetings, I pointed out how the MDC fish community protocol and the fish IBI impairment scores were not correlated to poor water quality. Instead, scores were significantly affected by habitat impairments. Consequently, fish IBI scores should not be used to assess stream impairments since such scores are highly variable based upon habitat conditions. Although Appendix E places a habitat assessment limitation on the use of data, that study has undergone peer review and was not part of the department’s initial study describing the MDC Fish Community (RAM) Protocol.

Comment No. 7:

Historically, the department has not included habitat evaluations for 303(d) listed streams that have low macroinvertebrate MSCI scores. The department should include habitat evaluation information in the data sheets that are posted on the website. Furthermore, there should be a written evaluation of the habitat data and a determination of the extent to which habitat affected the MSCI score. Consequently, the department should re-analyze whether all waters in categories 4 and 5 based upon biological MSCI impairments were due to poor habitat, poor water quality, or both. The department should also re-analyze whether 303(d) listed waters based upon biological impairments were based upon comparisons to appropriate local control streams with the same stream order, similar watershed size, land use and geology. For example, the department has listed Strother Creek (WBID 2751) as impaired by invertebrate data collected in 2003 and 2004. However, there is no data published in the data sheets documenting the habitat condition, the stream order, geology, and watershed size of the alleged impaired segments. Therefore, it is impossible to determine if the Strother Creek samples should be compared to the larger reference stream MSCI benchmarks. Without this data, the department should remove Strother Creek from the 303(d) list based upon invertebrate data.

Comment No. 8:

The narrative criteria for “objectionable bottom deposits” is found in Table 1.2 on page 23 and in Table B-1 on page 35 of the revised 2016 LMD. For streams with flow velocity greater than 0.5 feet/second what test applies? In Table B-1, the hypothesis test is a one tailed “t test.” It is not clear why the one tailed t test is included because it does not appear to be the method used in the decision process. The decision seems to be based on the 20% coverage threshold and a comparison of the LCL’s between the study site and the reference site. In regards to the methodology for determining the percent coverage of bottom deposits, what is the field method to collect this data? Stated differently, what is the “standard method” for determining percent bottom deposits? It appears the test requires a measurement of the percent fine sediment

deposition. However, the description in Table 1.2 also discusses “trash or other materials reaching the water due to anthropogenic sources.” How are trash and other materials measured by the percent fine sediment deposit measurement?

Comment No. 9:

On page 25, Table 102, the aquatic invertebrate protocol describes full attainment of beneficial uses, for 7 or fewer samples, when 75 percent of the stream condition index scores are 16 or greater. Compare that to the “non-attainment” description where 75 percent of the stream condition index scores are 14 or lower. What happens when you have 50 percent of the scores 14 or lower and 50 percent of the scores 16 or higher (14, 14, 16 and 16)?

Comment No. 10:

On page 25, Table 1.2 describes the aquatic invertebrate protocol. For 7 or fewer samples, 75 percent of the stream condition index scores must be 14 or lower to make a non-attainment finding. In other words, a stream with a single macroinvertebrate sampling at one location that receives a score of 14 or lower could be listed as impaired on the 303(d) list. It seems that the department should require more than a single sample to list a stream as impaired on the 303(d) list.

Comment No. 11:

The LMD indicates in Section 3.1 that “more recent data is preferable; however, older data can be used to assess present conditions if the data remains representative of present conditions.” For sediment sample results, only the most recent sample result should be used when comparing to sediment threshold values. While water column concentrations may be expected to vary up-and-down in response to short term variations in loadings or climatic conditions, sediment concentrations are not expected to experience the same variability. The most recent sediment sample provides the best representation of present conditions.

Comment No. 12:

In the proposed 2014 303(d) list, the department is proposing to add several lakes to 303(d) list based upon an alleged nutrient impairment. This proposed listing is based upon the nutrient criteria that EPA approved several years ago. As you recall, the EPA disapproved most of the nutrient criteria. Since then, there have been several stakeholder meetings discussing the nutrient criteria. It has become widely apparent that the nutrient criteria that were adopted by the Commission were not science based and were not tied to the attainment of beneficial uses. I previously encouraged the department and the Commission to rescind the nutrient criteria in its entirety including that portion that was approved by EPA. The purpose of this was to avoid any unattended consequences. Now, the department is proposing to add lakes to the 303(d) list based upon flawed criteria. I would encourage the Commission to not add these lakes to the 2014 303(d) list.

Comment No. 13:

The proposed 2014 303(d) list has columns for the "Pollutant" and "Source." In some instances, the pollutant is unknown. In previous 303(d) lists, the department used the term "unknown" under the "Pollutant" column. However, the department has not included the word "Unknown" in the "Pollutant" column. Instead, the department is now inserting words such as "fishes bioassessments." See Buffalo Creek. I agree that it is a good idea to include the type of test or monitoring that was performed to support the impairment decision. However, in the case of a fish bioassessment, the source of the pollutant was unknown. Therefore, the pollutant column should, at a minimum, include the word "unknown." The department should consider citing "unknown" pollutants in the "Pollutant" column as follows: "Unknown – fishes bioassessment (W)."

Comment No. 14:

303(d) listings should be supported by transparent, reproducible, and independently verifiable information and assessments of data quality. Information provided in the 303(d) listing worksheets for each impaired waterbody is insufficient to make an independent assessment of the quality of the data being used to support impairment determinations. For example, in response to Sunshine requests for quality assurance/quality control (QA/QC) information for specific datasets in 303(d) listing worksheets, DNR provided additional information. However, very limited QA/QC information was provided. The DNR includes a simple indicator that data quality was acceptable, but provides no basis for that conclusion. The additional data the MDNR provided to me includes a field that says whether or not the sample was a field duplicate. However, the 303d list worksheets do not provide information on whether samples are field duplicates. This information would be useful in the worksheets.

Comment No. 15:

The methodology for calculating average concentrations when duplicate samples are included in a dataset is unclear and is not consistent across existing 303(d) listing worksheets. For example, a duplicate sediment sample in Strother Creek (site 2751/5.8/0.5) on 2/27/2006 is included in the 303(d) listing worksheet but is not averaged before being included in calculating an average with results from other sample locations and then compared to sediment threshold values. A duplicate sample at site 2916/28.5 on Big Creek collected on 5/19/2008 is handled similarly.

Comment No. 16:

303(d) listing worksheets appear to have errors or unclear methods for calculating averages. Sediment data for site 1928/0.5 on Crooked Creek are averaged for samples collected in 2004 and 2006, but results from a sample collected in 2010 are not included in the averaging. Averages for some metals at site 2916/28.5 on Big Creek are calculated for all five of the sample results listed, while averages for other metals at the same site are based on only two sample results.

Comment No. 17:

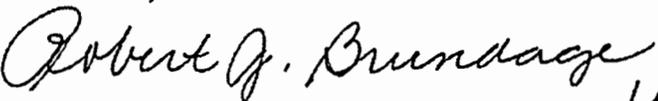
The Middle Fork Black River (WBID 2744) is listed based on aquatic macroinvertebrate bioassessments. A review of the 303(d) listing worksheet indicates that this impairment determination is based on crayfish densities measured in 2004 at a site below Strother Creek (site 2744/16.3). The measured densities were 6.9 and 5.2 per square meter as compared to a control site density of 15.4 per square meter. However, no assessment of the impact of habitat on the crayfish density was presented. Sediment chemistry and water chemistry data also included in the worksheet do not indicate impairment. The worksheet also notes that "Toxicity testing of Middle Fork sediments in 2004 by the USGS using *Hyalella azteca* found 99 percent survival at site 2744/16.3." Control site survival was 96 percent. Finally, information in the listing worksheet for Strother Creek includes the score from a 2004 invertebrate assessment at this same site of 17, on par with reference sites (typically a score less than or equal to 14 is considered a basis for a determination of impairment). The weight of evidence at this site points to attainment of the aquatic life beneficial use. Therefore, the listing should be removed.

Thank you for the opportunity to submit these comments.

Sincerely,

NEWMAN, COMLEY & RUTH P.C.

By:


/KH

Robert J. Brundage

EPA Comments to MoDNR on 2014 Draft 303(d) List

Bruce Perkins, Region 7 Integrated Reporting Coordinator

December 16, 2013

In the assessment of causes like dissolved oxygen and pH; the binomial is only applicable when there are 30 or fewer samples according to the 2014 listing methodology. There are instances in the proposed delistings where this methodology is not followed. These include the North Fork Cuivre River (WBID 0170) and Williams Creek (WBID 3594). There are some water bodies where the binomial is used with greater than 30 samples but that there are less than 30 samples in the last three years and an application of the binomial shows the water body is meeting water quality standards for the last three years. These include Burris Fork (WBID 0968), Coldwater Creek (WBID 1706), Dardenne Creek (WBID 0221), Dardenne Creek (WBID 0222), Dark Creek (WBID 0690), Grand Glaize Creek (WBID 2184), Maline Creek (WBID 1709), Tributary to Big Otter Creek (WBID 1225) and Watkins Creek (WBID 1708).

Hays Creek (WBID 0097) and Dry Fork (WBID 3178) Using watershed size to assess biological samples is allowed in the MO water quality standards [MO 10 CSR 20-7.031(4) (R)] where the size is not significantly different than reference streams in the same ecoregion. For these two streams the statistical significance was not calculated to show that reference streams in the same ecoregion were significantly larger. Additionally, for Hays Creek the state used control streams instead of reference streams identified in Table I as directed by the state's water quality standards.

Urban stream sampling by the U.S. EPA Region 7 environmental services division has identified streams which should be listed for toxic bottom sediments according to the state's methodology. These include Brush Creek (Jackson County, unclassified tributary to Blue River, USGS Reach Code 10300101000565 and 10300101000566) for numerous PAH compounds (These findings are consistent with USGS studies performed in the earlier portions of the 2000's), Blue River (WBID 0419 and 0418), Line Creek (WBID 3575), Shoal Creek (WBID 0397) and East Fork Shoal Creek (WBID 0398) for cadmium, Wilsons Creek (WBID 2375) for lead and numerous PAH compounds, North Branch Wilsons Creek (WBID 3745) for zinc, Jordan Creek (WBID 3374) for numerous PAH compounds and Jones Branch (unclassified tributary to Pearson Creek, USGS Reach Code 11010002001683) for lead. This data is available in the EPA on-line data management program STORET. Data for Brush, Line, Shoal and East Fork Shoal creeks for the years 2010 and 2011 were not successfully uploaded to STORET and are included with this comment for consideration. The data is also available on the web site KCWaters.org.

The TMDL for Wilsons, Jordan and Pearson creeks has been withdrawn so these waters again need a TMDL and should be relisted.

For Troublesome Creek (WBID 0074) the habitat is stated as not being acceptable for the bioassessment to yield acceptable results. In this case one reason stated for poor habitat is sediment. Sediment is itself a pollutant and if sediment is preventing the stream biota from meeting full compliance, it would seem that the water body segment should be 303(d) listed for sediment.

The TMDL used to delist Whetstone Creek (WBID 1505U) was not approved for the upstream unclassified segment. The TMDL does not target a loading capacity which would result in meeting water quality standards. Further information on this can be obtained from the final EPA action on the 2012 Missouri 303(d) List where this water body was added back to the list.

The TMDL proposed to delist Chat Creek (WBID 3168) for cadmium was only approved for zinc. As such this water body should remain listed for cadmium.

Fox Creek (WBID 1842), is the unknown listing from 2012 being replaced with the aquatic macroinvertebrate bioassessment new to the 2014 listing cycle?

Dardenne Cr (WBID 0221) does the Aquatic Macroinvertebrate bioassessment replace the unknown cause from 2012?

Koen Creek (WBID 2171), the data collected in 1995 was discounted because of questions about its quality. As the data was collected under the EPA REMAP program according to the EPA QAPP for data collection it should be considered valid if that program's requirements meet the state's methodologies. As such, if there is no additional data to change the assessment done for the 2012 list and this water should remain listed as impaired.

For Coldwater Creek (WBID 1706) all available data was not assessed. The chloride concentration on 2/21/2012 was 274 mg/L which exceeds the chronic water quality criterion. This data is available from the state's web data search site (http://www.dnr.mo.gov/mocwis_public/wqa/waterbodySearch.do) With the sample taken on 1/5/2010 identified in the assessment spreadsheet for this water body, there were greater than one exceedance of the chronic chloride criterion in the last three years.

The *E. coli* data used to delist the North Fork Cuivre River (WBID 0170) was collected in a different segment of the stream below the confluence with Indian Creek (WBID 0171). As such this shows North Fork Cuivre River (WBID 0158) is not impaired but does not provide good cause that the upstream segment is not impaired.

For Turkey Creek (WBID 3282) the assessment sheet indicates impairment for lead in water not sediment. Additionally, this water body was listed as impaired for lead in water for 2012.

Peruque Creek (WBID 0217 and 0218) The delisting of inorganic sediment is not accompanied by any data files that show the inorganic sediment is no longer exceeding the narrative translator. MDNR water quality data search does not indicate that any new sediment samples have been collected since the 2012 list. Additionally, there is no fish assessment data provided on the review web site for the new listed impairment for these two segments.

Center Creek (WBID 3203) The impairment for zinc is covered by a TMDL.

Little Beaver Creek (WBID 1529) Is the sediment impairment being used as a pollutant for the macroinvertebrate community impairment. Should it be listed for both?

Salt River (WBID 0103) No DO data in assessment sheet for this site.

Shibboleth Branch has an EPA approved TMDL for lead and zinc in sediment and need not be listed in category 5 (303(d)) but category 4a (TMDL).

Is there an available site where WBIDs and the water body are identified and geolocated up to date with this proposed list?

Comments on the Draft 2016 Listing Methodology

In the 2016 methodology the state proposes to modify the bioassessment procedure to apply a different narrative translation to headwater streams from other wadeable streams. Using watershed size to assess biological samples is allowed in the Missouri water quality standards [MO 10 CSR 20-7.031(4) (R)] where the size is significantly different than reference streams in the same ecoregion. For these two streams the statistical significance was not calculated to show that reference streams in the same ecoregion were significantly larger. Additionally, the state proposes to use control streams instead of reference streams identified in Table I as directed by the state's water quality standards. Missouri's bioassessment procedure for fish is limited to stream orders of 3-5; presumably because this type of statistical significance process was integrated into the assessment methodology. The proposed demarcation is that a stream is "significantly smaller" than reference streams. There is no procedure outlined to identify such significance nor do the state's water quality standards make a reference to using control streams. The state's reference streams are outlined in Table I in the state's water quality standards. If a watershed size cutoff statistical methodology is defined for significantly smaller streams, then the public can meaningfully comment of the state's assessment of a water body's biological condition. Meaningful public comment is difficult to obtain if the methods used by the state to determine the results of bioassessment are not identified.

Has monitoring of raw water from drinking water reservoirs been discontinued or is it no longer being used for assessment?

Is the RAM monitoring program by MDC integrated into the DNR bioassessment web site? Is it available for stakeholder review?

In the discussion of toxic chemicals in Table 1.1 there is an exclusion for fish kills due to natural causes. Is there information to indicate that natural toxic chemicals are released at a frequency of more than once every three years on average?

In Table 1.1 the compliance column for dissolved oxygen references a footnote which states that the data is only used for wide scale 305(b) assessments and not 303(d) listing. If that reference is a typographical error and instead should reference footnote 10, then that footnote should not apply to dissolved oxygen either. If samples taken during a critical period of the year, for example high temperature low flow summer samples, and all of the samples show an excursion of the state's water quality standards, that data should not be averaged out over an annual period. An aquatic life use is not being met if there is a seasonal period where no life can exist in the assessment unit.

There is a reliance on appropriate or representative control streams for many assessments. There is no guidance on how the characteristics of such a control stream are determined. As there are many reference streams listed in the state water quality standards should there be an emphasis to shift from those reference streams to control streams. For small streams bioassessment targets see the first listing methodology comment above.

In relation to footnote 16 in Table 1.2, there are only two Mississippi Alluvial Plains reference streams identified in the state's water quality standards; these are Main Ditch and Maple Slough Ditch. This is to cover three Ecological Drainage Units. Because of the limited number of reference streams it is even more important that a method for choosing appropriate control streams is outlined in the state's listing methodology where the use of control streams is allowed in the state's water quality standards.

Table B-1 methods use a two-sided test for bottom deposits. Since the goal is to determine if the deposits are too high not just different from the control site, the test should be single-sided.

Table B-1 redefines how the binomial probability will be assessed for greater than 30 samples but there is no note or comment that this is being changed from the commission approved 2014 methodology. In later discussion in that appendix this change is identified in comment D42. The previous methodology, and the deleted text here, states that the use of a binomial is “difficult for larger sample sizes.” How has the state’s reconsideration of this difficulty led to the removal of the sample size mediated analysis?

For toxic sediments in Table B-1 the sample mean is identified as the assessment number. If this is the mean at a site it is appropriate. However, if it is the mean of multiple sites along a segment it could result in one site, of many sampled, being toxic but being averaged out by cleaner sites above and/or below that site. This could result in a portion of a segment being undeniably impaired but the segment not being listed. To alleviate this, the table should identify the site mean rather than the sample mean to eliminate any confusion.

Rielly, Trish

From: Perkins, Bruce <Perkins.Bruce@epa.gov>
Sent: Wednesday, December 18, 2013 9:45 AM
To: Rielly, Trish
Subject: RE: EPA comments on the proposed 2014 303(d) list and 2016 listing methodology
Attachments: 2016-lmd-proposed (Bob's comments) (2).pdf

Trish,

I also had Bob Angelo, the regional standards coordinator for Missouri, look over the methodology. He went through it with a fine-toothed comb and has many comments. I am forwarding you his mark-up of the methodology. His comments include some that are more programmatic suggestions also and may not influence your document per se.

You have a good holiday season also,
Bruce

Bruce Perkins
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Lenexa, KS 66219
(913) 551 7067

From: Rielly, Trish [<mailto:trish.rielly@dnr.mo.gov>]
Sent: Wednesday, December 18, 2013 9:33 AM
To: Perkins, Bruce
Cc: Rielly, Trish
Subject: RE: EPA comments on the proposed 2014 303(d) list and 2016 listing methodology

Hi Bruce, I just wanted to let you know I received your comments.

We will review and respond as needed/necessary.

Have a good week, and Holiday!!

Trish Rielly | Water Quality Monitoring and Assessment Unit | 1101 Riverside Drive, Jefferson City, Missouri | Phone: 573-526-5297 | E.mail: trish.rielly@dnr.mo.gov | Water Protection Program URL: <http://dnr.mo.gov/env/wpp/wp-index.html>

The Department of Natural Resources envisions a Missouri where people live and work in harmony with our natural and cultural resources; make decisions that result in a quality environment and a place where we can prosper today and in the future.

From: Perkins, Bruce [<mailto:Perkins.Bruce@epa.gov>]
Sent: Monday, December 16, 2013 10:07 AM
To: Rielly, Trish
Subject: EPA comments on the proposed 2014 303(d) list and 2016 listing methodology

Trish,

Here are some comments on the list and methodology. I have also attached a data file with EPA's urban waters sediment data in the Kansas City area. It was not all on the STORET site due to an oversight when uploading the data. The data I mention for sediment in the Springfield area was collected for our ongoing data collection for TMDL development. The data was sent to the TMDL section at the state but if they have not shared it with you I can also send you a copy.

If you have any questions or want further explanations just let me know.

Bruce

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**Methodology for the Development
of the
2016 Section 303(d) List in Missouri**

Comment [D1]: Updated date

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



Methodology for the Development of the 2016 Section 303(d) List

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I. Citation and Requirements

A. Citation of Section of Clean Water Act

This document is required by revisions of rules under the Federal Clean Water Act, Section 303(d), 40 CFR 130.7, and the timetable for presenting the finished document to the United States Environmental Protection Agency (EPA) and the public is given in Part 130.10. Section 303(d) requires states to list certain impaired waters and the rules require that states describe how this list will be constructed. Missouri fulfills reporting requirements under Section 303(d), 305(b) and 314 of the Clean Water Act by the submission to EPA of an integrated report at the time the 303(d) is approved by the Missouri Clean Water Commission. In years when no integrated report is submitted, the Department of Natural Resources (Department) submits a copy of its statewide water quality assessment database to EPA.

B. EPA Guidance

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" (Appendix A & B). 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. In subsequent years, EPA has provided additional guidance, but only limited new supplemental information has been provided since the 2008 cycle. Additional information can be found at EPA's website: <http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/guidance.cfm>

Comment [D2]: Inserted reference and made minor updates wording in the sentences following and added EPA web link

The Department is responsible for administration of the Federal Clean Water Act in Missouri. EPA regulations require that the Department describe the methodology used to develop the state's 303(d) List. Biennially, the methodology is reviewed and revised as necessary, and made available to the public for review and comment. In accordance with the guidance, the Department provides EPA with a document summarizing all comments received and the Department responses to significant comments. EPA's guidance recommends that the Department provide: (1) a description of the methodology used to develop the Section 303(d) List; (2) a description of the data and information used to identify (impaired and threatened) waters, including a description of the existing and readily available data and information used; and (3) a rationale for any decision for not using any existing and readily available data and information. The guidance also notes that "prior to submission of its Integrated Report, each state should provide the public with the opportunity to review and comment on the methodology." The guidelines further recommend that the methodology document include information on how interstate or international disagreements concerning the list are resolved.

Comment [D3]: Updated this sentence

Placement of Waters within the Five Categories in the 2006¹ EPA Assessment, Listing and Reporting Guidance

The guidance issued by EPA in 2006 recommends that all waters of the state be placed in one of five categories.

