Provisional Methodology for Clean Water Act Assessment of the Upper Mississippi River

Updated July 2017

Upper Mississippi River Basin Association Water Quality Task Force
Assessment Feasibility Project Work Group

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__**Acknowledgements**__

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BACKGROUND

Project Purpose

This provisional assessment methodology was prepared as part of the states' project to explore the feasibility of a shared Clean Water Act (CWA) assessment approach for the Upper Mississippi River (UMR). The assessment feasibility study accompanies the development and implementation of a comprehensive UMR CWA monitoring strategy. The monitoring strategy is designed to generate data that can be used by the states to assess the relative water quality condition of the UMR in supporting its four primary designated uses: aquatic life protection, water-based recreation, as a source of a public water supply, and fish consumption. The assessment study examines the potential for such assessments of water quality condition by states to be done according to a shared methodology. Data generated by the monitoring strategy, as well as any potential shared assessment outcomes, can be used by UMR states to help assess the degree to which the UMR meets the goal of the Clean Water Act *to restore and maintain the chemical, physical, and biological integrity of the Nation's waters* (33 U.S. Code § 1251).

This provisional methodology has been developed as a result of UMR CWA assessment work group discussions throughout 2014 and 2015. It also considers recommendations in the document *Upper Mississippi River Clean Water Act Monitoring Strategy 2013-2022: Part 1: Options and Considerations* (Yoder et al. 2013) and responds to the sampling designs in the states' recommended water quality monitoring plan for the Upper Mississippi River (UMRBA 2014). Where possible, recommendations received from other stakeholders have been incorporated into the methodology.

Additionally, and to the extent possible, the assessment methods proposed for the UMR are similar to those used by the Ohio River Valley Water Sanitation Commission (ORSANCO 2012) to assess water quality conditions of the Ohio River as part of CWA Section 305(b) requirements. For a comparison of UMRBA and ORSANCO assessment methods, see Appendix 1.

Assessment Unit

The primary units of assessment are the 13 UMRBA unified, minimum assessment reaches as agreed to by the five UMR basin states via a 2003 memorandum of understanding, plus an additional reach (Reach 0) internal to Minnesota. See Table 1 for a list of these reaches.

Please note that this assessment focuses on the UMR's *main channel* strata. CWA assessment tools and processes for the river's other strata (e.g., backwaters) have not yet been developed.

Table 1. Interstate UMR minimum Clean Water Act assessment reaches (from UMRBA 2014).

Reach Number	**Reach Name** (Description/8-digit HUC code)	**River Miles**	**Segment Length (miles)**
0	**Assessment Reach 0** (Upper Saint Anthony Falls to St. Croix River/HUC 07010206)	**854.0-811.5**	**42.5**
1	**Assessment Reach 1 (Rush-Vermillion)** (St. Croix River to Chippewa River/ HUC 07040001)	**811.5-763.4**	**48.1**
2	**Assessment Reach 2 (Buffalo-Whitewater)** (Chippewa River to Lock & Dam 6/ HUC 07040003)	**763.4-714.2**	**49.2**
3	**Assessment Reach 3 (La Crosse-Pine)** (Lock & Dam 6 to Root River/HUC 07040006)	**714.2-693.7**	**20.5**
4	**Assessment Reach 4 (Coon-Yellow)** (Root River to Wisconsin River/HUC 07060001)	**693.7-630.7**	**63.0**
5	**Assessment Reach 5 (Grant-Maquoketa)** (Wisconsin River to Lock & Dam 11/ HUC 07060003)	**630.7-583.0**	**47.7**
6	**Assessment Reach 6 (Apple-Plum)** (Lock & Dam 11 to Lock & Dam 13/ HUC 07060005)	**583.0-522.5**	**60.5**
7	**Assessment Reach 7 (Copperas-Duck)** (Lock & Dam 13 to Iowa River/ HUC 07080101)	**522.5-434.0**	**88.5**
8	**Assessment Reach 8 (Flint-Henderson)** (Iowa River to Des Moines River/ HUC 07080104)	**434.0-361.4**	**72.6**
9	**Assessment Reach 9 (Bear-Wyaconda)** (Des Moines River to Lock & Dam 21/ HUC 07110001)	**361.4-324.9**	**36.5**
10	**Assessment Reach 10 (The Sny)** (Lock & Dam 21 to Cuivre River/ HUC 07110004)	**324.9-236.7**	**88.2**
11	**Assessment Reach 11 (Peruque-Piasa)** (Cuivre River to Missouri River/ HUC 07110009)	**236.7-195.7**	**41.0**
12	**Assessment Reach 12 (Cahokia-Joachim)** (Missouri River to Kaskaskia River/ HUC 07140101)	**195.7-118.0**	**77.7**
13	**Assessment Reach 13 (Upper Miss-Cape Girardeau)** (Kaskaskia River to Ohio River/ HUC 07140105)	**118.0-0**	**118.0**