Comment [D4]: Updated the year and added EPA web link to footnote

Category 1

All designated beneficial uses are fully maintained. Data or other information supporting full beneficial use attainment for all designated beneficial uses must be consistent with the state's listing methodology document. The Department will place a water in Category 1 if the following conditions are met:

- 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, *E. coli* or fecal coliform bacteria) that indicates attainment with water quality standards.
- The level of mercury in fish filets or plugs used for human consumption does not exceed fish tissue guidelines of 0.3 mg/kg or less. Only samples of higher trophic level species (largemouth, smallmouth and Kentucky Spotted bass, sauger, walleye, northern pike, trout, striped bass, white bass, flathead catfish and blue catfish) will be used.
- The water is not rated as "threatened".

Comment [D5]: Removed fish eggs

Category 2

One or more designated beneficial uses are fully attained but at least one designated beneficial use has inadequate data or information to make a use attainment decision consistent with the state's listing methodology document. The Department will place a water in Category 2 if at least one of the following conditions are met:

- 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 total nitrogen, total phosphorus or secchi data in lakes.
- There is inadequate *E. coli* or fecal coliform bacteria data to assess attainment with the whole body contact recreational use.
- There is insufficient fish fillet tissue, or plug data available for mercury to assess attainment with the fish consumption use.

Category 2 waters will be placed in one of two sub-categories.

¹ http://water.epa.gov/lawsregs/lawguidance/cwa/tmdl/upload/2005_08_11_tmdl_2006IRCI_report_2006irg-sec5.pdf

Category 2A: Waters will be placed in this category if available data, using best professional judgement, suggests compliance with numeric 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 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 this data is 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.

Comment [D6]: Added hyperlink to CSR

Category 3

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 beneficial uses. Category 3 waters will be placed in one of two sub-categories.

Category 3A. Waters will be placed in this category if available data, using best professional judgement, suggests compliance with numeric 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 3B. Waters will be placed in this category if the available data, using best professional judgement, 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. Category 3B waters will be given high priority for additional water quality monitoring.

Category 4

State Water Quality Standards or other criteria, as per the requirements of Table 1 of this document, are not attained, but a Total Maximum Daily Load study is not required. Category 4 waters will be placed in one of three sub-categories.

Category 4A. EPA has approved a Total Maximum Daily Load study that addresses the impairment. The Department will place a water in Category 4A if both the following conditions are met:

- Any portion of the water is rated as being in non-attainment with state Water Quality Standards or other criteria as explained in Table 1 of this document due to one or more discrete pollutants or discrete properties of the water², and

² 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.

- EPA has approved a Total Maximum Daily Load for all pollutants that are causing non-attainment.

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:

- Any portion of the water is rated as being in non-attainment with state Water Quality Standards or other criteria as explained in Table 1 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.

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 Table 1 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 *E. coli* bacteria.

Category 5

At least one discrete pollutant has caused non-attainment with state Water Quality Standards or other criteria as explained in Table 1 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) List³.

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. These segments must be listed as Category 5 unless the state can demonstrate that no discrete pollutant or pollutants causes or contributes to the impairment. Pollutants causing the impairment will be identified before a TMDL study is written. The TMDL must be written within the time period allowed for TMDL development in EPA guidelines.

Threatened Waters

When a water that would otherwise be in Categories 1, 2, or 3 has a time trend analysis for one or more discrete water quality pollutants that indicates the water is currently maintaining all

³ 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.

beneficial uses but will not continue to meet these uses before the next listing cycle, it will be considered a "threatened water." A threatened water will be treated as an impaired water and placed in the appropriate Category (4A, 4B, or 5).

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;
- to better understand daily, flow event and seasonal water quality variations and their underlying processes;
- to characterize aquatic biological communities;
- to assess time trends in water quality;
- to characterize local and regional impacts of point and nonpoint source discharges on water quality;
- to check for compliance with Water Quality Standards or wastewater permit limits;
- to 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 to avoid overlap with other agencies, and to provide and receive interagency input on monitoring study design. Data from other sources is used for meeting the same objectives as Department sponsored monitoring. The agencies most often involved are the U.S. Geological Survey, the U.S. Army Corps of Engineers, EPA, the Missouri Department of Conservation, and the Missouri Department of Health and Senior Services. The Department 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 Quality Assurance/Quality Control tests.

Existing Monitoring Networks and Programs

The following list is a 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 event, and seasonal water quality variations and their

underlying processes, to assess time trends and to check for compliance with Water Quality Standards.

B. Design Methodology: Sites were 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:

- Department/U.S. Geological Survey cooperative network: 70 sites statewide, horizontally and vertically integrated grab sampled, six to 12 times per year. Samples are analyzed for major ions, nutrients, temperature, pH, dissolved oxygen, specific conductance and flow on all visits, two to four times annually for suspended solids and heavy metals, and for pesticides six times annually at six sites.
- Department/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 (typically weekly during the recreational season) of swimming beaches at Missouri's state parks during the recreational season by the Department's Division of State Parks.
- Monitoring of sediment quality by the Department at approximately 10 discretionary sites annually. All sites are monitored for several heavy metals and organic contaminants.

Comment [D7]: Updated information to reflect current monitoring efforts

Comment [D8]: Replaced "summer" with "recreational season"

Comment [D9]: Removed pore water analysis for ammonia and microtox toxicity

2. Special Water Quality Studies

A. Objective: Special water quality studies are used to characterize the water quality impacts from a specific pollutant source area.

B. Design Methodology: These studies are designed to determine 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, season of the year and time of day variation must be accounted for in the sampling design.

C. Number of Sites, Sampling Methods, Sampling Frequency and Parameters: The

Department conducts or contracts for 10 to 15 special studies annually, as funding allows. Each study has multiple sampling sites. 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 toxic chemicals. In addition, major municipal and industrial dischargers must monitor for toxicity in their effluents as a condition of their Missouri State Operating Permit.

4. Biological Monitoring Program

- A. Objectives: The objectives of this program 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 continue a statewide fish and aquatic invertebrate monitoring program.
- B. Design Methodology: Development of biocriteria for invertebrates and fish involves identification of reference streams in each of Missouri's 17 ecological drainage units. It also includes intensive sampling of invertebrate and fish communities to quantify temporal and spatial variation in reference streams within ecoregions and variation between 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 invertebrates for many years. Since 1991, this program has consisted of standardized monitoring of approximately 55 sites twice annually. The Missouri Department of Conservation presently has a statewide fish and aquatic invertebrate monitoring program, the Resource Assessment and Monitoring Program, designed to assess and monitor the health of Missouri's stream resources. This program samples a minimum of 450 random and 30 reference sites every five years.

5. Fish Tissue Monitoring Program

- A. Objective: Fish tissue monitoring can address two separate objectives. These are: (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 plugs, or fillets.
- B. Design Methodology: Fish tissue monitoring sites were 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

Comment [D10]: Added plugs, and removed fish eggs. The collection of fish eggs is conducted on occasion, but routinely. Mention of fish egg monitoring is retained in section C below.

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 and EPA have a cooperative fish tissue monitoring program that collects whole fish composite samples⁴ at approximately 12 fixed sites. Each site is sampled once every two years. The preferred species for these sites are either carp or redhorse sucker.

The Department, EPA and the Missouri Department of Conservation also sample 40 to 50 discretionary sites annually for two fish fillet composite samples or plug samples (mercury only) from fish of similar size and species. One sample is of a top carnivore such as largemouth bass, smallmouth bass, walleye or sauger. The other sample is for a species of a lower trophic level such as catfish, carp or sucker. 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.

Comment [D11]: Added

6. Volunteer Monitoring Program

Two major volunteer monitoring programs are now generating water quality data in Missouri. The first is the Lakes of Missouri Volunteer Program. This cooperative program consists of persons from the Department, the University of Missouri-Columbia and volunteers that monitor approximately 137 sites on 66 lakes, including Lake Taneycomo, Table Rock Lake and several lakes in the Kansas City area. Data from this program is used by the university as part of a long-term study on the limnology of midwestern reservoirs.

Comment [D12]: Updated information to reflect current efforts

The second program involves volunteers who monitor water quality of streams throughout Missouri. The Volunteer Water Quality Monitoring Program is a subprogram of the Missouri Stream Team Program, a cooperative project sponsored by the Department, the Missouri Department of Conservation and the Conservation Federation of Missouri. By the end of 2012 over 5,000 citizen volunteers had attended at least one training workshop. After the introductory class, many proceed on to 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 Program volunteers represent increasingly higher quality assurance. Of those completing an introductory course, about 35 percent proceed to Levels 1 and 2. One hundred-two volunteers have reached Level 3 and six volunteers have reached Level 4. The Cooperative Site Investigation 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 25 volunteers qualified to work in the Cooperative Site Investigation Program. All Level 2, 3, and 4 volunteers as well as all CSI

Comment [D13]: Added last two sentences

⁴ A composite sample is one in which several individual fish are combined to produce one sample.

trained volunteers are required to attend a validation session every 3 years to insure, equipment, reagents and methods meet our standards. To date 70 individuals have attended a validation at least once.

Laboratory Analytical Support

Laboratories used:

- Department/U.S. Geological Survey Cooperative Fixed Station Network: U.S. Geological Survey Lab, Denver, Colorado
- Intensive Surveys: Varies, many are done by the Department's Environmental Services Program
- Toxicity Testing of Effluents: Many commercial laboratories
- Biological Criteria for Aquatic Invertebrates: 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)
- Missouri State Operating Permit: Self-monitoring or commercial laboratories
- Department's Public Drinking Water Monitoring: Department's Environmental Services Program and commercial laboratories
- Other water quality studies: Many commercial laboratories

Comment [D14]:

Removed Department's Public Drinking Water Reservoir Network – no longer conducting

B. Identification of All Existing and Readily Available Water Quality Data Sources:

The following data sources are used by the Department to aid in the compilation of the state's 305(b) Report. Where quality assurance programs are deemed acceptable, these 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.
9. Annual fish tissue monitoring programs by the Environmental Protection Agency/Department Regional Ambient Fish Tissue Monitoring Program and the Missouri Department of Conservation.
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 invertebrates 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 St. Louis, Kansas City and Springfield, Missouri, and
 - d) Bacterial and nutrient contamination of streams in southern Missouri.
12. Special water quality studies by other agencies such as the Missouri Department of Conservation, the U.S. Public Health Service, and the Missouri Department of Health and Senior Services.
13. Monitoring of fish occurrence and distribution by the Missouri Department of Conservation.
14. Fish Kill and Water Pollution Investigations Reports published by the Missouri Department of Conservation.
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, the Environmental Protection Agency 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.

Comment [D15]: Previously the LMD repeated this statement in bullet number 24. That duplication was removed.

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 invertebrate 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 is eligible for use in distinguishing between waters in Categories 2A and 2B or Categories 3A and 3B. Most of this data is not used to place waters in main Categories (1, 2, 3, 4 and 5) because analytical procedures do not use EPA or Standard Methods 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 any assessment purposes. 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 can be used in the Section 303(d) assessment process.

Comment [D16]: Previously the LMD repeated this statement in bullet number 25. That duplication was removed.

The following data sources (22-25) cannot be used 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 purposes.

22. Fish Management Basin Plans published by the Missouri Department of Conservation.
23. Fish Consumption Advisories published annually by the Missouri Department of Health and Senior Services. Note: the department may use data from data source No. 9 (as listed above) to list individual waters as impaired due to contaminated fish tissue.

Comment [D17]: Added

The Department will review all data of acceptable quality that is submitted to the Department prior to the end of the first public notice of the draft 303(d) list. The Department reserves the right to review and use data of acceptable quality submitted after this date if the data results in a change to the assessment status of the water.

C. Data Quality Considerations

1. 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 Plan. The agency or organization responsible for collection and/or analysis of the environmental sampling must write and adhere to a Quality Assurance Project Plan approved through the Department's Quality Management Plan. Any environmental data generated by a monitoring plan with a Department approved Quality Assurance Project Plan is considered suitable for use in the 303(d) assessment process. This includes data generated by volunteers participating in the department's Cooperative Site Investigation 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 Cooperative Site Investigation Program. Individual volunteers that collect samples and deliver them to an approved laboratory must first successfully complete Department training in proper collection and handling of samples. The kind of information that should allow the department to make a judgment on the acceptability of a 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 used and maintenance and calibration procedures used, (3) a description of sample collection and handling procedures and (4) a description of all analytical methods used for samples taken to a laboratory for analysis.

2. Other Quality Assurance/Quality Control Programs

Data generated in the absence of a Department-approved Quality Assurance Project Plan may be used to determine the 303(d) status of a waterbody if the Department determines that the data is scientifically defensible after making a review of the quality assurance procedures 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 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.

3. Other Data Quality Considerations

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

If the department uses data to make a 303(d) List decision that predates the date the list is initially developed by more than seven years, the Department will provide a written justification for the use of such data.

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 time trends.

3.2 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 1997⁵). 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 analytes and Data Code Four the greatest. Based on EPA’s guidance, the Department uses the following rules to assign code numbers to data.

Comment (D18): Added EPA web link to footnote

- Data Code⁶ One: All data not meeting the requirements of Data Code Two, Three or Four.
- 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 fish tissue samples per water body.
- 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 quantitative biological monitoring of at least one aquatic assemblage (fish, invertebrates or algae) at multiple sites, 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 quantitative biological monitoring of at least two aquatic assemblages (fish, invertebrates 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 305(b) 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.

⁵ *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>)

⁶ 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.

In general, when selecting water bodies for the Missouri 303(d) List, only Data Code Two or higher data are used, unless the problem can be accurately characterized by Data Code One data.⁷ The reason is that Data Code Two data provides a higher level of assurance that a Water Quality Standard is actually being exceeded and that a Total Maximum Daily Load study is necessary. All water bodies placed in Categories 2B or 3B receive high priority for additional monitoring so that data quality is upgraded to at least Data Code Two.

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

Each reporting cycle, the Department and stakeholders review and revise the guidelines for determining water quality impairment. These guidelines are shown in Tables 1.1 and 1.2 which provide the general rules of data use and assessment and Tables B-1 and B-2 that provide details about the specific analytical procedure used. In addition, if time trend data indicates that presently unimpaired waters will become impaired prior to the next listing cycle, these “threatened waters” will be judged to be impaired. Where antidegradation provisions in Missouri’s Water Quality Standards apply, those provisions shall be upheld. The numeric criteria included in Table 1.1 have been adopted into the state Water Quality Standards, 10 CSR 20-7.031, and are used, as described in Table 1.1, to make use attainment decisions. For narrative criteria, the numeric thresholds included in Table 1.2 have not been adopted into state Water Quality Standards. The Department will use a weight of evidence analysis for all narrative criteria. For those analytes with numeric thresholds, the threshold values given in Table 1.2 will trigger a weight of evidence analysis to determine the existence or likelihood of use impairment and the appropriateness of proposing a listing based on narrative criteria. This weight of evidence analysis will include the use of other types of environmental data when it is available. Examples of other relevant environmental data might include biological data on fish or aquatic invertebrate animals (which will be given greater weight than the other types) or toxicity testing of water or sediments. When the weight of evidence analysis suggests, but does not provide strong, scientifically defensible 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 use attainment decision. All such documents will be made 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 waterbody based on narrative criteria will only be made after full consideration of all comments on the proposal.

Comment [D19]: Added

For the interpretation of biological data, where habitat assessment data indicates habitat scores are less than 75 percent of reference or appropriate control stream scores, and in the

⁷ 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 Table 1.1 of this document.

absence of other data indicating impairment by a discrete pollutant, a waterbody judged to be impaired will be placed in Category 4C.

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*, *Pimephales promelas* or *Hyalella azteca* 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 is data of another kind (freshwater toxicity tests, sediment chemistry, water chemistry or biological sampling) that indicates water quality impairment.

**TABLE 1.1. 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**

BENEFICIAL USES	DATA TYPE	DATA QUALITY CODE	COMPLIANCE WITH WATER QUALITY STANDARDS ⁸
Overall use protection (all beneficial uses)	No data. Evaluated based on similar land use/ geology as stream with water quality data. ⁹	Not applicable	Given same rating as monitored stream with same land use and geology.
Any beneficial uses	No data available or where only effluent data is available. Results of dilution calculations or water quality modeling. (see ALRR p.38)	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	Water temperature, pH, total dissolved gases, oil and grease.	1-4	<u>Full:</u> No more than 10% of all samples exceed criterion. ¹⁰ <u>Non-Attainment:</u> Requirements for full attainment not met.
Protection of Groundwaters	E. coli bacteria	1-4	<u>Full:</u> No more than 10% of all samples exceed criterion. ² <u>Non-Attainment:</u> Requirements for full attainment not met. The criterion for E. coli is 126 counts/100ml.

Comment [D20]: Previously the LMD repeated this footnote two times. The duplication was removed.

Comment [D21]: Removed wording "The Criteria for E. Coli is 126 counts/100ml 10 CFR 20-7.031(4)(c) - did not need to be stated for this beneficial use

⁸ See section on Statistical Considerations, Table B-1 and B-2.

⁹ 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.

¹⁰ 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.

**TABLE I.1. 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**

BENEFICIAL USES	DATA TYPE	DATA QUALITY CODE	COMPLIANCE WITH WATER QUALITY STANDARDS ⁸
			10 CSR 20-7.031 (4)(C)
Protection of Aquatic Life	Dissolved oxygen.	1-4	<u>Full:</u> No more than 10% of all samples exceed criterion. ⁹ <u>Non-Attainment:</u> Requirements for full attainment not met.
Protection of Aquatic Life	Toxic Chemicals	1-4	<u>Full:</u> No more than one acute toxic event in three years that results in a documented fish kill (does not include fish kills due to natural causes). No more than one exceedance of acute or chronic criterion in the last three years for which data is available. <u>Non-Attainment:</u> Requirements for full attainment not met.
Protection of Aquatic Life	Nutrients in Lakes (total phosphorus, Total nitrogen, Chlorophyll)	1-4	<u>Full:</u> Nutrient levels do not exceed WATER QUALITY STANDARDS following procedures stated in Table B-1. <u>Non-Attainment:</u> Requirements for full attainment not met. ¹¹
Fish Consumption	Chemicals (water)	1-4	<u>Full:</u> Water quality does not exceed WATER QUALITY STANDARDS following procedures stated in Table B-1. <u>Non-Attainment:</u> Requirements for full attainment not met.
Drinking Water Supply -Raw Water. ¹²	Chemical (toxics)	1-4	<u>Full:</u> WATER QUALITY STANDARDS not exceeded following procedures stated in Table B-1.

Comment [D22]: added

Comment [D23]: Added

Comment [D24]: Added

Comment [D25]: Added

¹¹ Nutrient criteria will be used in the 2016 LMD only if these criteria appear in the Code of State Regulations, and have not been disapproved by the U.S. Environmental Protection Agency.

¹² Raw water is water from a stream, lake or ground water prior to treatment in a drinking water treatment plant.

**TABLE 1.1. 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**

BENEFICIAL USES	DATA TYPE	DATA QUALITY CODE	COMPLIANCE WITH WATER QUALITY STANDARDS ⁸
			<u>Non-Attainment</u> : Requirements for full attainment not met.
Drinking Water Supply- Raw Water	Chemical (sulfate, chloride, fluoride)	1-4	<u>Full</u> : WATER QUALITY STANDARDS not exceeded following procedures stated in Table B-1. <u>Non-Attainment</u> : Requirements for full attainment not met.
Drinking Water Supply- Finished Water	Chemical (toxics)	1-4	<u>Full</u> : No MCL* violations based on Safe Drinking Water Act data evaluation procedures. <u>Non-Attainment</u> : Requirements for full attainment not met. 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. ¹³ <u>Non-Attainment</u> : Requirements for full attainment not met.

Comment [D26]: Added

Comment [D27]: Updated to reflect minimum numbers of samples needed to make an assessment

¹³ A geometric mean of 206 cfu/100 ml for *E. coli* 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 *E. coli* sampling has determined the status of the water.

**TABLE 1.1. 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**

BENEFICIAL USES	DATA TYPE	DATA QUALITY CODE	COMPLIANCE WITH WATER QUALITY STANDARDS ⁸
Irrigation, Livestock and Wildlife Water	Chemical	1-4	<p><u>Full</u>: WATER QUALITY STANDARDS not exceeded following procedures stated in Table B-1.</p> <p><u>Non-Attainment</u>: Requirements for full attainment not met.</p>

Comment [D28]: Added

**Maximum Contaminant Level*

TABLE 1.2. 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 ⁷
Overall use protection (all beneficial uses)	Narrative criteria for which quantifiable measurements can be made.	1-4	<p><u>Full</u>: Stream appearance 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 exceed 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 waterbody 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 twenty percent.</p> <p>Note: Waters in mixing zones and unclassified waters which 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 (ZID) shall not be subject to acute toxicity criteria.</p>

TABLE 1.2. 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 ⁷
Protection of Aquatic Life	Toxic Chemicals	1-4	<p>Full: No more than one acute toxic event in three years (does not include fish kills due to natural causes). No more than one exceedence of acute or chronic criterion in three years for all toxics.^{14 15}</p> <p>Non-Attainment: Requirements for full attainment not met.</p>

Comment [D29]: Added

¹⁴ 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 insure only representative data is 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.

¹⁵ 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 McDonald, D.D. et al. 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 Table B-1 and Appendix D for more information on the Probable Effect Concentrations Quotient.

TABLE 1.2. 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 ⁷
Protection of Aquatic Life	Biological: Aq. Invertebrates-DNR Protocol. ¹⁶	3-4	<p><u>Full:</u> 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 stream¹⁷</p> <p><u>Non-Attainment:</u> 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>
	Biological: MDC Fish Community (RAM) Protocol (Ozark Plateau only)	3-4	<p><u>Full:</u> For seven or fewer samples and following MDC RAM fish community protocols, 75% of the IBI 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 and evaluation protocols, results must be</p>

¹⁶ DNR invert protocol will not be used for assessment in the Mississippi Alluvial Plains (bootheel area) due to lack of reference streams for comparison.

¹⁷ See Table B-1 and B-2. For test streams that are significantly smaller than bioreference streams 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.

TABLE 1.2. 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 ⁷
	Other Biological Data	3-4	<p>statistically similar to representative reference or control stream¹⁸</p> <p><u>Suspected of Impairment</u>: data not conclusive (Category 2B). For first and second order streams IBI score < 29.</p> <p><u>Non-Attainment</u>: First and second order streams will not be assessed for non-attainment. For third to fifth order streams; For seven or fewer samples and following MDC RAM fish community protocols, 75% of the stream condition index 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.^{19, 20}</p> <p><u>Full</u>: Results must be statistically similar to representative reference or control streams.¹⁵</p> <p><u>Non-Attainment</u>: Results must be statistically dissimilar to control or representative reference streams.</p>

Comment [D30]: Added

¹⁸ See Table B-1 and B-2. For test streams that are significantly smaller than bioreference streams 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.

¹⁹ IBI scores are from "Biological Criteria for Stream Fish Communities in Missouri" 2008. Doisy, et al. for MDC. If habitat is a likely problem the waterbody won't be listed as Category 5 based on this data. It still could be Category 4C, 2B, or 3B.

²⁰ 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 as suspect of impairment (categories 2B or 3B).

TABLE 1.2. 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 ⁷
Protection of Aquatic Life	Toxicity testing of streams or lakes using aquatic organisms	2	<p>Full: No more than one test result of statistically significant deviation from controls in acute or chronic test in a three-year period.¹⁵</p> <p>Non-Attainment: Requirements for full attainment not met.</p>
Fish Consumption	Chemicals (tissue)	1-2	<p>Full: Fish tissue levels in fillets, plugs, and eggs do not exceed guidelines.²¹</p> <p>Non-Attainment: Requirements for full attainment not met.</p>

Comment [D31]: Added

Duration of Assessment Period

Except where the assessment period is specifically noted in Table 1.1, the time period for which data will be used in making the assessments noted in Table 1 will be determined by the data age considerations provided in Section II.C.3.3.1 and data representativeness considerations in Table 1.1 and 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 water quality data indicate a reduction in the waters' historical quality. Historical quality is determined from past data that best describes the waters' quality following promulgation of the antidegradation rule and at the time the water was given Tier Three protection.

²¹ 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.

- In a 2012 DHSS Memo (not yet approved) these values have changed: Chlordane - 0.2; Mercury -0.27; PCBs - 0.540; lead has not changed, but they do add atrazine and PDBEs (Fish Fillet Advisory Concentrations (FFACs) in Missouri)
- <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.

Historical data gathered at the time the 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 segments upstream from assessed segments that receive discharges of the quality and quantity that mimic the historical discharges to the assessed segment, and 2) data from other bodies of water in the same ecoregion having a similar watershed and landscape and receiving discharges and runoff of the quality and quantity that mimic the historical discharges to 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 point in time in which upstream discharges, runoff and watershed conditions remained the same may if 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 the test will be that assessed segment and the representative segment have the same water quality. 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 value can be applied to the pollutant (see Table I page 15). These narrative criteria apply to both classified and unclassified waters and prohibit the following in waters of the state:
 - a. Unsightly, putrescent or harmful bottom deposits,
 - b. Oil, scum and floating debris,
 - c. Unsightly color, turbidity or odor,
 - d. Substances or conditions causing toxicity to human, animal or aquatic life,
 - e. Human health hazard due to incidental contact,
 - f. Acute toxicity to livestock or wildlife, when used as a drinking water supply,
 - g. Physical, chemical or hydrologic changes that impair the natural biological community, and
 - h. Used tires, car bodies, appliances, demolition debris, used vehicles or equipment and any solid waste as defined by Missouri’s Solid Waste Law,
 - i. Acute toxicity.

2. Habitat assessment protocols for wadeable streams have been established and are conducted in conjunction with sampling of aquatic invertebrates and the analysis of aquatic invertebrates data. The Department will not use habitat assessment data alone for assessment purposes.

E. Other 303(d) Listing Considerations

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

The listed portion of an impaired water 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 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.

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

The listed portion of an impaired water 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 already on the list based on recent monitoring data following these same guidelines. Waters may be completely removed from the list for several reasons²², the most common being (1) water has returned to compliance with water quality standards or (2) the water has an approved Total Maximum Daily Load study.

3. Prioritization of Waters for Total Maximum Daily Load 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 still requiring Total Maximum Daily Loads. The department will prioritize development of Total Maximum Daily Loads based on several variables including:

- severity of the water quality problem
- amount of time necessary to acquire sufficient data to develop the Total Maximum Daily Load
- court orders, consent decrees or other formal agreements
- budgetary constraints, and
- amenability of the problem to treatment

The department's Total Maximum Daily Load schedule will represent its prioritization.

4. Resolution of Interstate/International Disagreements

²² 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 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 in another state is different than in Missouri, the department will request the data upon which the listing in the other state is based. This data will be reviewed following all data evaluation guidelines previously discussed in this document. The Missouri list may be changed pending the evaluation of this additional data.

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.

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.

I. 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 a 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" – Total Suspended Solids, pH, Biochemical Oxygen Demand, fecal coliform bacteria and oil and grease – 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 the applicable water quality criterion are expressed. An example of a water quality criterion for which an assessment based on the 10% rule would be appropriate is the EPA acute water quality criterion for fecal coliform bacteria, applicable to protection of water contact recreational use. This 1976-issued water quality criterion was expressed as, "...no more than ten percent of the samples exceeding 400 CFU per 100ml, during a 30-day period. This assessment methodology is clearly reflective of the water quality criterion.

On the other hand, use of the 10 percent rule for interpreting water quality data is usually not consistent with water quality criterion 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 10 percent rule typically leads to the belief that segment conditions are equal to or better than specified by the water quality criterion, when they in fact are considerably worse. (That is, pollutant concentrations are above the criterion concentration a far greater proportion of the time than specified by the water quality criterion). Conversely, use of this decision rule in concert with water quality criterion expressed as average concentrations over specific times can lead to

concluding that segment conditions are worse than water quality criterion, 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 versus 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.

2. 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 Water Quality Standards” or “not meeting Water Quality Standards” as the null hypothesis (refutable 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 the presumption. By contrast, making the null hypothesis “Water Quality Standards not being met” shifts the burden of proof to those who believe the segment is, in fact, meeting Water Quality Standards.

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 was no previous data on the segment, and no additional existing and readily available data and information is 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 assured 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 Water Quality Standards”: 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 10 percent. Hence, if the chosen null hypothesis is “segment meeting Water Quality Standards”, the state is trying to keep the chance of saying a segment is impaired, when in reality it is not, under 10 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 those 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 following two 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 Water Quality Standards), 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 water quality criteria (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 statewide, or in a given group of segments, assuming a degree of variance in levels of the pollutant often observed over typical 30-day periods.

Comment [D32]: Added

Appendix B 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 which 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 used under various circumstances.

Description of Analytical Tools

The Tables B-1 and B-2 below describes the analytical tools the department will use to determine impairment (Table B-1) and to determine when listed waters are no longer impaired (Table B-2).

TABLE B - 1. DESCRIPTION OF ANALYTICAL TOOLS FOR DETERMINING IF WATERS ARE IMPAIRED

Beneficial Use	Analytes	Analytical Tool	Decision Rule/ Hypothesis	Criterion Used with the Decision Rule ²³	Significance Level
Narrative Criteria	Color (Narrative)	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	0.10

²³ 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.

TABLE B - I. DESCRIPTION OF ANALYTICAL TOOLS FOR DETERMINING IF WATERS ARE IMPAIRED

Beneficial Use	Analytes	Analytical Tool	Decision Rule/ Hypothesis	Criterion Used with the Decision Rule ²³	Significance Level
	Bottom Deposits (Narrative)	Hypothesis Test, Two Sample, one tailed "t" Test ²³	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) ²⁴	0.40
Aquatic Life	Biological Monitoring (Narrative)	For DNR Invert protocol: Binomial probability for Sample sizes 8 or more. For RAM Fish IBI protocol: Binomial probability for Sample sizes 8 or more.	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.	0.10

Comment [D33]: Added, and removed "one sided confidence limit"

Comment [D34]: Added, and removed "30 or more"

Comment [D35]: Same comment as above

²⁴ 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 we use the Mann-Whitney test.

TABLE B - 1. DESCRIPTION OF ANALYTICAL TOOLS FOR DETERMINING IF WATERS ARE IMPAIRED

Beneficial Use	Analytes	Analytical Tool	Decision Rule/ Hypothesis	Criterion Used with the Decision Rule ²³	Significance Level
		For DNR Invert protocol and sample sizes greater than 30: Direct comparison. For RAM Fish IBI protocol and sample sizes greater than 30: Direct comparison.	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 sustaining scores is more than five percent more than test stream.	Not applicable
		For other biological data: An appropriate parametric or nonparametric test will be used.	Null Hypothesis, Community metric(s) in test stream is the same as for a reference stream or control streams.	Reject Null Hypothesis If metric scores for test stream are significantly less than reference or control streams.	0.1
			Other biological monitoring to be determined by type of data.		
Aquatic Life	Toxic Chemicals in Water. (Numeric)	Not applicable	No more than one toxic event, toxicity test failure or exceedance of acute or chronic criterion in 3 years.	Not applicable	Not applicable
	Toxic Chemicals in Sediments (Narrative)	Comparison of mean to PEL value.	Waters are judged to be Impaired if sample mean Exceeds 150% of PEL or 150% of PEQ. ²⁵		
Aquatic Life	temperature, pH, total diss. gases, oil and grease, diss. 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

Comment [D36]: Added

Comment [D38]: Added, removed "0.10"

Comment [D37]: Added, removed "exceedance frequency is significantly more than 10%"

²³ Where there is convincing evidence of a healthy biological community (fish and/or aquatic invertebrate monitoring data) or convincing evidence of a lack of toxicity (two species bioassay tests of sediment elutriate water or sediment pore water), this evidence will be evaluated in conjunction with the sediment PEL data.

TABLE B - 1. DESCRIPTION OF ANALYTICAL TOOLS FOR DETERMINING IF WATERS ARE IMPAIRED

Beneficial Use	Analytes	Analytical Tool	Decision Rule/ Hypothesis	Criterion Used with the Decision Rule ²³	Significance Level
Groundwater Protection	E.coli	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	0.10
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.	0.40
Fish Consumption	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.	0.40
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.	0.40
Drinking Water Supply (Raw)	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.	0.40
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
Whole Body Contact and Secondary Contact Rec.	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

Comment [D39]: Removed "10% Exceedance"

Comment [D40]: Added, removed "exceedance frequency is significantly more than 10%"

TABLE B - 1. DESCRIPTION OF ANALYTICAL TOOLS FOR DETERMINING IF WATERS ARE IMPAIRED

Beneficial Use	Analytes	Analytical Tool	Decision Rule/ Hypothesis	Criterion Used with the Decision Rule ²³	Significance Level
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.	0.40
Protection of Aquatic Life	Nutrients in Lakes (Numeric)	Hypothesis test ²⁶	Null hypothesis: Criteria are not exceeded.	Reject Null hypothesis if 60% LCL value is more than criterion value.	0.40

²⁶ 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.

TABLE B - 2. DESCRIPTION OF ANALYTICAL TOOLS FOR DETERMINING WHEN WATERS ARE NO LONGER IMPAIRED

Beneficial Use	Analytes	Analytical Tool	Decision Rule/ Hypothesis	Criterion Used with the Decision Rule ¹⁹	Significance Level
Narrative Criteria	Color (Narrative)	Same as Table B-1	Same as Table B-1	Same as Table B-1	0.40
	Bottom Deposits (Narrative)	Same as Table B-1	Same as Table B-1	Same as Table B-1	0.40
Aquatic Life	Biological Monitoring (Narrative)	DNR Invert Protocol: For 8 to 30 samples Same as Table B-1	Same as Table B-1	Same as Table B-1	0.40
		RAM Fish IBI Protocol: For 8 to 30 samples Same as Table B-1	Same as Table B-1	Same as Table B-1	0.40
		For DNR Invert Protocol For more than 30 Same as Table B-1	Same as Table B-1.	Same as Table B-1.	Same as Table B-1.
		RAM Fish IBI Protocol: For 8 to 30 samples Same as Table B-1	Same as Table B-1.	Same as Table B-1.	Same as Table B-1.
	For other biological data: Same as Table B-1.	Same as Table B-1.	Same as Table B-1.	0.40	
	Toxic Chemicals in Water.	Same as Table B-1.	Same as Table B-1.	Same as Table B-1.	Same as Table B-1.
Toxic Chemicals in Sediments	Comparison of mean to PEL value.	Water is judged to be unimpaired if sample mean does not exceed 150 % of PEL or 150% of PEQ. ²⁵	Not applicable	Not applicable	
Aquatic Life	Temperatur e, pH, total diss. gases, oil and grease, diss. oxygen	30 or fewer samples: Same as Table B-1.	Same as Table B-1.	Same as Table B-1.	Same as Table B-1.
		More than 30 samples: Same as Table B-1.	Same as Table B-1.	Same as Table B-1.	Same as Table B-1.
Groundwater Protection	E.coli	Same as Table B-1.	Same as Table B-1.	Same as Table B-1.	Same as Table B-1.
Fish Consumption	Toxic Chemicals in water	Same as Table B-1.	Same as Table B-1.	Reject null hypothesis if the 60% UCL is greater than the criterion value.	0.40

Comment [D41]: Previously footnote 27 was a duplicate of footnote 25. Removed duplication

TABLE B - 2. DESCRIPTION OF ANALYTICAL TOOLS FOR DETERMINING WHEN WATERS ARE NO LONGER IMPAIRED

Beneficial Use	Analytes	Analytical Tool	Decision Rule/ Hypothesis	Criterion Used with the Decision Rule ¹⁹	Significance Level
	Toxic Chemicals in Tissue	Same as Table B-1.	Same as Table B-1.	Reject null hypothesis if the 60% UCL is greater than the criterion value.	0.40
Drinking Water Supply (Raw)	Toxic Chemicals	Same as Table B-1.	Same as Table B-1.	Reject null hypothesis if the 60% UCL is greater than the criterion value.	0.40
Drinking Water Supply (Raw)	Non-toxic Chemicals	Same as Table B-1.	Same as Table B-1.	Reject null hypothesis if the 60% UCL is greater than the criterion value.	0.40
Drinking Water Supply (Finished)	Toxic Chemicals,	Same as Table B-1.	Same as Table B-1.	Same as Table B-1.	Same as Table B-1.
Whole Body Contact and Secondary Contact Rec.	Bacteria	Same as Table B-1.	Same as Table B-1.	Same as Table B-1	Not applicable
Irrigation & Livestock Water	Toxic Chemicals	Same as Table B-1.	Same as Table B-1.	Reject null hypothesis if the 60% UCL is greater than the criterion value.	0.40
Protection of Aquatic Life	Nutrients in Lakes	Same as Table B-1.	Same as Table B-1.	Same as Table B-1.	0.40

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 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 (Table B-1) test significance levels are set at either 0.1 or 0.4, meaning the data must show a 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 had been restored to an unimpaired status (Table B-2) some undesirable results can occur.

For example, using a 0.1 significance level for determining both impairment and nonimpairment; if the sample data indicate the stream had a 92 percent probability of being impaired, it would be rated as impaired. If subsequent data was 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 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 is concerned 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 databases, the disparity between Type I and Type II errors can be large. The table 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 for a stream with a 15 percent exceedence rate of a standard. Note that choosing a Type I error rate of 0.05 rather than 0.10 increases an already very large Type II error rate by about 10 percent. Also note that for a given Type I error rate, the Type II error rate declines as sample size increases.

Table B - 3. Effects of Type I Error Rates and Sample Size on Type II Error Rates

No. of Samples	No. Meeting Standards	Type I Error Rate	Type II Error Rate	No. of Samples	No. Meeting Standards	Type I Error Rate	Type II Error Rate
6	5	.469	.78	4	2	.05	.89
11	9	.302	.78	9	6	.05	.86
18	15	.266	.72	15	11	.05	.82
25	21	.236	.68	21	16	.05	.80
				27	20	.05	.78

Use of the Binomial Probability Distribution for Interpretation of the Ten Percent Rule

There are two options for assessing data for compliance with the ten 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 ten percent. The second method is to use some evaluative procedure that can review the data and provide a probability statement regarding the compliance with the ten 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.

Comment [D42]: Removed from sentence "for data sets up to size 30. Use of the binomial probability is difficult for larger sample sizes. And for these larger data sets impairment will be determined by making direct comparison of percent of samples not compliant with the criterion value with the ten percent guideline."

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 exceedence 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 exceedence 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.

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.

Appendix C Examples of Statistical Procedures

Two Sample "t" Test for Color

Null Hypothesis: Amount of color is no greater in 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 (also known as the alpha level): 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 waterbody is placed in either Category 2B or 3B.

Comment [D43]: This example was updated from the 50% CL to the 60% LCL that is currently used. The 60% LCL is followed regardless of sample size. Therefore reference to fish tissue samples less than or greater than 4 data set for fish tissue were removed.

Appendix D The Meaning of the Sediment Quotient and How to Calculate It

While sediment criteria in the form of Probably Effect Concentrations²⁷ 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 McDonald et al¹⁰ is the calculation of a Probably Effect Concentrations Quotient. This calculation is made by dividing the pollutant concentration in the sample by the Probably Effect Concentrations value for that pollutant. For single samples, the values are summed and normalized by dividing that sum by the number of pollutants. For multiple samples, the mean of the concentration value for each parameter will be used for the quotient.

Example: A sediment sample contains the following results in mg/kg.
Arsenic 2.5, Cadmium 4.5, Copper 17, Lead 100, Zinc 260.

The Probably Effect Concentrations values for these five pollutants in respective order are
33, 4.98, 149, 128, 459.

Probably Effect Concentrations Quotient =
 $((2.5/(33)) + (4.5/(4.98)) + (17/(149)) + (100/(128)) + (260/(459)))/5 = 0.488$

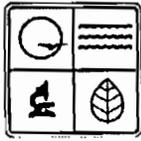
Based on research by McDonald (2000) 83% of sediment samples with Probably Effect Concentrations quotients less than 0.5 were non-toxic while 85% of sediment samples with Probably Effect Concentrations quotients greater than 0.5 were toxic. Based on these findings a Probably Effect Concentrations to insure consistency with the threshold values used for individual pollutants (150% of PEC value), a quotient greater than 0.75 will be judged to be toxic.

Comment [D44]: Added

Comment [D45]: Removed " Since the LMI uses 150% of the PEL as the "threshold value", we have modified the calculation of the sediment quotient by using 150% of the PEL value in the calculation."

Comment [D46]: Added

²⁷ Level at which harmful effects on the aquatic community are likely to be observed.



**Missouri
Department of
Natural Resources**

**Proposed 2016 Listing Methodology Document
RESPONSES TO PUBLIC COMMENTS**

**Public Notice
October 15, 2013 – January 31, 2014**

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

Proposed 2016 Listing Methodology - Summary of Public Comments and MDNR Responses

The Missouri Department of Natural Resources posted the draft 2016 Listing Methodology for public comment. The Department accepted written comments from October 15, 2013 through January 31, 2014.

Below is a summary of the Public Comments received in response to the Proposed 2016 Listing Methodology. The comments and responses will be saved to the public administrative record file and is available from the Department's website.

General Listing Methodology Comments

1. Comments received from the St. Louis Metropolitan Sewer District (MSD), city of Springfield, and city of St. Joseph

Making modifications to the proposed 2016 Listing Methodology Document (LMD) during the public notice process makes public comment difficult and have likely led to inconsistencies and confusion. The Department should improve the consistency of language within and between Tables 1.1, 1.2, B-1, and B-2. Several typographical errors were also noted.

MDNR Response and Action:

The Department apologizes for any confusion it may have caused when posting a revised version of the LMD. The revision was completed at the request of a stakeholder during the November 2013 public availability meeting. Additional information was provided to allow reviewers to gain a broader understanding on how fish community data was assessed. Other minor additions or grammatical corrections also occurred, but the additions and changes were noted on the Department's 303(d) webpage. Both versions of the LMD were retained on the Department's website to provide comparison as needed. All changes and updates were indicated in Microsoft Word using the track changes feature.

The Department agrees the consistency of language within and between Tables 1.1, 1.2, B-1, and B-2 can be improved. As previously stated, it appears that many inconsistencies are new to the proposed 2016 versions, while others appeared to have carried over from previous versions. The Department reviewed the tables and updated as necessary to correct any discrepancies. Any major revisions will occur during the next revision.

Typographical errors and other inconsistencies were also corrected.

General Assessment Methodology Comments

2. Comment received from the EPA

In the discussion of toxic chemicals in Table 1.1 there is an exclusion for fish kills due to natural causes. Is there information to indicate that natural toxic chemicals are released at a frequency of more than once every three years on average?

MDNR Response:

A majority of the fish kill notifications are reported to the Department's Environmental Emergency Response (EER) hotline. The EER staff sends notification to the Department's regional office, Missouri Department of Conservation (MDC), and other interested agencies. MDC conducts a follow-up fish kill investigation and provides a report to the Department through their fish kill reporting system summarizing their findings. If a fish kill is not directly associated with a reported incident, then specific toxins are not analyzed due to the expense of characterizing an unknown substance, with the exception of ammonia or other field measurements that can be measured with handheld devices or field kits (e.g., Hach).