Sources of Data

CWA water quality assessments for the UMR will be based on results of biological, chemical, and physical monitoring at a combination of fixed stations, randomly-selected (probabilistic) sites, and monitoring stations targeted for assessment of a specific uses (i.e., drinking water use) per the *UMR CWA Recommended Monitoring Plan* (UMRBA 2014). To the extent that existing data sets match the requirements of the *Plan,* they may also be incorporated into the assessment.

Fixed Station Network approach. In general, the UMRBA main-stem fixed stations (Table 2) are placed to measure background water quality conditions. As such, monitoring data from these stations can be used to approximate ambient water quality conditions within an assessment reach. Also, fixed sites have been added in proximity to community public water systems drawing water from the river (Table 3) if there was not already a fixed site nearby. An additional suite of parameters (pesticides, VOCs, phenols) will be sampled at each site in proximity to an intake. Thus, monitoring data from fixed stations will be used to assess the water quality condition for both recreation and drinking water uses.

Table 2. Proposed UMR main-stem fixed monitoring sites.

Site No.	Fixed Station Location	River Mile	Includes Drinking Water Parameters?	UMRBA Reach	Reach Length (miles)
1	Lock and Dam 2 (Prescott, MN)	815.3	No	0	42.5
2	Lock and Dam 3 (Red Wing, MN)	796.9	No	1	48.1
3	Winona, MN	725.5	No	2	49.2
4	Lock and Dam 7 (La Crosse, WI)	702.5	No	3	20.5
5	Lock and Dam 9 (Lynxville, WI)	647.9	No	4	63.0
6	Lock and Dam 11 (Dubuque, IA)	583	No	5	47.7
7	Clinton, IA	520.0	No	6	60.5
8	Riverdale, IA	490.0	Yes	7	88.5
9	Lock and Dam 15 (Quad Cities)	482.8	Yes		
10	Lock and Dam 17 (New Boston, IL)	437	No		
11	Burlington, IA	404.8	Yes	8	72.6
12	Keokuk, IA	364.0	Yes		
13	Lock and Dam 21 (Quincy, IL)	325.0	Yes	9	36.5
14	Hannibal, MO	309.6	Yes	10	88.2
15	Lock and Dam 24 (Clarksville, MO)	273.5	No		
16	Alton, IL	200.8	Yes	11	41.0
17	Below St. Louis, MO	180.0	Yes	12	77.7
18	Crystal City, MO	150.2	Yes		
19	Chester, IL*	110.0	Yes		
20	Thebes, IL	44.0	No	13	118.0

**Site located in Reach 13 but effectively measures condition in Reach 12.*

Table 3. Community public water systems utilizing the interstate UMR (adapted from Appendix 1 in UMRBA 2014).