The Department uses the exclusion language in the LMD to eliminate fish fill reports that conclude the problem was due to "summerkill" or "winterkill", both of which are related to oxygen demand exceeding supply caused by high rates of respiration and low volumes in summer, and loss of aeration caused by ice cover in winter.

3. Comment received from the Association of Missouri Clean Water Agencies

The Department needs to consistently and properly express its one-in-three year listing criteria for toxics. The one-in-three year policy is an EPA policy and not a binding rule. The Department should rely on a greater than 10 percent provision.

MDNR Response:

The Department has adopted EPA's once-in-three year maximum allowable excursion recurrence frequency – which is the times conditions in a water are worse than those specified by the concentration and duration components of a freshwater aquatic life criterion for a toxic chemical. EPA's Office of Research and Development recommended the adoption of a 1 in 3 year maximum recurrence interval based upon a literature survey they conducted which looked at recovery rates of freshwater ecosystems from various kinds of natural disturbance and anthropogenic stressors.

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4. Comment received from the EPA

In Table 1.1 the compliance column for dissolved oxygen references a footnote which states that the data is only used for wide scale 305(b) assessments and not 303(d) listing. If this reference is a typographical error and instead should reference footnote 10, that footnote should not apply to dissolved oxygen either.

MDNR Response and Action:

The Department agrees, this was an error and was not meant to refer to dissolved oxygen data. This error has been corrected in the "revised" version posted to the Department's 303(d) website (<http://dnr.mo.gov/env/wppp/waterquality/303d.htm>).

5. Comment received from the EPA

Table B-1 methods used a two-sided test for bottom deposits. Since the goal is to determine if the deposits are too high not just different from the control site, the test should be single-sided.

MDNR Response:

The Department reviewed Table B-1, located in Appendix A. The LMD states "Hypothesis Test, Two Sample, one tailed t-test" for Bottom Deposits (Narrative) under the "Analytical Tool" column.

6. Comments received from Newman, Comley and Ruth

Table 1.2 and B-2 provides information regarding the assessment of "objectionable bottom deposits." What test applies to the assessment? The t-test should not be used because it does not appear to be a method used in the decision process. A field method for the collection of fine sediment is not provided. How are trash and other materials measured by the percent fine sediment deposit measurement?

MDNR Response:

The Department has a draft field procedure for estimating fine sediment deposition. This procedure can be provided upon request.

7. Comment received from EPA

Table B-1 redefines how the binomial probability will be assessed for greater than 30 samples but there is no note or comment that it is being changed from the commission

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approved 2014 methodology and it is inconsistent with the appendix information. How has the state's reconsideration of this difficulty led to the removal of the sample size mediated analysis?

MDNR Response:

The Department has discovered that Microsoft Excel provides a binomial probability function (BINOMDIST). Using the Microsoft Excel function allows the Department to calculate the binomial probability of samples sizes greater than 30.

8. Comments received from MSD and city of Springfield

The methods used to list a water as impaired should be the same as those used to delist the same water.

MDNR Response:

As new information is obtained for a water body, it is reassessed to determine if conditions remain the same or have improved. As long as watershed conditions have remained consistent and no significant or documented pollutant controls have been implemented in the watershed, then all available data will be considered representative and used during the biennial assessment process. With a larger data set (which tends to increase confidence levels), often times the data is assessed using different methods (e.g., 10 percent rule instead of the binomial probability) described in the LMD.

If watershed conditions have changed, significant and documented pollution control measures implemented within a watershed, the Department will consider the historical data (pre-implementation) to no longer be representative. The Department will continue to schedule monitoring or request quality assured data from other available sources to build a representative data set in an effort to document instream changes.

In a few cases, the "level of significance" changes from 0.1 to 0.4 for delisting a water, while in other instances, the data is compared to the upper confidence level instead of the lower confidence level. This is to ensure a previously listed water is now supportive of the beneficial use. The Department has been following these procedures for the past several listing cycles to prevent a water body from continually being listed and delisted if lower level of significance or confidence levels are used.

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9. Comment received from MSD

Revise the Section I. B. regarding “Threatened Waters” to more accurately reflect EPA guidance. Currently the Department is not specific when addressing how threatened waters will be evaluated. Suggested wording was provided “When a statistically-valid time trend analysis indicates that a water currently in Categories 1, 2, or 3, for one or more discrete water quality pollutants will not continue to maintain designated beneficial uses before the next listing cycle, it will be considered a “threatened water.” A threatened water will be treated as an impaired water and placed in the appropriate Category (4A, 4B, or 5).

MDNR Response and Action:

The Department agrees with the suggested wording.

10. Comment received from MSD

The Department should add language to Section II.B that allows the use of site-specific calculations, as opposed to default assumptions, when evaluating compliance for some parameters (such as, pH, hardness, and water temperature). The Department should amend Section II.B, and any other relevant section, to both identify any default data assumptions that will be used to make listing decisions and indicate that site-specific data may be used in place of these default assumptions.

MDNR Response:

The Department is not clear where this information is stated in the LMD. The Department requests clarification from the commenter.

11. Comment received from Newman, Comley and Ruth

The methodology for calculating average concentrations when duplicate samples are included in the dataset is unclear and is not consistent across existing 303(d) listing worksheets (examples included Crooked Creek, Strother Creek and Big Creek).

MDNR Response and Action:

The Department agrees, additional wording could be added to the listing methodology to describe how duplicate samples are handled (averaged). A note has already been added to many of the sediment worksheets indicating which duplicate samples were averaged. Other worksheets will be revised during the next listing cycles.

Sediment Toxicity Comments

12. Comment received from EPA

For toxic sediments in Table B-1, the sample mean is identified as the assessment number. If this is the mean of multiple sites along a segment, it could result in one site, of many sampled, being toxic but being averaged out by cleaner sites above and/or below that site. This could result in a portion of a segment being impaired but the segment not being listed. The table should identify the site mean rather than the sample mean to eliminate confusion.

MDNR Response:

The Department agrees this is a potential concern. When completing an assessment and the accompanying worksheet, if large differences in pollutant concentrations are observed in different parts of the same watershed, then the Department will assess each segment separately and will physically separate the data within the assessment worksheet. This process is the basis for the Department's frequent listing of only a portion of a water body.

13. Comments received from city of Springfield, Association of Missouri Clean Water Agencies, and city of St. Joseph

The LMD provides little detail on how to analyze sediment data quality and does not include averaging procedures. In addition, multiple samples collected within one segment or reach should be averaged into a single data point for temporal comparisons and reporting limits. Data values below the detection or reporting limits (censored data) should be considered "0" as detection or reporting limits can be above the PECs and potentially lead to a false positive impairment decision.

MDNR Response and Action:

Sediment samples should be averaged using the geometric mean. Previously, in error, the Department had calculated concentration according to an arithmetic mean. In light of this error, the Department reassessed all sediment pollutant worksheets and recalculated using the geometric mean. As a result five streams will be requested to be delisted:

- *Big River (WBID 2080) delisted for zinc in sediment*
- *Shaw Branch (WBID 2170) delisted for cadmium in sediment*

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- *Village Creek (WBID 2864) was shown as category 4A based on a 2010 TMDL for fine sediment deposition and lead*
- *Bee Fork (WBID3966) delisted for lead in sediment*
- *Turkey Creek (WBID 3217) delisted for lead in sediment*

Stream data may be assessed within smaller assessment reaches to delineate or bracket any potential areas of concerns (e.g., upstream and downstream comparisons). If data is statistically similar and no observed demarcation or known pollutant source is present within that reach/segment, then that set of data may be combined.

See MDNR response to comment 11.

Additional wording can be added to the LMD to describe how censored data is handled. This information will be provided on the next revision. In general, if data are reported less than the detection limit, the data value is divided by 2. If the value is greater than the criterion, the data is not used in the assessment. If the value is less than the criterion, the data is used in the assessment.

14. Comments received from Newman, Comley and Ruth

The Department may use older data to assess present conditions if the data remains representative of present conditions. For sediment, since concentrations are not expected to experience the same variability as water column concentrations, the most recent sediment sample provides the best representative of conditions.

MNDR Response:

The Department agrees the most recent sediment data may be representative of current conditions, however, older data may be of value to gain an overall understanding of historical, ongoing, or sporadic events that may be occurring over time or indicate if conditions are improving.

TMDL Comments

15. Comments received from MSD, city of Springfield, and city of St. Joseph

Water bodies currently listed as impaired for water quality criteria or beneficial uses that are expected to change in the near future should be considered low priority for Total Maximum Daily Load development.

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MDNR Response and Action:

While prioritization of TMDLs is a 303(d) listing function, EPA policy no longer requires States to include this information as part of the 303(d) listing process. A TMDL schedule is developed by the program; therefore, this comment will be shared with program staff. The present TMDL schedule can be found on the Department's TMDL website: <http://dnr.mo.gov/env/wpp/tmdl/wpc-tmdl-progress.htm>

Data Age, Quantity, Quality, and Minimum Sample Size comments

16. Comments received from MSD, city of Springfield, Association of Missouri Clean Water Agencies, and city of St. Joseph

Data age, quantity, and minimum sample size should be addressed when making impairment decisions. Any data greater than 7 years old should be considered suspect. Small data sets should not be used (e.g., less than 10 samples). Waters with small data sets should be placed with suspected impairments into Categories 2B or 3B until sufficient data are available to make informed decisions.

MDNR Response:

As stated by the EPA, data should not be treated as unrepresentative of water quality conditions solely on the basis of age. Older data and information should be considered unless supporting information indicates the data are not a representative of current conditions. An explanation is provided in the LMD.

Department currently provides short, concise and descriptive comments on every assessment worksheet describing the assessment procedures followed. There may be worksheets that need additional information or explanation. The Department will review worksheets and update as necessary and as time allows. The public are welcome to indicate specific water bodies they feel are lacking written justification.

Regarding sample size, although, the listing methodologies do not provide a set value necessary for making a listing determination, these values can be inferred by referencing the data quality code explanations.

17. Comments received from MSD and Association of Missouri Clean Water Agencies

A complete factsheet should be provided for each listing and delisting decision and for each water body proposed for assignment to Categories 2B, 3B, and 4C.

MDNR Response:

The Department does not clearly understand the suggestion of creating a factsheet for each listing category (2B, 3B, 4C, or 5) for each water body assessed. If we understand the comment correctly, this would cause the Department to potentially create hundreds of factsheets for all the water bodies placed in categories 2B, 3B, 4C, and 5. This is because each water body has multiple designated beneficial uses that are assessed and placed in one of five major categories (which each major category may include additional subcategories); resulting in one water body having multiple factsheets developed.

The Department appreciates the comment; however, at this time the Department does not have the resources to complete this type of work. However, the Department would like to remind stakeholders that water quality data and biological assessment reports are available for public review from the Department's website. The web links have been provided here for reference and ease of access. These websites have been available from the Department's website for a number of years, but may have not been widely known or easily located. In the future, the Department will provide web links from the 303(d) webpage.

- *Web link to the Department's on-line searchable Water Quality Assessment Database.
http://dnr.mo.gov/mocwis_public/wqa/waterbodySearch.do*
- *Web link to the Department's Environmental Services Program, Water Quality Monitoring Section. From the below link, you will find links to Aquatic Macroinvertebrates Bioassessment Reports, and on-line database.
<http://dnr.mo.gov/env/esp/wqm/biologicalassessments.htm>*

18. Comments received from Association of Missouri Clean Water Agencies and city of St. Joseph

The Department should post all data used to support the 303(d) listing and quality assurance project plans (QAPPs) on the 303(d) webpage. The Department should certify that all the data used for actual 303(d) listings meet the requirements of the QAPP.

MDNR Response:

The Department's QAPPs can be provided at anytime upon request through a Sunshine Request. Biennially, the Department requests data and supporting documentation from other data collection entities (e.g., other state agencies, local governments, Universities, federal governments, etc.). Supporting documents include, field and laboratory

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procedures, monitoring plans, quality control information, field and laboratory staff experience and training. The Department reviews this information to ensure monitoring data is collected following EPA approved methods and the field and analytical staff have qualifications to complete the scope of work.

19. Comments received from Newman, Comley and Ruth

A stream should not be listed as impaired for a single macroinvertebrate sample if there is only one sample collected and it receives a score of 14 or lower.

MDNR Response:

A according the data code requirements for biological assessments for macroinvertebrates, a water body cannot be listed as impaired based upon a single data point. In cases where only one macroinvertebrate sample has been collected from a water body, the water body is placed in either the 2B or 3B category until additional data is available.

Water Quality Criteria Comments

20. Comments received from MSD, city of Springfield, Association of Missouri Clean Water Agencies, and city of St. Joseph

The *E. coli* value listed in Table 1.1 is not a groundwater protection criterion.

MDNR Response and Action:

The Department agrees with this comment. The groundwater protection criteria will need to be addressed by a beneficial use assignment in a future water quality standards revision. The reference to "groundwater" will be removed and replaced with "losing stream."

21. Comment received from MSD

Environmental indicators used to detect beneficial use impairment on a statewide basis should be limited to criteria or requirements listed in Missouri's Water Quality Standards.

MDNR Response:

The Department has a responsibility of protecting all waters of the state under the antidegradation, general (narrative) criteria, and specific criteria sections provided in 10 CSR 20-7.031 (2), (3) and (4), respectively. The general (narrative) criteria states "the

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following water quality criteria shall be applicable to all waters of the state at all times including mixing zones. No water contamination, by itself or in combination with other substances shall prevent the water of the state from meeting the following conditions.” The general criteria continues to outline these conditions in a series of “free from” statements which includes color, turbidity, offensive odor, unsightly bottom deposits and the prevention of the full maintenance of beneficial uses. The listing methodology has provided criteria for which quantifiable measurements can be made and compared to control stream segments (e.g., upstream) or, other local streams to compare differences and/or similarities.

Biological Assessments and Habitat Comments

22. Comment received from Newman, Comley and Ruth

After the Clean Water Commission approval of the 2012 Listing Methodology Document (LMD), the Department hosted Biological Assessment workgroup meetings to consider changes to the 2014 LMD. A document titled “Evaluation of the Biological Data in the DNR Listing Methodology Document” was developed and workgroup members commented. It is unclear how the recommendations and unresolved issues were incorporated into the 2016 LMD.

MDNR Response:

A summary of how the recommendations were incorporated into the 2016 LMD was provided to the Bioassessment Workgroup during a meeting held on February 26, 2014.

23. Comments received from MSD, city of Springfield, city of St. Joseph, and Newman, Comley and Ruth

Including considerations for habitat limitation have strengthened the fish community assessment listing methodology protocols, but these protocols may need to be refined. There are several questions about how the habitat metrics and 0.39 threshold were chosen. It was also suggested to revise footnote 20 to improve consistency with Appendix E.

MDNR Response:

The Department continues to work with members of the biological assessment workgroup to discuss and resolve any on-going concerns. When completing biological assessments, the assessment staff will also review all available data including habitat scores. If there is any question about the data, staff will consult with the appropriate biologist (fish or macroinvertebrate) to gain specific information about the site and conditions. The

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Department will continue to work with the Bioassessment Workgroup to refine the biological assessment criteria. Additional information, regarding biological workgroup meetings(s) will be forthcoming. We look forward to your participation.

The Department has revised the wording of footnote 20 as suggested.

24. Comment received from Newman, Comley and Ruth

Currently, when habitat assessment data indicates habitat scores are less than 75 percent of reference or appropriate control streams, the Department reports that the 75 percent habitat threshold and MSCI score of 16 are not interchangeable. Based upon reviewing from Plafkin et. al (1989) study results, it has been suggested it would be more appropriate to set the habitat score at 90 percent.

MDNR Response:

The Stream Habitat Assessment Project Procedure (SHAPP) [which draws from the Plafkin et al. (1989) document] states, "The total score from the physical habitat assessment of the study sites is expected to be from 75% to 100% similar to the total score of the reference site in order to support a comparable biological community." The following table, a slight modification of Plafkin et al. (1989), is found in the SHAPP.

Habitat assessment categories are as follows:

1) Comparable to Reference	≥90%
2) Supporting	75-89%
3) Partially Supporting	60-74%
4) Non-supporting	<59%

Based on this breakdown, the 75 percent habitat quality threshold is appropriate to use for determining whether a test site should be capable of a fully supporting macroinvertebrate community. By comparison, the 90 percent threshold goes beyond supporting and into the range of reference quality.

25. Comments received from the EPA, MSD, city of Springfield, city of St. Joseph, and Newman, Comley and Ruth

The Department should specify the methods for choosing appropriate reference and control streams for biological data comparisons. Specific examples include: The fish community Index of Biotic Integrity (IBI) comparisons should only occur in streams from similar ecoregions where adequate relationships between IBI scores and impairments exist. Test/subject streams should be compared to control streams with similar land use, geology, watershed size, and stream morphology. Stakeholders urge the

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Department to begin using the Missouri Resources Assessment Partnerships Valley Segment Type mapping layer that has been adopted by reference in the State's water quality standards.

MDNR Response:

The Department provided a detailed explanation of how these streams are selected. This information was given in a document produced by the Department and a group of stakeholders interested in the Department's use of biological data. Several stakeholders, including EPA Region 7, participated in the workgroup. The document was shared with the group members, and all on the 303(d) stakeholder group mailing list. The document is not available from the Department's website, but it can be made available upon request.

In addition, the Department is currently beginning work on a tiered aquatic life use designation. Part of that foundation work for doing this is defining, selecting, and biomonitoring of small order stream classifications. When this work is completed and promulgated with water quality standards, there will be a clear separation between streams that need to be assessed using different scoring procedures based on their stream/watershed size and/or aquatic life use tier. Until then, the Department will continue to rely on the best professional judgment of the Department's biologist to decide when a target stream needs to be assessed against a group of small control streams rather than the Macroinvertebrate Stream Condition Index (MSCI) reference streams.

26. Comment received from EPA

In relation to footnote 16 in Table 1.2, there are only two Mississippi Alluvial Plains reference streams identified in the state's water quality standards; these are Main Ditch and Maple Slough Ditch. This is to cover three Ecological Drainage Units. Because of the limited number of reference streams it is even more important that a method for choosing appropriate control streams is outlined in the state's listing methodology where the use of control streams is allowed in the state's water quality standards.

MDNR Response:

The Department agrees. This procedure will be improved by the development and promulgation of tiered aquatic life use designation specifically for streams in the Mississippi Embayment.

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27. Comment received from Newman, Comley and Ruth

The aquatic invertebrate protocol describes full attainment of beneficial uses for 7 samples or fewer, and when 75 percent of the stream condition index scores are 16 or greater or 14 or lower. What happens when there is an even split in the scores (14, 14, 16, 16)?

MDNR Response:

In the example provided the data would be considered inconclusive and the water body placed in category 2B or 3B until additional information becomes available.

28. Comment received from Newman, Comley and Ruth

The Department should include habitat evaluation information on the biological assessment worksheets, along with the control streams information so the information is transparent and allows external entities to understand and compare the information provided.

MDNR Response and Action:

The Department agrees. This information can be incorporated into future biological assessment worksheets. In addition, aquatic macroinvertebrate data and reports can also be accessed from the Department's website. This information has been available for a number of years, but may have not been widely known or easily located. The web link has been provide here for reference and will be added to the LMD and 303(d) website.

- *Web link to the Department's Environmental Services Program, Water Quality Monitoring Section. From this link, one will find links to the Aquatic Macroinvertebrates Bioassessment Reports, and on-line database:
<http://dnr.mo.gov/env/esp/wqm/biologicalassessments.htm>*

29. Comments received from MSD, city of Springfield, city of St. Joseph, and Newman, Comley and Ruth

The Department should clarify how it intends to apply and interpret "other biological data" when listing or de-listing water body segments. Other biological endpoints should be carefully assessed if considered for impairment decisions.

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MDNR Response:

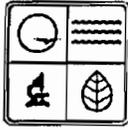
The Department may use "other biological data" when data is available for a particular water body. Because there are many other types of biological data, there is not just one method that would be used to assess this data. Generally the standard statistical hypothesis test would be the main tool used, however, in statistics the nature of the data itself often defines which tests may be more appropriate.

30. Comments received from MSD, city of Springfield, city of St. Joseph, and Newman, Comley and Ruth

The "Weight of Evidence" approach used to translate narrative criteria should be more clearly explained.

MDNR Response and Action:

Several years ago, the Clean Water Commission discussed that whenever a listing decision is made based on narrative criteria, a "Weight of Evidence" approach will be followed. As a result of this discussion, the Department provides all assessment worksheet information that may be relevant to a "Weight of Evidence" listing decision. The "Weight of Evidence" approach is not a type of assessment, but a method for analyzing and synthesizing information. Overall, the Department will look at all available data to determine if the beneficial uses are being met. This could be completed through conditional or causal type of Weight of Evidence approach. Clarification will be provided in the LMD.