Community Public Water System	State	Interstate Assessment Reach	Approximate River Mile	Estimated Population Served*
E. Moline Water Department	IL	7	490	20,500
Moline Water Department	IL	7	486	44,718
Iowa-American Water, Davenport	IA	7	484	137,201
Rock Island Water Department	IL	7	483	39,684
Rock Island Arsenal	IL	7	483	7,800
Burlington Municipal Water Works	IA	8	405	25,619
Nauvoo Water Department	IL	8	376	1690
Keokuk Municipal Water Works	IA	8	365	10,780
Hamilton Water Department	IL	8	364	2,951
Warsaw Water Department	IL	9	360	1,607
Quincy Water Department	IL	9	327	45,000
Hannibal Water Department	MO	10	309	17,456
Louisiana Water Department	MO	10	283	3,781
Illinois-American Water, Alton	IL	11	204	56,375
Illinois-American Water, Granite City	IL	12	192	40,541
City of St. Louis Water Department	MO	12	190	319,000
Illinois-American Water, East St. Louis	IL	12	181	155,382
Jefferson County Water Authority	MO	12	150	20,000
Chester Water Department	IL	13	110	8,702
TOTAL				958,787

**Does not include populations of indirectly served systems. All populations from U.S. EPA SDWIS data system.*

Probabilistic Monitoring: For each of the 14 assessment reaches (Table 1), 15 randomly-selected sample sites will be identified via a probabilistic "sample draw" process. U.S. EPA's Western Ecology Division in Corvallis, Oregon has generated this sample draw. Identification of these sites facilitates implementation of a probabilistic monitoring design that allow extrapolation of results of biological, chemical, and physical monitoring to unmonitored portions of the assessment segment. Probabilistic monitoring data will be used to evaluate aquatic life and fish consumption use attainment, and will augment recreational use assessment.

Results of all monitoring will be made available to states for use in their respective CWA programs.

Condition Categories

For each of the 14 assessment reaches, the water quality condition of all primary designated uses will be assessed as either "good," "fair," or "poor." This three-tiered water quality assessment framework is analogous to the assessment framework of designated use support (fully supporting, partially supporting, and not supporting) historically recommended by U.S. EPA for purposes of state-level CWA Section 305(b) reporting (U.S. EPA 1997). As opposed to the two-tiered approach ["fully supporting" (good) and "impaired" (poor)] currently recommended by U.S. EPA for use in state-level biennial Integrated (CWA Section 305(b) and 303(d)) Reports (U.S. EPA 2002), the three-tiered framework provides for more specific communication and understanding regarding the relative severity of water quality problems.

In order to classify water quality condition, it is necessary to identify thresholds and decision processes (e.g., a "10% rule") within this assessment methodology. In some cases, these thresholds and decision processes may differ from those used by individual states. **Therefore, it is critical to recognize that this shared assessment is secondary to and supportive of states' individual Clean Water Act assessment and impaired waters listing processes: each state's existing 305(b)/303(d) determinations remain the decision of record.**

Proposed Timeline

For design and planning purposes, the UMR monitoring strategy and provisional assessment methodology are based on a recommended, repeating five-year monitoring cycle. Probabilistic monitoring is to be conducted in all 14 assessment reaches within a two-year period of each five year cycle. Main-stem fixed station monitoring, as well as fixed station tributary loading monitoring, are to be conducted monthly on an ongoing annual basis. Assessment development and review/revision of the monitoring plan are to occur in the fourth and fifth years of each five year cycle.

This preferred monitoring and assessment timeline is summarized in the UMRBA recommended monitoring plan (see Figure 1). While the actual implementation of monitoring and assessment may likely vary from this schedule, the five year cycle is proposed as common goal and reference point to aid the states' planning and implementation.

	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Initial Staffing & Training, Finalizing Design					
Reach-Based Probabilistic Monitoring					
Mainstem Fixed Monitoring			(Ongoing)		
Aquatic Life Follow-up Monitoring					
Fish Consumption Targeted or Follow-up Monitoring					
Tributary Load Network Monitoring*			(Ongoing)		
Revise Monitoring Plan for Next Cycle					

*Figure 1. Possible monitoring timeline for the UMRBA monitoring strategy: initial monitoring cycle assuming full implementation (from UMRBA 2014). *Tributary load network does not have a direct function in use attainment assessment and therefore is not discussed further in this document.*

METHODOLOGIES FOR SPECIFIC DESIGNATED USES

Aquatic Life Use Assessment

Summary: *Utilize biological assemblages (e.g., fish, macroinvertebrates) to characterize aquatic life condition.*

Based on recommendations in Yoder et al. (2013:59), this assessment of aquatic life use will be based on biological indices derived from aquatic assemblages. That is, **for purposes of this UMRBA assessment, biological information is the primary driver of aquatic life assessment outcomes** with results of chemical/physical water quality and habitat monitoring being used primarily to diagnose causes of any biological impairment identified (Yoder et al. 2013:55-56). Per the *UMR Clean Water Act Biological Assessment Implementation Guidance* (Yoder et al. 2011), the assemblages to be used to assess aquatic life use condition are fish and macroinvertebrates. Submersed aquatic vegetation and total suspended solids are also available as additional indicators, as described later in this section.