**Missouri
Department of
Natural Resources**

**Biological Assessment Workgroup
Agenda Topics and Discussion Summary**

February 26, 2014

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Biological Assessments and Habitat Comments

- **Overview of how the recommendations and unresolved issues were incorporated into the 2016 Listing Methodology Document (LMD)** (Refer to Table 1 for additional information).
 - John Ford provided an overview of the Bioassessment Workgroup Recommendation document and how those recommendations were incorporated into the 2016 LMD.
 - Item 1. Continue using DNR method for selecting small control streams: These procedures were developed by the DNR lab. These are currently not in the LMD. It was agreed that information would be included as an appendix to the 2016 LMD. (Completed: See Appendix E of Revises 2016 LMD)
 - Item 2. Continue DNR policy of not using biological samples collected during extreme climatic conditions: Currently the assessments do not include biological data collected during extreme non-representative conditions (e.g., drought or flood). This language will be added to the LMD. (Completed: See Appendix E of Revised 2016 LMD)
 - Item 2. a. Describe procedure for assessing small biological data: The LMD currently has a footnote saying “both reference streams and small control stream data will be used.” There was much discussion relating to this topic. The Department explained it may not be appropriate to score small headwater streams to the regular biological reference streams provided in water quality standards. Therefore, to gain an idea of how these small streams compare, the field biologists are collecting data on both small candidate reference streams and biological reference streams (wadeable perennial streams). The Department is not using the candidate reference streams to calculate criteria, only comparing information to determine if the scores compare to the biological reference streams. Specific discussion and clarification was provided for Buffalo Creek and Hays Creek. If the small candidate reference streams don’t compare well with the biological reference streams, then the test stream is compared to the small candidate reference stream. There may be times where a weight of evidence or best professional judgment approach is followed when the candidate reference stream data is split (e.g., 50/50). If the data is questionable, lack of confidence in the data, or it is split and hard to interpret, then the data would be considered inconclusive and the stream is scheduled for follow-up monitoring. Much of the information is provided in the biological reports and are available the Environmental Services Program website. Overall, it was recommended additional information could be included in the 2016 LMD to provide a framework on how macroinvertebrates are assessed using candidate reference streams. Also a link from the 303(d) website will be provided. (Completed: See Appendix E of Revised 2016 LMD and 303(d) webpage for links to Biological Assessment Reports for Aquatic Macroinvertebrates).
 - Item 2. b. Describe how macroinvertebrate habitat data will be used in the assessment process. The LMD currently states macroinvertebrates data with habitat scores less than 75% of reference streams will not be used.

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Item 3. Fish IBI scores on first and second order streams will not be used to judge impairment. This is clearly stated in the 2016 LMD. Only first and second order streams will be assessed.

Item 4. Fish IBI scores will be assessed in the same statistical manner as Macroinvertebrate Stream Condition Index (MSCI) invertebrate scores. This is clearly stated in the LMD tables showing statistical methods and proposed in the 2016 LMD. Fish index of biological integrity (IBI) data will be evaluated similar to invertebrate assessment processes. The fish data will be compared to the 36 score and to determine the percentage of scores above or below this threshold.

Item 4. a. Interpretation of Fish IBI scores should include consideration of habitat and other potential impacts on these scores other than water quality. The 2016 LMD currently has two footnotes indicating the Department will consult with Missouri Department of Conservation (MDC) on other reasons for low IBI scores. An example on Buffalo and Hays creeks was provided. MDC was consulted not only on this stream but a list of streams where the Fish IBI scores were low. In these discussions the Department and MDC removed streams where habitat was considered a problem and those streams considered losing, or had low water quantity (volume). It was agreed that habitat scores will be included on the biological assessment sheets for fish and invertebrates. The reference stream habitat scores will also be included. (Will incorporate into future biological assessment worksheets)

Item 4. b. The Quality Assurance Project Plan (QAPP) documents supporting the Resource Assessment and Monitoring (RAM) program are sufficient. The LMD currently has a general footnote discussion of quality assurance which covers all types of data used in the assessment. In the past Matt Combes, MDC, provided a document to the workgroup. At that time, the workgroup was satisfied with the information provided.

Item 5. -6. How other biological data should be used. The LMD currently allows a judgment of impairment based only on this type of data. Further discussion is provided later on the agenda. Any new stream size designation will not be incorporated into the LMD until Water Quality Standards are approved.

Discussions continued regarding headwater stream size classification: Matt Combes described the fisheries work being completed by the University of Missouri (MU) Fish Co-op unit regarding headwater reference reaches. He stated a graduate student is in year 1 of a 3-year project. The overall goal is to have a group of headwater reference streams within 3 years. MDC will start field work this summer.

The stream size ranges are published by Pflieger. The Department and MDC are exploring several of the attributes from the Valley Segment-Type (VST). Currently, they are looking at five attributes relating to size range to find the best available streams for reference. Overall, there are hundreds of attributes to consider.

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Matching stream order and VST. Is this possible to match up? The criteria are different between Ozark and prairie streams. Overall, the first digit corresponds to the stream size, not stream order. The LMD will be updated to incorporate VST stream size when the Water Quality Standards are approved. If this should happen prior to the 2016 303(d) list, then information will be sent out to the workgroup or explained during the public notice.

- **Fish habitat metrics (the 0.39 threshold):** The habitat score was created to allow the Department to determine if the Fish IBI score was a result of a habitat impairment. Matt Combes provided an overview of how the provisional information was developed. It will be used until the MU Fish Co-op workgroup has completed their work. MDC looked at the 70 published reference sites cited in the Doisey and Rabeni publication. For all of those sites, the Fish IBI scored 36 or above (not impaired for fish). The lowest habitat score obtained from these sites was .39. The Department sent MDC a list of waters potentially impaired for fish bioassessments. MDC looked at this list and compared those waters against the losing streams GIS layer, and field observations provided by the field crews noting if a significant stream volume was being lost to the streambed. The MU Fish Co-op workgroup is currently developing a threshold similar to this, but fitted to Missouri data. The QCPH1 habitat metrics value was developed by the Environmental Protection Agency (EPA), Office of Research and Development staff from EPA Regional Environmental Monitoring and Assessment Program (REMAP) data. The data includes reference reach and core sites from all four states within EPA Region 7. The REMAP data is not a perfect fit for Missouri. A statewide habitat index will be developed through the MU Fish Co-op workgroup and specific to Missouri.

There is not one habitat protocol that can be used for both fish and invertebrates. For the visual aspect of the assessment, it is important the same scientist complete this work to provide consistency and standardization by the field staff conducting the work.

Discussion on how a site with missing habitat information is handled during the assessment process. It was recommended that any missing habitat information be noted on the biological assessment worksheets and a web link and/or reference to the bioassessment report title be added to the assessment worksheets. (Will be incorporated into future biological assessment worksheets)

- **Aquatic macroinvertebrate habitat scores and how those compare to the 75% reference conditions and MCSI scores:** The entire stream segment is not looked at to determine if it is meeting the 75% of reference conditions. The Department may look at stream segments to make determinations of which segments are meeting 75% of reference. Therefore, if only a portion of the stream meets 75% of reference conditions, then this portion may be evaluated against the (MCSI) score. Streams do not have to be as good as reference (90% of reference conditions) to support the use; they just need to support the aquatic life beneficial use (75% of reference conditions). The purpose of the 305(b) report is to show if the stream is supporting or not supporting the beneficial use.

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- **The methods followed for choosing appropriate reference and control streams for biological data comparisons:** reference item 2.a. above.
- **Biological assessment worksheets – additional information requested to be added:** This information was previously discussed in Item 4.a. above.
- **Interpretation of “other biological data”:** In the past, biological data (other than Fish IBI or aquatic macroinvertebrates) could be used as stand-alone data to make an assessment decision. What was recommended by the bioassessment workgroup and what will be updated in the 2016 LMD, is this data will be used, but will not be the sole source for an impairment decision. It will be used as part of the “weight of evidence” approach in conjunction with any other biological data or narrative data. (Completed: See Appendix E of Revised 2016 LMD)
- **“Weight of evidence” approach:** Several 303(d) listing cycles ago, at a Clean Water Commission meeting, there were a number of discussions regarding how the Department assessed narrative criteria (criteria without numeric limits). For fish tissue and sediment quality, the Department established translator values that are used in lieu of a numeric value. The Commission asked the Department to use a weight of evidence approach when assessing this data. Therefore, all the various types of data (e.g., fish tissue, biological, sediment, water quality, etc.) available for a stream are used together to make a determination if that stream is impaired or unimpaired. It would be very difficult to provide a detailed description of how the weight of evidence approach would be followed, due to the number of variables and situations that need to be considered. It was asked from the workgroup to provide additional wording to how the weight of evidence would be used to give biological data more weight. In general, the Department will collect other information (e.g., biological) in conjunction with numeric translator data to provide evidence to support a decision. (Additional wording was added to page 15 of the Revised 2016 LMD and Appendix E)

General Assessment Methodology Comments

- **One in three-year listing criteria for toxicity:** This is an EPA guideline that the Department agrees with. There is a lot of evidence that shows if you have one single toxic event that kills most of the biological life in a stream, it can take up to nine months to a year for the aquatic faunal community to recover. Therefore, if you have more than one toxic event occurring, then you may have a diminished faunal community more than half the time during a three-year period. This applies to both acute and chronic toxicity.
- **Methods used to list and delist waters:** The reason for using a more rigorous level of significance (e.g., 0.1 to 0.4) for certain parameters (e.g., bottom deposits and toxic chemicals relating to human health) is because this increases the probability a water is

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actually meeting water quality standards. This process prevents a water from bouncing back and forth from being listed and delisted if assessed using the same methods for listing.

There was discussion regarding a higher burden of proof needed to delist a stream. In summary, if a water is listed as impaired and significant management practices have been completed in the watershed, the stream would be assessed using only the newer data collected after the date the majority of the practices were implemented. If no management practices have been implemented or other documented changes have occurred in the watershed, monitoring would continue until enough data has been collected to indicate the water is meeting beneficial uses. For waters where long-term trend data is available, it was suggested the Department look at the dataset temporally and spatially to determine if the data can be broken up and either assessed independently of one another or focus on the newer data. (Will continue to review data for temporally or spatial differences)

The Department can work through a few scenarios to determine how much difference there is by changing the level of significance from 0.1 to 0.4 (Completed. Attached as Attachment I of this summary)

- **Binomial probability for used for assessing greater than 30 samples:** Previously the Department had been using the binomial probability for sample sizes up to 30, any higher sample sizes the binomial probability distribution coefficient values became too large to handle. However, the Department has found that MicroSoft Excel has a binomial distribution feature that allows the calculation of samples sizes greater than 30. The binomial probability distribution will be used for the 10% rule outlined for all of the conventional pollutants (pH, temperature, dissolved oxygen, total dissolved gases). This provides more confidence in the decision with a Type 1 – alpha error rate of 10%, and provides a 90% confidence rate that the listing is correct. This is an improvement in the LMD and keeps streams off the impaired list that should not be there.
- **Method followed for calculating duplicate samples:** Duplicate samples noted on the sediment assessment worksheets were not handled consistently over time. These sediment worksheets were reviewed and now all duplicate samples are averaged using the arithmetic mean and recorded on the assessment worksheet as one sample. In addition, as a follow-up to a Clean Water Commission meeting comment, the sediment PECs were calculated using the geometric mean instead of arithmetic mean. This resulted in four delistings.
- **Method followed for handling censored data:** Method for values less than the detection limit: Remove the less than value, divide the value by 2. If that value is greater than the criterion value, this data is dropped out and not used during the assessment. If that value is less than the criterion value, that value is included and used in the assessment. There was some discussion if the sample is dropped out, should it still be counted in the sample size, where it plays a role in calculating a percent exceedance. The participants were asked to provide written comments on how the Department should to handle this in our assessment procedure.

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Data Age, Quantity, Quality, and Minimum Sample Size

- **Age greater than 7 years old:** The Department's current position is any data that is still representative of current conditions can be used in the 303(d) listing assessment. What would exclude older data is the evidence (through documentation) that changes have been made in that watershed that would potentially change water quality enough where the prior data collected in the watershed is considered no longer representative of current conditions. In the case where a site has several years of data (30+ years), the Department will only look at the most recent data (e.g., within the last 5 or 7 years). The Department may look back further than 7 years at sites with smaller datasets and there has not been any documented change in the watershed. When data older than 7 years is used in an assessment it should be noted on the assessment worksheet that no known changes in the watershed has occurred. (Will continue to indicate how/why older is used in assessment)
- **Minimum sample size:** EPA has stated numerous times in their guidance documents that there should be no minimum sample size stated in the LMD. The definition of the data codes provides information about the amounts of data needed to make an assessment. For a few sample types minimum sample sizes are provided in the LMD [e.g., biological (2), *E. coli* (5) (within the recreational season), and sediment quality (3)]. Some types of data are collected during certain times of year to characterize low flow, worst case scenarios (e.g., dissolved oxygen). This dataset may be small, but representative of typical conditions that can persist for several months during that timeframe. Additional information can be obtained by reviewing the assessment worksheets. They provide an indication on how much data was used to make an assessment decision.
- **Data transparency - posting all data to web to support 303(d) listing:** Currently the Department's QAPPs are not available on-line, but can be provided upon request. When data is obtained from other entities, the Department will ask for additional information to ensure the data is of quality. Examples include field/lab staff training and experience in completing this type of work, written protocols, analytical method numbers (if EPA approved), and etc. This information is evaluated and this organization's data is coded in the Department's database as acceptable or unacceptable for assessment purposes.

When data is pulled from the Environmental Services Program's Laboratory Information Systems (LIMS) database, the quality control data (field and trip blanks) are also downloaded into the Water Quality Assessment (WQA) database. The WQA database is available from the Department's website. All the data downloaded into the WQA database can be viewed along with data qualifiers or flags. A web link to the WQA database will be provided on the 303(d) website (Completed: see 303(d) webpage). For quality control data received from external entities, this information may need to be requested from that entity. Sample spike information would need to be obtained from the laboratory.

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Sediment Toxicity

- **Method for assessing a water body segment vs reach:** When the dataset is viewed and assessed, the Department will look for marked differences between segments. If there are differences, the water body will be separated into segments based on the spatial differences in the data, and these segments assessed separately. It is noted on the 303(d) list which part of the stream or segment is impaired. When this information is provided to EPA, they will list the entire stream reach as impaired. The Department will always maintain the actual impaired segment in our assessment database, and it will be noted in the TMDL document. It was recommended to add general wording or clarification on how spatial averaging is conducted and what would cause segmentation of the data/reach. (Completed: See page 15 of Revised LMD)

TMDL

- **TMDL priorities:** In the past, 303(d) lists were required to include the prioritization of TMDLs. In recent years EPA has stated prioritization of TMDLs does not have to be included on the 303(d) list. To satisfy this requirement, EPA now only asks for a TMDL schedule to be submitted along with the 303(d) list. The TMDL program provided an update on their priorities. Many are already low priorities (e.g., nutrients, ammonia, chloride, sediments, dissolved oxygen, etc.). The only exception is the development of bacteria TMDLs. EPA has an expectation that states will complete a certain number of TMDLs annually. Therefore, the Department cannot keep deferring the development of TMDLs for future years since they are required to be completed within a 13-year timeframe. (Completed: Web link to TMDL schedule added to page 25 of Revised 2016 LDM)

WQ Criteria

- **Groundwater criteria (*E. coli* assessments):** The Department does not have a beneficial use criterion for groundwater. Therefore, the Department has agreed to remove this from the LMD. The LMD has been updated and is consistent with water quality standards for the protection for losing streams. The losing stream criterion is not to be an exceeded value. It will be assessed the same as dissolved oxygen, pH, and water temperature, which are also "not to exceed" standards. This data will be assessed using the 10% rule and binomial probability distribution.
- **Beneficial use assessments limited to criteria listed in MO Water Quality standards:** EPA requires all states to consider all water quality standards (numeric, narrative, and antidegradation provision) when assessing waters.

Other Discussions:

Information regarding the category 2b, 3b, 4a waters is provided in the appendices of the 305(b) report. GIS shape files for category 4 and 5 waters should be available from the MSDIS website.

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Agenda Topics and Discussion Summary

For sediment assessment, the sediment calculations were updated from using the arithmetic mean to geometric mean based upon the information presented in the MacDonald (2000) paper. Therefore, the Department is looking at revising the assessment procedure for assessing sediment metals from 150% of the PEC and PEQ to 100%, with the exception of arsenic which will remain at 150%. This will allow the Department to still meet they type 1 error rate, however, type 1 error rates for organic constituents will still need to be reviewed. (Completed: Attachment 2 of this summary)

There were a couple articles produced by MacDonald: 1) Joplin mining area and 2) old lead belt mining area. Those papers were reviewed by John Ford, DNR, who also contacted MacDonald and sent information to Chris Ingersoll, for review/comments. The purpose of the LMD is to develop guidelines that allows a clear process for distinguishing impaired streams from unimpaired streams. Information was not used from that provided in the later papers (Joplin mining area) because the later papers did not use PEC values, they used TTS10 levels. The TTS10 levels allowed a certain amount of toxicity in the aquatic community, therefore, allowing a certain amount of impairment to occur within the aquatic community. This process was not consistent with the 303(d) listing process to separate impaired waters from unimpaired waters. In addition, both papers discussed toxicity testing using the same type of organisms (particular species of *Hyzella* and mussels), but the results presented were opposite of one another. In addition, in one of those studies they used mussels that were of an older life stage, therefore, their sediment toxicity exposure was much shorter. The Department believes MacDonald's (2000) paper provides the best assessment option. It was requested that the Department's comparison summary be provided to the workgroup. (Completed: Attachment 3 of this summary)

Meeting Action Items:

- A new appendix will be added the LMD to discuss the assessment process of biological data and the weight of evidence approach. (See Appendix E of Revised 2016 LMD)
- John Ford to work through scenarios to determine how the different test alphas (0.1 and 0.4) affect various types of datasets. (See Attachment 1)
- Trent and/or workgroup members will provide suggested wording regarding the weight of evidence approach.
- The workgroup was asked to provide suggested wording regarding how to handle censored data that is dropped out (not used) during assessment purposes. Should it still be counted in the sample size?
- Provide the comparison document completed by John Ford regarding the MacDonald publications for the Joplin area and old lead belt area. (See Attachment 3)

Table 1. How Bioassessment Work Group Recommendations Were Incorporated into 2016 LMD.

Work Group Recommendation	What is in LMD?	Change Needed in LMD?
1. Continue using DNR method for selecting small control streams.	These are procedures developed by DNR lab. Not currently in LMD.	Should this be added to LMD? It would add about 2-3 pages to the document.
2. Continue DNR policy of not using biological samples collected during extreme climatic conditions.	This language is already in the LMD.	
2a. Describe procedure for assessing small stream biological data.	LMD currently has footnote saying "both reference streams and small control stream data will be used".	Should this be expanded to include the exact wording in the WG recommendation? This would add about ½ page to the LMD.
2b. Describe how invertebrate habitat data will be used in the assessment process.	LMD currently says invert. data with habitat scores less than 75% of reference stream mean will not be used.	Should this be expanded to include exact wording in WG recommendation? This would add about 1/3 page to the LMD.
3. Fish IBI scores on first and second order streams will not be used to judge impairment.	This is clearly stated in the current LMD.	
4. Fish IBI scores will be assessed in the same statistical manner as MSCI Invertebrate scores.	This is clearly stated in the LMD tables showing statistical methods.	
4a. Interpretation of Fish IBI scores should include consideration of habitat and other potential impacts on these scores other than water quality.		Should DNR develop more specific language describing the consultation process? habitat metrics used? their derivation? And describe other factors such as methods of assessing low water volume? This might add 2-4 pages to the LMD.
4b. The QAPP documents supporting the RAM program are sufficient.	LMD currently has a general discussion of quality assurance which covers all types of data used in the assessment.	
5-6. How should other biological data be used.	LMD currently allows a judgment of impairment based only on this type of data.	This is a discussion topic in today's meeting.

Attachment 1- Type One Error Rates For Different Test Alphas

Table 1 below uses the binomial probability distribution to calculate Type One error rates for invertebrate community data assuming that reference streams in the EDU in question have an MSCI score of 16 or higher in 80 percent of all samples. A Type One error would be a decision that the stream has an impaired invertebrate community when in fact, it does not.

Table 1. Type One Error Rates for Assessment Decisions on Stream in an EDU with 80 percent sustaining scores on reference streams.

No. of Samples with MSCI scores less than 16	Total Number of Samples						
	10	12	15	18	22	27	34
2	.624	.725					
3	.322	.442	.602	.729			
4	.121	.205	.352	.499	.668		
5	.033	.073	.164	.283	.457	.652	
6			.061	.133	.267	.461	.700
7				.051	.133	.287	.534
8					.056	.156	.367
9						.074	.227
10							.125
11							.062

Table 2. Number of Invertebrate Samples with MSCI Scores of 16 or Greater needed to make a decision that a stream has an unimpaired invertebrate community.

Test Alpha	Total Number of Samples						
	10	12	15	18	22	27	34
0.1	6	8	10	12	15	19	24
0.2	7	9	11	13	16	20	25
0.3	8	9	12	14	17	21	26
0.4	8	9	12	14	17	21	27

For sample sizes of 8-13, using a test alpha of 0.4 instead of 0.1 would require one-two more samples with a score of 16 or higher. For sample sizes 14-30 it would require two more samples to have scores of 16 or higher. For samples of 31 up to presumably 50 or 60, it would require three more MSCI scores of 16 or higher.

Table 3. Number of additional samples needed to show unimpaired after impairment decision is made using the 75% Rule, on a stream in an EDU with 80 percent sustaining scores on reference streams.

# of Samples Below 16 / Total # of Samples -- 75% Rule						
75% Rule	2/2	3/3	3/4	4/5	5/6	6/7
# of additional samples with scores ≥ 16 needed to delist a water. *						
75%	6	9	8	11	14	17
<i>Total # of Samples</i>	8	12	12	16	20	24
0.1	6	5	5	5	9	12
<i>Total # of Samples</i>	8	8	9	10	15	19
0.2	6	5	5	7	11	16
<i>Total # of Samples</i>	8	8	9	12	17	23
0.3	6	7	7	9	14	18
<i>Total # of Samples</i>	8	10	11	14	20	25
0.4	6	9	9	11	16	21
<i>Total # of Samples</i>	8	12	13	16	22	28

* When the total number of samples reaches 8 or more, binomial probability is used instead of the 75% rule. Numbers shown for the 75% row are for comparison if we listed using the 75% rule what number it would take to delist using the 75% rule. (Purely for comparison, I'm not suggesting a change here.)

Table 4. Number of additional samples needed to show unimpaired after impairment decision is made using binomial probability, on a stream in an EDU with 80 percent sustaining scores on reference streams

# of Samples Below 16 / Total # of Samples -- Binomial Probability							
Test Alpha	4/(8-9)	5/(10-13)	6/(14-16)	7/(17-20)	8/(21-24)	9/(25-28)	10/(29-32)
# of additional samples with scores ≥ 16 needed to delist a water.							
0.1	2	4	3	4	4	4	4
<i>Total # of Samples</i>	10	14	17	21	25	29	33
0.2	4	6	7	8	8	8	9
<i>Total # of Samples</i>	12	16	21	25	29	33	38
0.3	6	9	9	11	11	12	13
<i>Total # of Samples</i>	14	19	23	28	32	37	42
0.4	8	11	12	14	14	15	16
<i>Total # of Samples</i>	16	21	26	31	35	40	45

Attachment 2 - PEQ Comparisons at 150% and 100%

Results of using 100% PEL vs 150% PEL				
WBID	WB Name	HUC 8	Change from current listing status	Already Impaired for Metals in Sediment
1943	Courtois Cr.	7140102	Y - Ni	Y
3961	Crooked Cr.	7140102	Y - Cu	Y
1946	Indian Cr.	7140102	Y - Ni, Cd	Y
2080	Big R.	7140104	Y - Zn	Y
2168	Flat River Cr.	7140104	Y - Cd	Y
2111	Old Mines Cr.	7140104	Y - Pb,Zn BUT INVERT COMM NOT IMPAIRED	N
2128	Pond Cr.	7140104	Y - Pb	Y
2120	Shibboleth Br.	7140104	Y - Hg	Y
2916	Big Cr.	8020202	Y - Zn	Y
2863	Village Cr.	8020202	Y - Pb	Y
3965	Strother Cr.	11010007	Y - Cd	Y
2755	W. Fk. Black R.	11010007	Y - Zn	Y
3810	Douger Br.	11070207	Y - Cd	Y
3217	Turkey Cr.	11070207	Y - Pb	Y

Attachment 3 – Sediment Toxicity Correspondence Regarding the Tri-State and Southeast Mining Areas

Date: 1-20-2012

To: Frances Klahr, Mike McKee, Chris Ingersoll, Bob Hinkson

From: John Ford, DNR Water Protection Program

Below are my notes (to myself) on Besser's 2009 report. We are in the process of revising our impaired waters methodology. We do not have sediment criteria promulgated within our water quality standards, but we recognize the need to identify waters that appear to have toxic levels of contaminants in sediments. Thus, we have been using 150% of the consensus-based PEC values in MacDonald, Ingersoll and Berger 2000 in our current methodology. We've recently reviewed the MacDonald report on sediment toxicity in the Tristate district and Besser's report on the Old Lead Belt and are looking for comments on whether or not the findings in these two reports should cause us to change our current use of PECs in assessing impairment. At least one stakeholder has asked us to consider changing our sediment assessment methods based on the recent Tristate study. Currently, my reservations in doing so include the following: (1) SST10s developed for the Tri-State seem to inherently allow more toxicity than PEC values, (2) SST10s appear to be less accurate at predicting toxicity than PECs, (3) the SST10s may not be protective for early life stages of mussels. I would greatly appreciate your thoughts on these and any other issues related to assessing sediment toxicity and encourage you to share these with me in writing (email or letter). The public comment period on the proposed 2014 Listing Methodology document ends March 15.

“Assessment of Metal Contaminated Sediments for Southeast Missouri Mining District Using Sediment Toxicity Tests...” Besser, J. 2009. US Geological Survey. AR 08-NRDAR-02

Major Findings

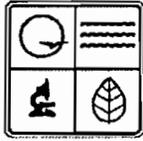
1. Big River sediments were more toxic to juvenile mussels (2 mos.) than juvenile amphipods (7 days).
2. Mussel toxicity correlated with bulk sediment metal concentration while amphipod toxicity correlated better with aqueous metals in pore water.
3. Lab studies of mussel toxicity from sediments at several Big R. sites correlated well with observed mussel communities at those sites.
4. Previously established PEC values for Cd and Zn were 85-100% accurate in predicting toxicity to mussels and were 93% accurate in predicting declines in mussel taxa richness. PEC for Pb was less reliable.
5. Mussel toxicity was found at sites nearer to tailings areas which had finer sediments and higher concentrations of Cd and Zn in sediments, and finer average sediment size.

Amphipod toxicity was found at further downstream sites where sediments were somewhat coarser and had lesser amounts of Cd and Zn but greater concentrations of aqueous lead in pore water.

6. Five of six sites on Big River with Cd + Zn PEQ >1.0 were toxic to mussels. Sediments at all sites with a Cd PEQ of 2.4 and Zn PEQ of 1.7 were toxic to mussels. All eight sites with a Cd or Zn PEQ >0.5 had reduced mussel taxa richness compared to historical data.

Comparison of Findings to MacDonald Study in Tri-State Mining District

1. Contrary to Big River study, amphipods were found to be more sensitive to metals than mussels. This study used somewhat older mussels (3-4 months) and there may be a shift in feeding methods to more water filtration as the mussels age, meaning less contact with bottom sediments. I.e., this study may not have evaluated mussels at their most sensitive stage.
2. Sediment Toxicity Threshold (SST) values for lead, zinc and cadmium were established using amphipod toxicity data. SST(10) values for sediment concentration were levels at which a 10% reduction in growth or 10% mortality could be expected. The ability of these SST10s to predict toxicity was 76%. These values were: Pb 150 mg/Kg, Zn 2083 mg/Kg and Cd 11.1 mg/Kg. These concentrations, when translated as PEQs would be: Pb 1.17, Cd 2.23 and Zn 4.54. The Pb PEQ is close to the previously established PEC value for lead and seems to confirm the accuracy of this value. The PEQs for Cd in these two studies are similar but the PEQ for Zn is much higher in the Tri-State study and may not be protective for younger mussels. Had younger mussels been used all of these SST10s may have been lower.
3. MacDonald, using the SST10 values established toxicity indices for mixtures of sediment pollutants including: PEC-Q (all pollutants) = 0.556, PEC-Q (metals) = 1.11, \sum PEC-Q (Cd, Zn, Pb) = 7.92, \sum STT-Q (Cd, Cu, Pb, Zn) = 2.97. These indices were 79-80% accurate at predicting toxicity as measured by survival or biomass of amphipods or mussels.
4. Pore water samples were found to be better predictors of toxicity than bulk sediment analysis



**Missouri
Department of
Natural Resources**

**Revised Proposed 2016 Listing Methodology Document
Biological Assessment Workgroup Comments and Responses**

April 30, 2014

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

2016 Listing Methodology Summary of Comments Following February 26, 2014 Workgroup Meeting

Background: The 2016 Listing Methodology Document (LMD) was originally posted for public comment at the same time as the 2014 303(d) impaired waters list (October 15, 2013 – January 31, 2014). Due to comments and concerns from stakeholders regarding the proposed 2016 LMD, the Department postponed seeking Clean Water Commission approval during the April 2, 2014 meeting. This allowed the Department to schedule a meeting with the biological assessment workgroup to discuss comments and concerns. The biological assessment workgroup meeting was held on February 26, 2014.

The below comments are in response to the updated LMD following the February 2014 Biological Assessment Workgroup meeting. A revised version of the 2016 LMD was provided to the bioassessment workgroup members on April 14, 2014 for review. The Department requested comments to be provided by April 30, 2014.

All revisions made to the revised 2016 proposed LMD are noted as comments or through track changes within the document.

Biological Workgroup Members receiving the revised 2016 LMD:

Missouri Department of Natural Resources

Dave Michaelson
Randy Sarver
Lynn Milberg
John Hoke
Colleen Meredith
Joe Engeln
John Ford
Robert Voss
Kirk Lambrecht
Bill Whipps

Missouri Department of Conservation

Matt Combes
Mike McKee
Karen Bataille

U.S. Environmental Protection Agency

Catherine Wooster-Brown

Geosyntec Consultants, Inc.

Chris Zell
David Carani
Randy Crawford

Barr Engineering

Rob Morrison

City of Springfield

Jan Millington
Steve Meyers
Errin Kemper

St. Louis Metropolitan Sewer District

Nick Bauer

Missouri Department of Health and Senior Services

Jeff Wenzel

Ozark Water Watch, Org.

Dave Casaletto

Tyson Foods

Jason McCauley

Missouri Farm Bureau

Leslie Holloway

Missouri Public Utility Alliance

Phil Walsack

Newman, Comley & Ruth P.C.

Robert Brundage

Hemming, Durham & Richardson, Inc.

Trent Stober

2016 Listing Methodology Summary of Comments Following February 26, 2014 Workgroup Meeting

General Comments received on May 2, 2014

City of Springfield and Barr Engineering

Many commenters' appreciated the efforts of the Department to address the stakeholders' comments to the draft LMD. The revised draft sent to the workgroup members on April 14, 2014 provides much of the greater detail and specificity requested.

Specific Comments received on May 2, 2014

City of Springfield and Barr Engineering

Weight of Evidence Analysis

The Department provided additional information regarding the weight of evidence approach, but recommends the Department to collect additional data in many situations where the Department may rely on the weight of evidence analyses to make use of attainment decisions. For instance, in the case of sediment toxicity, the Department should rely on a multiple lines of evidence including biologic, chemistry, and toxicity data. Where multiple lines of evidence are not available in these instances, the Department should assign waters to Category 2b or 3b until additional data are available for an assessment decision. The city of Springfield suggested additional refinements to the text located on page 14 and page 15 of the LMD.

MDNR Response

Much wording has been added to Appendix E of the LMD to clarify the assessment approach to be taken. The Department has considered and/or incorporated much of the suggested wording. 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.

City of Springfield and Barr Engineering

Sediment Assessments

The Department relies upon the Probable Effects Concentrations (PEC) and Probable Effect Quotients (PEQs) to predict sediment toxicity as outlined by McDonald et al (2000). The initial draft of the 2016 LMD used a long standing threshold of 150% of PECs to trigger a weight of evidence analysis. If the average concentration exceeded 150% of the PEC threshold value, the water body was determined to have a narrative criteria aquatic life use impairment for the particular pollutant in question (metals). In the revised LMD the threshold was reduced to 100% for all sediment (metals) contaminants with the exception of arsenic. It was suggested the Department restore the 150%

2016 Listing Methodology Summary of Comments Following February 26, 2014 Workgroup Meeting

threshold; otherwise, the rate of false positives for assuming sediments that exceed the PEC are toxic would be as high as 25%.

MDNR Response

The Department restored the 150% PEC threshold for sediment toxicity at this time, but will take the opportunity to explore this further for potential incorporation into the 2018 LMD. The assessment process followed for PEC was revised to assess following the geometric mean instead of the arithmetic mean. Overall, the geometric mean for a set of values is generally less than that of the arithmetic mean for the same set of values. For example, given the set of values: 0.596, 1.235, 0.939, 2.851, 0.345, 1.284, 0.794, 0.129. The average is 1.022, while the geomean is 0.739. Updating the calculation to the geomean resulted in a number of water bodies falling below the PEC threshold. Preliminary review of changing the PEC threshold from 150% to 100% did not indicate this would cause a significant increase in waters being returned to the 303(d) list of impaired waters. Overall, revising the 100% PEC threshold would provide consistency with McDonalds et al (2000) recommendations. Due to stakeholder concerns, the Department will conduct additional research and discussion regarding the potential differences between using the 150% to 100% PEC threshold.

City of Springfield

Biological Monitoring and Assessments

The Department should provide flexibility to use more quantitative habitat assessments in addition to the Department's Stream Habitat Assessments for evaluating habitat impairments.

MDNR Response

There is nothing precluding any interested party from conducting habitat assessment studies. Provided that the proposed habitat assessment study methods are reviewed by Department staff and judged to be well-documented and scientifically robust, the Department would consider the study as part of its weight of evidence analyses. The Department's habitat assessment protocols, however, are designed to take into account some of the factors that may contribute to impaired macroinvertebrate scores. Although not strictly quantitative, this method is based on methods designed by EPA (Barbour et al. 1999), and they are carried out consistently among reference streams and test streams to gauge differences.

Barbour, M.J., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid bioassessment protocols for use in streams and wadeable rivers: periphyton, benthic macroinvertebrates, and fish. Second edition. EPA 841-B-99-002. United States Environmental Protection Agency. Office of Water, Washington, D.C.

2016 Listing Methodology Summary of Comments Following February 26, 2014 Workgroup Meeting

Sampling events with missing habitats should not be used for impairment decisions.

MDNR Response

After discussions with Department biologists, we have concluded that results of a biological assessment will not be discounted based solely upon missing habitats at this time. There are documented instances when stream segments have met full biological attainment in absence of a habitat type. The Department would like to maintain flexibility to allow for consultation with Department biologists to determine the extent to which habitat availability is responsible in the event of a non-supporting (< 16) Missouri Stream Condition Index (MSCI) score.

The Department should specify that candidate reference and study streams should be identified within, not only the same Ecological Drainage Unit, but also the same Aquatic Ecological System Types when possible.

MDNR Response

Based on work conducted by Sowa and others through the Missouri Resource Assessment Partnership (MoRAP), the Ecological Drainage Unit hierarchical level has an acceptable level of precision to account for differences in taxonomic composition. A publication explaining the makeup of several of the eight ecological classifications used in Missouri is cited below.

Sowa, S.P., G. Annis, M.E. Morey, and D.D. Diamond. 2007. A gap analysis and comprehensive conservation strategy for riverine ecosystems of Missouri. Ecological Monographs 77(3): 301-304.

Barr Engineering

2012 Department of Health and Senior Services (DHSS) memorandum

On page 23 of the draft LMD, footnote 21 of Table 1.2. has been revised to include reference to a "2012 DHSS memorandum (not yet approved)..." to identify revised threshold values for fish tissue and additional pollutants for consideration. These values and additional pollutants have not been finalized by the DHSS for use in their Fish Advisories; therefore, it does not seem appropriate for the Department to utilize a draft memorandum in the 2016 LMD. The memorandum should be incorporated into the LMD after the memorandum in question has been finalized.

MDNR Response

This footnote was included for informational purposes only. Additional wording has been added to reflect the potential for future revisions of the LMD based upon approval of the DHSS.

2016 Listing Methodology Summary of Comments Following February 26, 2014 Workgroup Meeting

Other Comments

Missouri Department of Conservation

In Table 1.1 on page 17, it was recommended to add clarification regarding Toxic Chemicals. Does an exceedence of water quality criteria constitute an “event” or does a documented fish kill have to occur even if water concentrations of a chemical exceed the water quality criteria for aquatic life?

MDNR Response

As stated in Table 1.1, if any of the conditions occur once in a three-year period it will cause a non-attainment listing.

Does the death of other aquatic organisms (e.g., crayfish or mussels) trigger an acute event?

MDNR Response

The Department tracks all reported aquatic life die-off events due to toxic events. The wording has been updated to reflect die-off of aquatic life such as fish, mussels, and crayfish.

Other Updates to the proposed 2016 LMD

Category 5 explanation (page 5) was reworded to provide additional clarity.

Additional wording was provided to pages 47-48. Terminology was updated and is now consistent with wording stated in the Code of State Regulations.

2016 Listing Methodology Summary of Comments Following February 26, 2014 Workgroup Meeting

RECEIVED

May 1, 2014

MAY 6 2014

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

WATER PROTECTION PROGRAM

Subject: Public Comments Regarding the Draft Methodology for the Development of the 2016 Section 303(d) List in Missouri Document

Ms. Rielly:

The City of Springfield sincerely appreciates the Missouri Department of Natural Resources' (MDNR) efforts to address stakeholders' comments related to the draft Methodology for the Development of the 2016 Section 303(d) List in Missouri (2016 LMD). The draft 2016 LMD sent to stakeholders on April 14, 2014 provides much of the greater detail and specificity requested by the City. We offer the following comments to further improve this critically important process for determining beneficial use attainment within Missouri's waters.

Additional refinements to the Weight of Evidence approach are suggested.

The City urged MDNR to provide greater detail into the types of environmental data that may be considered when assessing the Weight of Evidence within the City's January 31, 2014 comment letter. MDNR did provide additional detail to the appropriate sections of the 2016 LMD. We recommend collection of additional data in many situations where MDNR will rely on Weight of Evidence analyses to make use attainment decisions. Many times inadequate data are available to make these decisions, particularly for potential impacts to aquatic life. In the case of sediment toxicity, MDNR should rely on multiple lines of evidence including biologic, chemistry, and toxicity data. The proposed LMD includes Probable Effects Concentrations (PECs) from McDonald (2000) as the primary measures of sediment toxicity. However, the true aquatic life impacts from these constituents is complicated by the actual bioavailability of contaminants, which can vary significantly based upon site conditions. Where multiple lines of evidence are not available in these situations, MDNR should assign waters to Category 2B or 3B until additional data are available for an impairment decision. To address these concerns, we offer the following additional refinements (in bold) to the text on Page 14.

For narrative criteria, the numeric thresholds included in Table 1.2 have not been adopted into state Water Quality Standards. The Department will use a weight of evidence analysis for evaluating all narrative criteria. Under the weight of evidence approach, all available information is examined and the greatest weight is given to data that provide the best supporting evidence. In determining the

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Trish Rielly
May 2, 2014
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order of best supporting evidence, best professional judgment will be used to consider factors such as data quality and site-specific environmental conditions. For those analytes with numeric thresholds, the threshold values given in Table 1.2 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 a more 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 or aquatic invertebrate animals or toxicity testing of water or sediments. See Appendix E for clarification on use of the weight of evidence approach.

When the weight of evidence analysis suggests, but does not provide strong, scientifically defensible evidence of impairment supported by multiple lines of evidence, 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 use attainment decision. All such documents will be made 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 proposal.

We also suggest the following refinements MDNR's additions with respect to data management on Page 15.

For any given water, available data may occur throughout the system and/or be concentrated in certain areas. Data collected within a waterbody segment are aggregated unless discrete pollution sources impact specific locations. 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 which are more diffuse.

Sediment quality screening thresholds should be raised to former levels in the 2016 LMD.

MDNR relies upon PECs and Probable Effect Quotients (PEQs) to predict sediment toxicity as outlined by McDonald et al. (2000). The initial draft 2016 LMD used MDNR's long standing threshold of 150% of PECs to trigger a Weight of Evidence analysis. However, MDNR reduced this threshold to 100% for all sediment contaminants with the exception of arsenic. We suggest that MDNR restore the 150% threshold given the screening nature intended for PECs. PECs are defined so that sediments with concentrations exceeding the PEC show some toxicity 75% of the time (MacDonald et al., 2000). By definition, therefore, the rate of false positives for assuming sediments that exceed the PEC are toxic would be as high as 25% (i.e., "false positive" means that a non-toxic sediment is identified as toxic). A high rate of false positives may be appropriate when PECs are used as a screening procedure as part of a tiered approach that identifies sediments for

Trish Rielly
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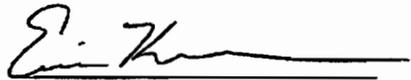
which more in-depth and accurate methodologies are considered. However, using PECs directly as the basis for 303(d) listing suggests that as many as 25% of the site listed as impaired may be listed incorrectly. MDNR primarily uses 10% significance levels for impairment decisions. Therefore, the use of PEC values directly as a definition of impairment would produce a higher incidence of Type I errors than likely intended.

Further modifications to evaluation of biologic data are suggested.

Based upon stakeholders' comments, MDNR developed a new and detailed section describing biologic evaluation methods. These details provide much greater transparency and reproducibility of biologic use attainment decisions. We suggest that MDNR provide flexibility to use more quantitative habitat assessments in addition to MDNR's Stream Habitat Assessments for evaluating habitat impairments. In addition, sampling events with missing habitats should not be used for impairment decisions. With respect to small stream assessments, we recommend always collecting contemporaneous study and control or candidate reference stream data to rule out potential climatic impacts to biologic scores. We also recommend that streams of similar size should always be directly compared regardless of the comparability of control or candidate reference stream data to wadeable/perennial reference streams. Lastly, MDNR's inclusion of a process to select small candidate reference streams is very helpful and a significant improvement. We suggest refining the draft process to specify that candidate reference and study streams should be identified within, not only the same Ecological Drainage Unit, but also the same Aquatic Ecological System Types when possible.

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

Sincerely,



Errin Kemper, P.E., D.WRE
Assistant Director of Environmental Services
Springfield, MO 65802

CC: Trent Stober
Steve Meyer
Jan Millington
Paul Calamita

2016 Listing Methodology Summary of Comments Following February 26, 2014 Workgroup Meeting

Rielly, Trish

From: Rob K. Morrison <RMorrison@barr.com>
Sent: Friday, May 02, 2014 4:20 PM
To: Rielly, Trish
Subject: RE: Revised 2016 LMD

Trish, thanks for the effort to coordinate and sending out the revisions. I intended to send these to you earlier, but I got busy and didn't make it. I'll offer these for your consideration.