The use of multiple indicators enhances the robustness of the resulting bioassessment because individual assemblages have different temporal responses and sensitivities to various stressors existing along a disturbance gradient. Thus, the accuracy of the overall bioassessment is improved with multiple assemblages. In addition, the dual assemblage approach is equally important for determining proximate causes of non-attainment. As such, we will evaluate the sensitivities of the two assemblage indicators, fish and macroinvertebrates, to environmental stressors in the UMR main channel. Optimally, indicators based on different assemblages will each track the overall stressor gradient in a generally similar manner but will show different sensitivities to the magnitude and severity of the effects of individual stressors along the disturbance gradient.

Determinations of water quality condition will be made at both the site and reach level. Site level calculations will be incorporated into the reach-level assessments and will also be used to track longitudinal trends in status. Reach-level water quality condition will be apportioned to reach river miles according to the probability-based percentage of the site-level assessments use.

<u>Site Level Determination</u>: Site level determinations will be based on a dual assemblage approach from a single sampling event for each assemblage with each site being sampled once during a five-year period. The sampling of all 14 assessment reaches will take place over the course of two consecutive years within the five year sampling window. Fish and macroinvertebrate communities will be assessed at probabilistic sites in all reaches. Each community will be assessed independently and a “poor” or non-supporting status will be determined if one or more assemblages fall below the impairment threshold (biocriterion). Assessment decisions of “good” or fully supporting water quality condition will be assigned at the site level only when all communities meet aquatic life condition thresholds.

Of note, biological samples are susceptible to being compromised for various reasons (e.g., equipment malfunction and laboratory errors) resulting in sites that have information from only a single assemblage. When this occurs a condition assessment can be made using a single assemblage. For stations missing assemblage data it will be necessary to adjust site apportionment of reach-wide water quality condition.

Aquatic life use condition assessment thresholds for each of the indicator assemblages are derived per recommendations of Yoder et al. (2011) as shown in Table 4, which reflects the recommended indices, reach groups, and biocriteria for each aquatic assemblage in both the impounded and open river. The Great River Fish Index (GRFIn) was derived from stations associated with a fish community based biological condition gradient (BCG) level of 4, while the Submersed Macrophyte Index (SMI) (discussed later) was derived from the midpoint of the quadrisection of the range of site scores.

However, the invertebrate assessment tools recommended by Yoder et al. (2011), see Table 4, did not perform to the levels ideally expected of a biological index. While the GRMIn showed a response to the stressor index similar to the GRFIn, the lack of stressor-specific responses indicated that additional work needed to be done to improve the invertebrate index. An *ad hoc* macroinvertebrate index was developed by the Midwest Biodiversity Institute (Yoder et al., 2011) to address this issue using some of the metrics from the GRMIn, along with additional metrics. While an improvement over the original GRMIn, it still lacked the stressor-response relationship found with the GRFIn and SMI.

Subsequently, as part of the Minnesota-Wisconsin pilot project to implement UMR CWA sampling, the Wisconsin Large River IBI was calibrated for use on the impounded UMR, utilizing data from pilot monitoring, the Wisconsin Non-wadeable Rivers IBI development project, the Minnesota Large River Survey Project, and an UMR methods comparison study. This work resulted in a provisional threshold of 50 for a macroinvertebrate IBI score. As such, Table 4 reflects the integration of this provisional impounded river macroinvertebrate threshold into those as proposed in Yoder, et al. 2011. Note that moving to use of the Wisconsin Large River IBI required a methods change from qualitative multihabitat to Hester-Dendy artificial substrates.