1. On pages 15, 32, and 35 of the draft 2016 Listing Methodology Document (LMD), the procedure used to assess whether pollutant levels in sediments are of sufficient concentration to render a narrative criteria impairment of the aquatic life use of the waterbody are proposed for revision. The Department is proposing to alter the procedure used in previous LMDs by changing the statistical analysis method of the sediment chemistry samples from an arithmetic average concentration to geometric concentration and to lower the threshold Probable Effects Concentration (PEC) value from 150% to 100%. Utilizing the geometric of a given data set is the appropriate tool to evaluate the pollutant concentrations and the 2016 LMD should be revised accordingly. In previous LMD's, the average concentration of pollutants in sediments for stream segments were compared to 150% of the PECs that were developed in 2000 by DD MacDonald et al. If the average concentration exceeded 150% of the PEC threshold value, the waterbody was determined to have a narrative criteria aquatic life use impairment for the particular pollutant in question. The 150% threshold was developed to protect against false positive impairments since there has been some question historically with the universal applicability of the PECs developed by MacDonald et al. Since the department has not vetted these threshold criteria values via promulgation into regulation, these values should not carry the same weight as promulgated numeric criteria, in terms of impairment decisions. Without the usage of a threshold value, direct usage of the PEC value could result in false positive impairments. This approach of guarding against false positive impairment decisions continues to be embodied within the proposed 2016 LMD through the application of the PEC Quotient (PECQ). The 2016 draft LMD indicates that an impairment occurs when the PECQ is 0.75. Appendix D of the 2016 LMD further clarifies that according to the MacDonald research, 85% of sediment samples with a PECQ of greater than 0.5 were toxic, therefore, the Department chose 0.75 as the PECQ threshold for impairment determinations. This appears to be a clear usage of the weight of evidence approach for narrative criteria and a recognition that the PECQ has not been promulgated into the State of Missouri's water quality standards and does not enjoy the same weight as duly promulgated water quality criteria. The Department should revise the LMD to and utilize the geometric in the analysis of sediment chemistry samples for stream segments and retain the 150% PEC or develop a revised threshold that more appropriately correlates with the usage of a geometric mean in the analysis of the sediment chemistry data.
2. On page 23 of the draft LMD, footnote 21 of Table 1.2 has been revised to include a reference to a "2012 DHSS memorandum (not yet approved)..." to identify revised threshold values for fish tissue and additional pollutants for consideration. These values and additional pollutants, as of the drafting of this 2016 LMD, have apparently not been finalized by the DHSS for use in their Fish Advisories. It does not seem appropriate for the Department to utilize a draft memorandum that has not been finalized in revising fish tissue concentrations and adding pollutants for consideration in the 2016 LMD. Once these concentrations and additional pollutants have been finalized, the LMD should be revised accordingly, however, until the memorandum in question is finalized, revising the LMD does not seem appropriate.

Thanks again for the opportunity to comment.

Rob K. Morrison EE

2016 Listing Methodology Summary of Comments Following February 26, 2014 Workgroup Meeting

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From: Rielly, Trish [<mailto:trish.rielly@dnr.mo.gov>]
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Subject: FW: Revised 2016 LMD

If you already submitted comments, Thank You.

Just a friendly reminder. Your comments are due **Wednesday, April 30th**.

Trish Rielly, Water Quality Monitoring and Assessment Unit
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The Department of Natural Resources envisions a Missouri where people live and work in harmony with our natural and cultural resources, make decisions that result in a quality environment and a place where we can prosper today and in the future.*

From: Rielly, Trish
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Subject: Revised 2016 LMD

Bioassessment Workgroup Members,

Following the February 26th, 2014 workgroup meeting we've made additional revisions to the Proposed 2016 LMD to address major concerns/comments relating to biological assessment processes, and have completed a list of action items discussed during the meeting. We are still waiting on feedback from participants regarding specific wording suggestions or other information to consider – see attached meeting summary for specifics.

Attached:

2016 Listing Methodology Summary of Comments Following February 26, 2014 Workgroup Meeting

- *Revised 2016 LMD following Biological Assessment Workgroup meeting. In the proposed 2016 LMD, all updates and revisions are noted with a comment. Minor grammatical corrections are not noted in an effort to reduce document clutter.*
- *Biological Workgroup Meeting Summary 2-26-2014. All action items are highlighted in yellow. Additional comments were added to those items that have been completed and the location of the information.*

*Please review the attached version of the Revised 2016 LMD and provide comments by **Wednesday, April 30th 2014, at the latest**. Our plans are to present the draft 2016 LMD for the CWC approval at the July 9th, 2014 meeting. Therefore, we will need to have a final draft document completed and ready for the Commission Packet by early June.*

In closing, and as discussed during the February workgroup meeting, there are other aspects of the LMD we would like to address (e.g. formatting and consolidation of tables). These efforts will take more time to complete. We are planning to have these updates completed during the 2015 cycle.

Thanks,

Trish Rielly, Water Quality Monitoring and Assessment Unit

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Phone: 573-526-5297

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Water Protection Program URL: <http://dnr.mo.gov/env/wpp/wp-index.html>

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The Department of Natural Resources envisions a Missouri where people live and work in harmony with our natural and cultural resources; make decisions that result in a quality environment and a place where we can prosper today and in the future.

Methodology for the Development

of the

2016 Section 303(d) List in Missouri

Final July 9, 2014

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



Missouri
Department of
Natural Resources

Methodology for the Development of the 2016 Section 303(d) List

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I. Citation and Requirements

A. Citation of Section of Clean Water Act

This document is required by revisions of rules under the Federal Clean Water Act, Section 303(d), 40 CFR 130.7, and the timetable for presenting the finished document to the United States Environmental Protection Agency (EPA) and the public is given in Part 130.10. Section 303(d) requires states to list certain impaired waters and the rules require that states describe how this list will be constructed. Missouri fulfills reporting requirements under Sections 303(d), 305(b) and 314 of the Clean Water Act by the submission to EPA of an integrated report at the time the Section 303(d) list is approved by the Missouri Clean Water Commission. In years when no integrated report is submitted, the Missouri Department of Natural Resources (Department) submits a copy of its statewide water quality assessment database to EPA.

B. U.S. EPA Guidance

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” (Appendix A). 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. In subsequent years, EPA has provided additional guidance, but only limited new supplemental information has been provided since the 2008 cycle. Additional information can be found at EPA’s website: <http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/guidance.cfm>.

The Department is responsible for administration of the Federal Clean Water Act in Missouri. EPA regulations require that the Department describe the methodology used to develop the state’s 303(d) list. Biennially, the methodology is reviewed and revised as necessary, and made available to the public for review and comment. In accordance with the guidance, the Department provides EPA with a document summarizing all comments received and the Department responses to significant comments. EPA’s guidance recommends the Department provide: (1) a description of the methodology used to develop the Section 303(d) list; (2) a description of the data and information used to identify (impaired and threatened) waters, including a description of the existing and readily available data and information used; and (3) a rationale for any decision for not using any existing and readily available data and information. The guidance also notes that “prior to submission of its Integrated Report, each state should provide the public with the opportunity to review and comment on the methodology.” The guidelines further recommend that the methodology document include information on how interstate or international disagreements concerning the list are resolved.

Placement of Waters within the Five Categories in the 2006¹ EPA Assessment, Listing and Reporting Guidance

The guidance issued by EPA in 2006 recommends all waters of the state be placed in one of five categories.

Category 1

All designated beneficial uses are fully maintained. Data or other information supporting full beneficial use attainment for all designated beneficial 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:

- 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, *E. coli* or fecal coliform bacteria) that indicates attainment with water quality standards.
- The level of mercury in fish filets or plugs used for human consumption does not exceed fish tissue guidelines of 0.3 mg/kg or less. Only samples of higher trophic level species (largemouth, smallmouth and Kentucky Spotted bass, sauger, walleye, northern pike, trout, striped bass, white bass, flathead catfish and blue catfish) will be used.
- The water is not rated as "threatened."

Category 2

One or more designated beneficial uses are fully attained but at least one designated beneficial 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:

- 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 total nitrogen, total phosphorus or secchi data in lakes.
- There is inadequate *E. coli* or fecal coliform bacteria data to assess attainment with the whole body contact recreational use.
- There is insufficient fish fillet tissue, or plug data available for mercury to assess attainment with the fish consumption use.

Category 2 waters will be placed in one of two sub-categories.

¹ http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/upload/2005_08_11_tmdl_2006IRG_report_2006irg-sec5.pdf

Category 2A: Waters will be placed in this category if available data, using best professional judgement, suggests compliance with numeric 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 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 this data is 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.

Category 3

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 beneficial uses. Category 3 waters will be placed in one of two sub-categories.

Category 3A. Waters will be placed in this category if available data, using best professional judgement, suggests compliance with numeric 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 3B. Waters will be placed in this category if the available data, using best professional judgement, 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. Category 3B waters will be given high priority for additional water quality monitoring.

Category 4

State Water Quality Standards or other criteria, as per the requirements of Table 1 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.

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:

- Any portion of the water is rated as being in non-attainment with state Water Quality Standards or other criteria as explained in Table 1 of this document due to one or more discrete pollutants or discrete properties of the water², and
- EPA has approved a TMDL for all pollutants that are causing non-attainment.

² 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.

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:

- Any portion of the water is rated as being in non-attainment with state Water Quality Standards or other criteria as explained in Table 1 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.

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 Table 1 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 *E. coli* bacteria.

Category 5

At least one discrete pollutant has caused non-attainment with state Water Quality Standards or other criteria as explained in Table 1 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) List³.

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. These segments must be listed as Category 5 unless the state can demonstrate that no discrete pollutant or pollutants 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.

Threatened Waters

When a water that would otherwise be in Categories 1, 2, or 3 has a time trend analysis for one or more discrete water quality pollutants indicates the water is currently maintaining all beneficial uses but will not continue to meet these uses before the next listing cycle, it will be considered a "threatened water." A threatened water will be treated as an impaired water and placed in the appropriate Category (4A, 4B, or 5).

³ 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.

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;
- to better understand daily, flow event and seasonal water quality variations and their underlying processes;
- to characterize aquatic biological communities;
- to assess time trends in water quality;
- to characterize local and regional impacts of point and nonpoint source discharges on water quality;
- to check for compliance with Water Quality Standards or wastewater permit limits;
- to 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 to avoid overlap with other agencies, and to provide and receive interagency input on monitoring study design. Data from other sources is used for meeting the same objectives as Department sponsored monitoring. The agencies most often involved are the U.S. Geological Survey, the U.S. Army Corps of Engineers, EPA, the Missouri Department of Conservation, and the Missouri Department of Health and Senior Services. The Department 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 Quality Assurance/Quality Control tests.

Existing Monitoring Networks and Programs

The following list is a 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 event, and seasonal water quality variations and their

underlying processes, to assess time trends and to check for compliance with Water Quality Standards.

- B. Design Methodology: Sites were 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:
- Department/U.S. Geological Survey cooperative network: 70 sites statewide, horizontally and vertically integrated grab sampled, six to 12 times per year. Samples are analyzed for major ions, nutrients, temperature, pH, dissolved oxygen, specific conductance and flow on all visits, two to four times annually for suspended solids and heavy metals, and for pesticides six times annually at six sites.
 - Department/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 of swimming beaches at Missouri's state parks during the recreational season by the Department's Division of State Parks.
 - Monitoring of sediment quality by the Department at approximately 10 discretionary sites annually. All sites are monitored for several heavy metals and organic contaminants.

2. Special Water Quality Studies

- A. Objective: Special water quality studies are used to characterize the water quality impacts from a specific pollutant source area.
- B. Design Methodology: These studies are designed to determine 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, season of the year and time of day variation must be accounted for in the sampling design.
- C. Number of Sites, Sampling Methods, Sampling Frequency and Parameters: The Department conducts or contracts for 10 to 15 special studies annually, as funding allows. Each study has multiple sampling sites. 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 toxic chemicals. In addition, major municipal and industrial dischargers must monitor for toxicity in their effluents as a condition of their Missouri State Operating Permit.

4. Biological Monitoring Program

A. Objectives: The objectives of this program 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 continue a statewide fish and aquatic invertebrate monitoring program.

B. Design Methodology: Development of biocriteria for invertebrates and fish involves identification of reference streams in each of Missouri's 17 ecological drainage units. It also includes intensive sampling of invertebrate and fish communities to quantify temporal and spatial variation in reference streams within ecoregions and variation between 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 invertebrates for many years. Since 1991, this program has consisted of standardized monitoring of approximately 55 sites twice annually. The Missouri Department of Conservation presently has a statewide fish and aquatic invertebrate monitoring program, the Resource Assessment and Monitoring (RAM) Program, designed to assess and monitor the health of Missouri's stream resources. This program samples a minimum of 450 random and 30 reference sites every five years.

5. Fish Tissue Monitoring Program

A. Objective: Fish tissue monitoring can address two separate objectives. These are: (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 were 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 fish tissue monitoring program to collect whole fish composite samples⁴ at approximately 12 fixed sites. In previous years, this was a cooperative effort between EPA and the Department. Each site will be sampled once every two years. The preferred species for these sites are either carp or redhorse sucker.

The Department, EPA, and the Missouri Department of Conservation also sample 40 to 50 discretionary sites annually for two fish fillet composite samples or plug samples (mercury only) from fish of similar size and species. One sample is of a top carnivore such as largemouth bass, smallmouth bass, walleye or sauger. The other sample is for a species of a lower trophic level such as catfish, carp or sucker. 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 are now generating water quality data in Missouri. The first is the Lakes of Missouri Volunteer Program. This cooperative program consists of persons from the Department, the University of Missouri-Columbia and volunteers that monitor approximately 137 sites on 66 lakes, including Lake Taneycomo, Table Rock Lake and several lakes in the Kansas City area. Data from this program is used by the university as part of a long-term study on the limnology of midwestern reservoirs.

The second program involves volunteers who monitor water quality of streams throughout Missouri. The Volunteer Water Quality Monitoring Program is a subprogram of the Missouri Stream Team Program, a cooperative project sponsored by the Department, the Missouri Department of Conservation and the Conservation Federation of Missouri. By the end of 2012 over 5,000 citizen volunteers had attended at least one training workshop. After the introductory class, many proceed on to 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 Program volunteers represent increasingly higher quality assurance. Of those completing an introductory course, about 35 percent proceed to Levels 1 and 2. One hundred-two volunteers have reached Level 3 and six volunteers have reached Level 4. The Cooperative Site Investigation 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 25 volunteers qualified to work in the Cooperative Site Investigation 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 insure, equipment,

⁴ A composite sample is one in which several individual fish are combined to produce one sample.

reagents and methods meet our standards. To date 70 individuals have attended a validation session at least once.

Laboratory Analytical Support

Laboratories used:

- Department/U.S. Geological Survey Cooperative Fixed Station Network: U.S. Geological Survey Lab, Denver, Colorado
- Intensive Surveys: Varies, many are done by the Department's Environmental Services Program
- Toxicity Testing of Effluents: Many commercial laboratories
- Biological Criteria for Aquatic Invertebrates: 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)
- Missouri State Operating Permit: Self-monitoring or commercial laboratories
- Department's Public Drinking Water Monitoring: Department's Environmental Services Program and commercial laboratories
- Other water quality studies: Many commercial laboratories

B. Identification of All Existing and Readily Available Water Quality Data Sources:

The following data sources are used by the Department to aid in the compilation of the state's 305(b) report. Where quality assurance programs are deemed acceptable, these 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.
9. Annual fish tissue monitoring programs by the Environmental Protection Agency/Department Regional Ambient Fish Tissue Monitoring Program and the Missouri Department of Conservation.
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 invertebrates 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 St. Louis, Kansas City and Springfield, Missouri, and
 - d) Bacterial and nutrient contamination of streams in southern Missouri.
12. Special water quality studies by other agencies such as the Missouri Department of Conservation, the U.S. Public Health Service, and the Missouri Department of Health and Senior Services.
13. Monitoring of fish occurrence and distribution by the Missouri Department of Conservation.
14. Fish Kill and Water Pollution Investigations Reports published by the Missouri Department of Conservation.
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, the Environmental Protection Agency 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 invertebrate 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 is eligible for use in distinguishing between waters in Categories 2A and 2B or Categories 3A and 3B. Most of this data is not used to place waters in main Categories (1, 2, 3, 4 and 5) because analytical procedures do not use EPA or Standard Methods 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 any assessment purposes. 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 can be used in the Section 303(d) assessment process.

The following data sources (22-23) **cannot** be used 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 purposes.

22. Fish Management Basin Plans published by the Missouri Department of Conservation.
23. Fish Consumption Advisories published annually by the Missouri Department of Health and Senior Services. Note: the Department may use data from data source No. 9 (as listed above) to list individual waters as impaired due to contaminated fish tissue.

The Department will review all data of acceptable quality that is submitted to the Department prior to the end of the first public notice of the draft 303(d) list. The Department reserves the right to review and use data of acceptable quality submitted after this date if the data results in a change to the assessment status of the water.

C. Data Quality Considerations

1. 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 Plan. The agency or organization responsible for collection and/or analysis of the environmental sampling

must write and adhere to a Quality Assurance Project Plan approved through the Department's Quality Management Plan. Any environmental data generated by a monitoring plan with a Department approved Quality Assurance Project Plan is considered suitable for use in the 303(d) assessment process. This includes data generated by volunteers participating in the Department's Cooperative Site Investigation 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 Cooperative Site Investigation Program. Individual volunteers that collect samples and deliver them to an approved laboratory must first successfully complete Department training in proper collection and handling of samples. The kind of information that should allow the department to make a judgment on the acceptability of a 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 used and maintenance and calibration procedures used, (3) a description of sample collection and handling procedures and (4) a description of all analytical methods used for samples taken to a laboratory for analysis.

2. Other Quality Assurance/Quality Control Programs

Data generated in the absence of a Department-approved Quality Assurance Project Plan may be used to determine the 303(d) status of a waterbody if the Department determines that the data is scientifically defensible after making a review of the quality assurance procedures 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 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.

3. Other Data Quality Considerations

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

If the Department uses data to make a Section 303(d) list decision that predates the date the list is initially developed by more than seven years, the Department will provide a written justification for the use of such data.

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 time trends.

3.2 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 1997⁵). 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 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 Code⁶ One: All data not meeting the requirements of Data Code Two, Three or Four.
- 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 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 quantitative biological monitoring of at least one aquatic assemblage (fish, invertebrates or algae) at multiple sites, 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 quantitative biological monitoring of at least two aquatic assemblages (fish, invertebrates 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 305(b) 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 data are used, unless the problem can be accurately characterized by Data

⁵ *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>)

⁶ 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.

Code One data.⁷ The reason is that Data Code Two data provides a higher level of assurance that a Water Quality Standard is actually being exceeded and that a TMDL study is necessary. All water bodies placed in Categories 2B or 3B receive high priority for additional monitoring so that data quality is upgraded to at least Data Code Two.

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

Each reporting cycle, the Department and stakeholders review and revise the guidelines for determining water quality impairment. These guidelines are shown in Tables 1.1 and 1.2 which provide the general rules of data use and assessment and Tables B-1 and B-2 provide details about the specific analytical procedure used. In addition, if time trend data indicates that presently unimpaired waters will become impaired prior to the next listing cycle, these “threatened waters” will be judged to be impaired. Where antidegradation provisions in Missouri’s Water Quality Standards apply, those provisions shall be upheld. The numeric criteria included in Table 1.1 have been adopted into the state Water Quality Standards, 10 CSR 20-7.031, and are used, as described in Table 1.1, to make use attainment decisions.

For narrative criteria, the numeric thresholds included in Table 1.2 have not been adopted into state Water Quality Standards. The Department will use a weight of evidence analysis for evaluating all narrative criteria. Under the weight of evidence approach, all available information is examined and the greatest weight is given to data that provide the best supporting evidence. In determining the order of best supporting evidence, best professional judgment will be used to consider factors such as data quality and site-specific environmental conditions. For those analytes with numeric thresholds, the threshold values given in Table 1.2 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 biological data on fish or aquatic invertebrate animals or toxicity testing of water or sediments. See Appendix E for clarification on use of the weight of evidence approach.

When the weight of evidence analysis suggests, but does not provide strong, scientifically defensible 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 use attainment decision. All such documents will be made 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 proposal.

⁷ 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 Table 1.1 of this document.

For the 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 waterbody 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 habitat in poor condition (Appendix E). 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 related to the evaluation of biological data is provided in Appendix E.

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 given by MacDonald *et al.* (2000). The Probable Effect Concentration (PEC) is the level of a pollutant at 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 the LMD. 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 PEC Quotient (PECQ). Please see Appendix D for an example calculation of a PECQ. PECQs greater than 0.75 will be judged as toxic.

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*, *Pimephales promelas* or *Hyalella azteca* 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 is data of another kind (freshwater toxicity tests, sediment chemistry, water chemistry or biological sampling) that indicates 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 which are more diffuse.

TABLE 1.1. 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 STANDARDS⁸
Overall use protection (all designated uses)	No data. Evaluated based on similar land use/ geology as stream with water quality data. ⁹	Not applicable	Given same rating as monitored stream with same land use and geology.
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	Water temperature, pH, total dissolved gases, oil and grease.	1-4	<u>Full</u> : No more than 10% of all samples exceed criterion. ¹⁰ <u>Non-Attainment</u> : Requirements for full attainment not met.
Losing Streams	E. coli bacteria	1-4	<u>Full</u> : No more than 10% of all samples exceed criterion. <u>Non-Attainment</u> : Requirements for full attainment not met. The criterion for E. coli is 126 counts/100ml. 10 CSR 20-7.031 (4)(C)

⁸ See section on Statistical Considerations, Table B-1 and B-2.

⁹ 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.

¹⁰ 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.

**TABLE 1.1. 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 STANDARDS⁸
Protection of Aquatic Life	Dissolved oxygen	1-4	<u>Full</u> : No more than 10% of all samples exceed criterion. <u>Non-Attainment</u> : Requirements for full attainment not met.
Protection of Aquatic Life	Toxic chemicals	1-4	<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. <u>Non-Attainment</u> : Requirements for full attainment not met.
Protection of Aquatic Life	Nutrients in Lakes (total phosphorus, total nitrogen, chlorophyll)	1-4	<u>Full</u> : Nutrient levels do not exceed Water Quality Standards following procedures stated in Table B-1. <u>Non-Attainment</u> : Requirements for full attainment not met. ¹¹
Fish Consumption	Chemicals (water)	1-4	<u>Full</u> : Water quality does not exceed Water Quality Standards following procedures stated in Table B-1. <u>Non-Attainment</u> : Requirements for full attainment not met.
Drinking Water Supply -Raw Water. ¹²	Chemical (toxics)	1-4	<u>Full</u> : Water Quality Standards not exceeded following procedures stated in Table B-1. <u>Non-Attainment</u> : Requirements for full attainment not met.

¹¹ Nutrient criteria will be used in the 2016 LMD only if these criteria appear in the Code of State Regulations, and have not been disapproved by the U.S. Environmental Protection Agency.

¹² Raw water is water from a stream, lake or ground water prior to treatment in a drinking water treatment plant.

TABLE 1.1. 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 ⁸
Drinking Water Supply- Raw Water	Chemical (sulfate, chloride, fluoride)	1-4	<u>Full</u> : Water Quality Standards not exceeded following procedures stated in Table B-1. <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 violations based on Safe Drinking Water Act data evaluation procedures. <u>Non-Attainment</u> : Requirements for full attainment not met. 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. ¹³ <u>Non-Attainment</u> : Requirements for full attainment not met.
Irrigation, Livestock and Wildlife Water	Chemical	1-4	<u>Full</u> : Water Quality Standards not exceeded following procedures stated in Table B-1. <u>Non-Attainment</u> : Requirements for full attainment not met.

¹³ A geometric mean of 206 cfu/100 ml for *E. coli* 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 *E. coli* sampling has determined the status of the water.

TABLE 1.2. 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 ⁸
Overall use protection (all beneficial uses)	Narrative criteria for which quantifiable measurements can be made.	1-4	<p><u>Full</u>: Stream appearance 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 waterbody is statistically significantly higher than a control water.</p> <p>Objectionable Bottom Deposits: 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 twenty percent.</p> <p>Note: Waters in mixing zones and unclassified waters which 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>
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 fish kills die-offs of aquatic life due to natural origin). No more than one exceedence of acute or</p>

TABLE 1.2. 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 ⁸
			chronic criterion in three years for all toxics. ^{14, 15} <u>Non-Attainment:</u> Requirements for full attainment not met.

¹⁴ 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 insure only representative data is 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.

¹⁵ 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. et al. 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 Table B-1 and Appendix D for more information on the Probable Effect Concentrations Quotient.

TABLE 1.2. 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 ⁸
Protection of Aquatic Life	Biological: Aquatic Macroinvertebrates sampled using DNR Protocol. ^{16, 17}	3-4	<p><u>Full</u>: 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.¹⁸</p> <p><u>Non-Attainment</u>: 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>
	Biological: MDC Fish Community (RAM) Protocol (Ozark Plateau only) ¹⁷	3-4	<p><u>Full</u>: For seven or fewer samples and following MDC RAM fish community protocols, 75% of the IBI 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 and evaluation protocols, results must be</p>

¹⁶ DNR invert protocol will not be used for assessment in the Mississippi Alluvial Basin (bootheel area) due to lack of reference streams for comparison.

¹⁷ See Appendix E for additional criteria used to assess biological data.

¹⁸ See Table B-1 and B-2. For test streams that are significantly smaller than bioreference streams 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.

TABLE 1.2. 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 ⁸
	Other Biological Data ¹⁷	3-4	<p>statistically similar to representative reference or control streams.¹⁸</p> <p><u>Suspected of Impairment:</u> Data not conclusive (Category 2B or 3B). For first and second order streams IBI score < 29.</p> <p>Non-Attainment: 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 IBI 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.^{19,20}</p> <p>Full: Results must be statistically similar to representative reference or control streams.</p> <p>Non-Attainment: Results must be statistically dissimilar to control or representative reference streams.</p>

¹⁹ IBI Scores are from “Biological Criteria for Streams and Fish Communities in Missouri” 2008. Doisy et al. for MDC. If habitat limitations (as measured by either the QCPH1 index or other appropriate methods) are judged to contribute to low fish 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.

²⁰ 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).

TABLE 1.2. 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 ⁸
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>
Fish Consumption	Chemicals (tissue)	1-2	<p><u>Full</u>: Fish tissue levels in fillets, tissue plugs, and eggs do not exceed guidelines.²¹</p> <p><u>Non-Attainment</u>: Requirements for full attainment not met.</p>

Duration of Assessment Period

Except where the assessment period is specifically noted in Table 1.1, the time period for 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.

²¹ 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. <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).

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 segments upstream from assessed segments that receive discharges of the quality and quantity that mimic historical discharges to the assessed segment, and 2) data from other bodies of water in the same ecoregion having a similar watershed and landscape and receiving discharges and runoff of the quality and quantity that mimic historical discharges to 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 point in time in which upstream discharges, runoff and watershed conditions remained the same, if 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 such test will be that water quality is the same at the test segment and representative segment. 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 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. Unsightly, putrescent or harmful bottom deposits,
 - b. Oil, scum and floating debris,
 - c. Unsightly color, turbidity or odor,
 - d. Substances or conditions causing toxicity to human, animal or aquatic life,
 - e. Human health hazard due to incidental contact,
 - f. Acute toxicity to livestock or wildlife, when used as a drinking water supply,
 - g. Physical, chemical or hydrologic changes that impair the natural biological community,
 - h. Used tires, car bodies, appliances, demolition debris, used vehicles or equipment and any solid waste as defined by Missouri’s Solid Waste Law, and
 - i. Acute toxicity.

2. Habitat assessment protocols for Wadeable streams have been established and are conducted in conjunction with sampling of 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 assessment data alone for assessment purposes.

E. Other 303(d) Listing Considerations

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

The listed portion of an impaired water 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 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.

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

The listed portion of an impaired water 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 already on the list based on recent monitoring data following guidelines in Table B-2. Waters may be completely removed from the list for several reasons²², 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.

3. 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:

- severity of the water quality problem and risk to public health,
- amount of time necessary to acquire sufficient data to develop the TMDL,
- court orders, consent decrees or other formal agreements,
- budgetary constraints, and
- amenability of the problem to treatment.

The Department's TMDL schedule will represent its prioritization. The TMDL Program develops the TMDL schedule which can be found at the following website, <http://www.dnr.mo.gov/env/wpp/tmdl/>.

4. Resolution of Interstate/International Disagreements

²² 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 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 in another state is different than in Missouri, the Department will request the data upon which the listing in the other state is based. This data will be reviewed following all data evaluation guidelines previously discussed in this document. The Missouri Section 303(d) list may be changed pending the evaluation of this additional data.

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.

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.

1. 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 a 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" – Total Suspended Solids, pH, Biochemical Oxygen Demand, fecal coliform bacteria and oil and grease – 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 the applicable water quality criterion are expressed. An example of a water quality criterion for which an assessment based on the 10% rule would be appropriate is the EPA acute water quality criterion for fecal coliform bacteria, applicable to protection of water contact recreational use. This 1976-issued water quality criterion was expressed as, "...no more than ten percent of the samples exceeding 400 CFU per 100ml, during a 30-day period. This assessment methodology is clearly reflective of the water quality criterion.

On the other hand, use of the 10 percent rule for interpreting water quality data is usually not consistent with water quality criterion 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 10 percent rule typically leads to the belief that segment conditions are equal to or better than specified by the water quality criterion, when they in fact are considerably worse. (That is, pollutant concentrations are above the criterion concentration a far greater proportion of the time than specified by the water quality criterion). Conversely, use of this decision rule in concert with water quality criterion expressed as average concentrations over specific times can lead to

concluding that segment conditions are worse than water quality criterion, 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 versus 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.

2. 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 Water Quality Standards” or “not meeting Water Quality Standards” as the null hypothesis (refutable 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 the presumption. By contrast, making the null hypothesis “Water Quality Standards not being met” shifts the burden of proof to those who believe the segment is, in fact, meeting Water Quality Standards.

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 was no previous data on the segment, and no additional existing and readily available data and information is 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 assured 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 Water Quality Standards”: 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 10 percent. Hence, if the chosen null hypothesis is “segment meeting Water Quality Standards”, the state is trying to keep the chance of saying a segment is impaired, when in reality it is not, under 10 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 those 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 following two 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 Water Quality Standards), 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 water quality criterion (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 statewide, 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 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 which 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 used under various circumstances.

Description of Analytical Tools

Tables B-1 and B-2 below describe the analytical tools the Department will use to determine when a water is impaired (Table B-1) or when a listed water is no longer impaired (Table B-2).

TABLE B - 1. DESCRIPTION OF ANALYTICAL TOOLS FOR DETERMINING IF WATERS ARE IMPAIRED

Designated Use	Analytes	Analytical Tool	Decision Rule/ Hypothesis	Criterion Used with the Decision Rule ²³	Significance Level
Narrative Criteria	Color (Narrative)	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	0.10

²³ 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.

TABLE B - 1. DESCRIPTION OF ANALYTICAL TOOLS FOR DETERMINING IF WATERS ARE IMPAIRED

Designated Use	Analytes	Analytical Tool	Decision Rule/ Hypothesis	Criterion Used with the Decision Rule ²³	Significance Level
	Bottom deposits (Narrative)	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) ²⁴	0.40
Aquatic Life	Biological monitoring (Narrative)	For DNR Invert protocol: Sample sizes of 7 or less, 75% of samples must score 14 or lower. For RAM Fish IBI protocol: Sample sizes of 7 or less, 75% of samples must score less than 36.	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

²⁴ 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.

TABLE B - 1. DESCRIPTION OF ANALYTICAL TOOLS FOR DETERMINING IF WATERS ARE IMPAIRED

Designated Use	Analytes	Analytical Tool	Decision Rule/ Hypothesis	Criterion Used with the Decision Rule ²³	Significance Level
		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
		For RAM Fish IBI protocol and sample size of 8 or more: Binomial Probability.			
		For other biological data: An appropriate parametric or nonparametric test will be used.	Null Hypothesis, Community metric(s) in test stream is the same as for a reference stream or control streams.	Reject Null Hypothesis If metric scores for test stream are significantly less than reference or control streams.	0.1
			Other biological monitoring to be determined by type of data.	Dependent upon available information.	Dependent upon available information.
Aquatic Life	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
	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 ¹⁵ , or site PECQ is exceeded.	For metals except Arsenic, use 100% PEC threshold. For Arsenic, use 150% of PEC threshold. The PECQ threshold value is 0.75.	Not applicable
Aquatic Life	temperature, pH, total diss. gases, oil and grease, diss. 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

TABLE B - 1. DESCRIPTION OF ANALYTICAL TOOLS FOR DETERMINING IF WATERS ARE IMPAIRED

Designated Use	Analytes	Analytical Tool	Decision Rule/ Hypothesis	Criterion Used with the Decision Rule ²³	Significance Level
Losing Streams	E.coli	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 .	0.10
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.	0.40
Fish Consumption	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.	0.40
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.	0.40
Drinking Water Supply (Raw)	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.	0.40
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.
Whole Body Contact and Secondary Contact Rec.	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

TABLE B - 1. DESCRIPTION OF ANALYTICAL TOOLS FOR DETERMINING IF WATERS ARE IMPAIRED

Designated Use	Analytes	Analytical Tool	Decision Rule/ Hypothesis	Criterion Used with the Decision Rule²³	Significance Level
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.	0.40
Protection of Aquatic Life	Nutrients in lakes (Numeric)	Hypothesis test ²⁵	Null hypothesis: Criteria are not exceeded.	Reject Null Hypothesis if 60% LCL value is greater than criterion value.	0.40

²⁵ 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.

TABLE B - 2. DESCRIPTION OF ANALYTICAL TOOLS FOR DETERMINING WHEN WATERS ARE NO LONGER IMPAIRED

Designated Use	Analytes	Analytical Tool	Decision Rule/ Hypothesis	Criterion Used with the Decision Rule	Significance Level
Narrative Criteria	Color (Narrative)	Same as Table B-1	Same as Table B-1	Same as Table B-1	0.40
	Bottom deposits (Narrative)	Same as Table B-1	Same as Table B-1	Same as Table B-1	0.40
Aquatic Life	Biological monitoring (Narrative)	DNR Invert Protocol: For 7 or less samples, same as Table B-1.	Same as Table B-1	Same as Table B-1	Same as Table B-1
		RAM Fish IBI Protocol: For 7 or less samples, same as Table B-1.			
		For DNR Invert Protocol For 8 or more samples, same as Table B-1.	Same as Table B-1	Same as Table B-1	0.4
		RAM Fish IBI Protocol: For 8 or more samples, same as Table B-1.	Same as Table B-1	Same as Table B-1	0.40
	For other biological data: Same as Table B-1.				
	Toxic chemicals in water	Same as Table B-1			
	Toxic chemicals in sediments	Comparison of geomean to PEC value, or calculation of a PECQ value.	Water is judged to be unimpaired if parameter geomean is equal to or less than PEC ¹⁵ , or site PECQ equaled or not exceeded.	For metals except Arsenic, use 100% PEC threshold. For Arsenic, use 150% of PEC threshold. The PECQ threshold value is 0.75.	Not applicable
Aquatic Life	Temperatur e, pH, total diss. gases, oil and grease, diss. oxygen	Same as Table B-1	Same as Table B-1	Same as Table B-1	Same as Table B-1
		Same as Table B-1	Same as Table B-1	Same as Table B-1	Same as Table B-1
Losing Streams	E. coli	Same as Table B-1	Same as Table B-1	Same as Table B-1	Same as Table B-1

TABLE B - 2. DESCRIPTION OF ANALYTICAL TOOLS FOR DETERMINING WHEN WATERS ARE NO LONGER IMPAIRED

Designated Use	Analytes	Analytical Tool	Decision Rule/ Hypothesis	Criterion Used with the Decision Rule	Significance Level
Fish Consumption	Toxic chemicals in water	Same as Table B-1	Same as Table B-1	Reject null hypothesis if the 60% UCL is greater than the criterion value.	0.40
	Toxic chemicals in tissue	Same as Table B-1	Same as Table B-1	Reject null hypothesis if the 60% UCL is greater than the criterion value.	0.40
Drinking Water Supply (Raw)	Toxic chemicals	Same as Table B-1	Same as Table B-1	Reject null hypothesis if the 60% UCL is greater than the criterion value.	0.40
Drinking Water Supply (Raw)	Non-toxic chemicals	Same as Table B-1	Same as Table B-1	Reject null hypothesis if the 60% UCL is greater than the criterion value.	0.40
Drinking Water Supply (Finished)	Toxic chemicals	Same as Table B-1	Same as Table B-1	Same as Table B-1	Same as Table B-1
Whole Body Contact and Secondary Contact Rec.	Bacteria	Same as Table B-1	Same as Table B-1	Same as Table B-1	Not applicable
Irrigation & Livestock Water	Toxic chemicals	Same as Table B-1	Same as Table B-1	Reject null hypothesis if the 60% UCL is greater than the criterion value.	0.40
Protection of Aquatic Life	Nutrients in lakes	Same as Table B-1	Same as Table B-1	Same as Table B-1	0.40

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 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 (Table B-1) test significance levels are set at either 0.1 or 0.4, meaning the data must show a 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 had been restored to an unimpaired status (Table B-2) some undesirable results can occur.

For example, using a 0.1 significance level for determining both impairment and nonimpairment; if the sample data indicate the stream had a 92 percent probability of being impaired, it would be rated as impaired. If subsequent data was 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 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 is 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 databases, the disparity between Type I and Type II errors can be large. The table 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 for a stream with a 15 percent exceedence rate of a standard. Note that when sample size remains the same, as Type 1 error rates decrease Type II error rates increase (Table B-3). Also note that for a given Type I error rate, the Type II error rate declines as sample size increases.

Table B-3. 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 B-4. 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 Ten Percent Rule

There are two options for assessing data for compliance with the ten 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 ten percent. The second method is to use some evaluative procedure that can review the data and provide a probability statement regarding the compliance with the ten 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 exceedence 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 exceedence 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.

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.

Appendix C Examples of Statistical Procedures

Two Sample “t” Test for Color

Null Hypothesis: Amount of color is no greater in 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 (also known as the alpha level): 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 µg/Kg 130, 230, 450. Mean = 270, Standard Deviation = 163.7

The 60% Lower Confidence Limit Interval = the sample mean minus the quantity:

$$((0.253)(163.7)/\text{square root } 3) = 23.9. \text{ Thus the 60\% LCL Confidence Interval is } 246.088 \text{ } \mu\text{g/Kg.}$$

The criterion value is 300 µg/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 waterbody is placed in either Category 2B or 3B.

Appendix D

The Meaning of the Sediment Quotient and How to Calculate It

The Probable Effect Concentration (PEC) is the level of a pollutant at which harmful effects on the aquatic community are likely to be observed. While 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 PEC Quotient. This calculation is made by dividing the pollutant concentration(s) 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 geometric mean (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, Zinc 260.

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

33, 4.98, 149, 128, 459.

PEC Quotient =

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

Using PEC Quotients to Judge Toxicity

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

Appendix E

Evaluation of Biological Data

Introduction

Methods for assessing biological data typically receive considerable attention during public comment periods for the development of Listing Methodology Documents. 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”.

The purpose of this appendix is to describe the methods used to evaluate these three types of biological data. This appendix includes the following: 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 bioassessments to determine macroinvertebrate community health as a function of water quality and habitat. Almost all macroinvertebrate monitoring is “targeted,” where the health of the community from the “target” stream is compared to healthy macroinvertebrate communities from reference streams of the same general size and in the same ecological drainage unit (EDU).

The Department’s approach to monitoring and evaluating aquatic macroinvertebrates is largely based on the document *Biological Criteria for Wadeable/Perennial Streams of Missouri* (MDNR 2002). This document provides numeric 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. For macroinvertebrates, the numeric biocriterion translator is expressed as a multiple metric index referred to as the Macroinvertebrate Stream Condition Index (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.

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 metrics 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 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 Type I error rate 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 0.1, which is in fact the probability of committing a Type I error (rejecting a true null hypothesis). When the Type 1 error rate is less than 0.1, the null hypothesis is rejected; when the Type I error rate is greater than 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 Table B-1 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 of 10 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 10 samples.

The binomial probability formula may be summarized as:

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

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 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 1 error rate would change to 0.028, and since this value is less than the significance level of 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 since there are no 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 in an EDU.

Sample Representativeness

DNR 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 invertebrate 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 a 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 DNR’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 has to offer.

Assessing Small Streams

Occasionally, macroinvertebrate monitoring is needed to assess streams smaller than average 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 which 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 DNR'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; and in previous work by DNR, when the MSCI was calculated according to WPRS criteria, the failure rate for such candidate reference streams was 31%, 39% and 70%, respectively. The data trend showed a higher failure rate for increasingly smaller high quality streams when scored using WPRS biological criteria. This demonstrates the need to utilize candidate reference streams in biological stream assessments.

For test streams that are smaller than wadeable perennial reference streams, DNR 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 DNR 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 10 candidate reference stream (small control stream) scores are similar to WPRSs and meet LMD criteria for an unimpaired invertebrate community, then the test stream will be assessed using MSCI based procedures in the LMD.
- If the 10 candidate reference stream scores are lower than those of WPRSs and do not meet the LMD criteria for an unimpaired invertebrate 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 slightly lower than the candidate reference streams; or,
 - d. The test stream will be assessed as having an "impaired" macroinvertebrate community if its scores are much 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 is 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, 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 Missouri Department of Conservation (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: (1) number (#) of native individuals; (2) # of native darter species; (3) # of native benthic species; (4) # of native water column species; (5) # of native minnow species; (6) # of all native lithophilic species; (7) percentage (%) of native insectivore cyprinid individuals; (8) % of native sunfish individuals; and, (9) % 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 (Table 1.2 in the LMD). 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. For determining this a binomial probability Type I error rate (0.1) is calculated based

on the 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 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 percent 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. For determining this a binomial probability Type I error rate is calculated based on the 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 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 Table B-1 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.”

While 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 first and second 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 below information 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 if they were collected in ONLY the Ozark ecoregion, and based upon best professional judgment from MDC Staff, the samples were collected during normal representative conditions. Samples collected from the Central Plains and Mississippi Alluvial Basin are excluded from the 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 an 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 on losing streams, as defined by the Department of Geology and Land Survey, or, collected in close proximity to losing streams. Additionally, ineligible samples may also include those collected on streams that were considered to have natural flow issues (such as substantial 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, while 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:

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

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 \geq 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 the LMD. 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 Table 1.2, Table B-1, and Table B-2) 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

The Department may periodically, on a case by case basis, 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 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 in agreement

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 waterbody assessments occurs infrequently, but when available, it is usually assessed in combination with other information collected within the waterbody 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.

Weight of Evidence Analysis

When evaluating narrative criteria, the Department will use a weight of evidence analysis for assessing numeric translators which have not been adopted into state Water Quality Standards. 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. The weight of evidence analysis will include the use of other types of environmental data when available, including fish tissue, sediment chemistry, MSCI and FBI scores, and other biological data.

Biological data will be given greater weight in a weight of evidence analysis for making an attainment decision for aquatic life use and subsequently a Section 303(d) listing. 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 defensible 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 made 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 waterbody based on narrative criteria will only be made after full consideration of all comments on the proposed list.

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