Table 4. Aquatic Life Use Assessment Thresholds (adapted from Yoder, et al. 2011)

Applicability	**Basis**	**Indices**	**Biocriteria Score** (percentile rank, if applicable)	**Biological Condition Gradient (BCG) Level**
Impounded River (Reaches 0-11)	"Peer Rivers" GRFIn at 16^{th} percentile of UMR range	GRFIn (Fish Index)	38 (16^{th} percentile)	4.0
	Consensus of Quadrisection of UMR and "Peer Rivers" data, and BCG tier 4 of UMR data	Wisconsin Large River IBI (Macroinvertebrate Index)	50	
Open River (Reaches 12-13)	"Peer Rivers" Missouri River GRFIn and GRMIn at 16^{th} percentile of UMR range	Missouri River GRFIn (Fish Index)	38 (16^{th} percentile)	4.0
		Missouri River GRMIn (Macroinvertebrate Index)	39 (16^{th} percentile)	NA

Use of Supporting Data to Address Uncertainty in Site Level Determination: As stated previously, biology is the primary driver of aquatic life use condition determination in this assessment methodology. However, direct application of IBIs to the assessment of aquatic life is most appropriate in cases when the waterbody being sampled is of a similar stream class for which the IBI was developed (e.g., great river in the impounded reach of the river system) and when the ambient conditions (e.g. flow, weather, temperature) are within the range of conditions present when the data used in the IBI development process were collected. Occasionally, extreme ambient conditions are present, which cause the sample collection process to be altered or compromised. Additionally, sampling error can result in the collection of data not accurately representative of the habitat, flow, or water quality conditions present. Variability in sampling conditions and sample error have led some states to require the use of a minimum of two samples in order to conduct an aquatic life use assessment. The methodologies selected for this project specify the collection of a single sample for each aquatic life use indicator, so it is reasonable to allow for an error estimate to be used when interpreting support of the relevant biocriterion. Therefore, if IBI scores fall within 5% of the biocriteria, the assessment process may make use of all relevant water quality, flow, habitat, and (reach-level) vegetation data when determining assessment status.

> Example: The macroinvertebrate IBI score falls one point below the biocriterion (within 5% of the possible range of scores). The fish IBI score falls 25 points above the biocriteria. A direct interpretation of the biocriteria would result in a site level assessment of non-support “poor” due to the macroinvertebrate score. The assessor could then take the following information into consideration if there is reason to suspect the final assessment is not reflective of the condition: *All water quality parameters, habitat values, and flow conditions indicate a supporting condition. Riparian zone is intact, and there are no immediate upstream stressors. The calculated reach-level score for vegetation meets the recommended threshold. Notes taken at the time of sampling don’t indicate anything out the ordinary during sample collection. The list of taxa present in the sample are suggestive of a healthy community, despite an IBI score that fails to meet the biocriterion.* In this example it would be reasonable to assign a final assessment of fully supporting to the invertebrate community, resulting in a site assessment of fully supporting “good.”

<u>Reach Level Assessment:</u> The designation of reach condition class for aquatic life will be based on the number of stations within the reach in which both indicator assemblages meet or exceed their respective biocriterion (Table 5). Reaches with less than 50% of stations supporting aquatic life use will be considered “poor.” Reaches with less than 75%, and greater than or equal to 50% of river miles supporting aquatic life use will be considered “fair.” Reaches with greater than or equal to 75% of stations supporting aquatic life use will be considered “good.”

Table 5. Criteria for assemblage, site-level, and reach level aquatic life condition class assessments

	Determining UMRBA assemblage level condition for aquatic life use		Determining UMBRA site-level condition class for aquatic life use		Determining UMRBA reach-level condition class for aquatic life use		
Assemblage	**Impounded River Biocriterion**	**Open River Biocriterion**	**Supporting**	**Non-supporting**	**Good**	**Fair**	**Poor**
Fish	GRFIn (fish index) score of 38 or greater	Missouri River GRFIn score of 38 or greater	Both assemblages meet their respective biocriterion	One or both assemblages fail to meet their respective biocriterion	Greater than or equal to 75% of the stations within the reach are reflective of a condition in which both assemblages meet their respective biocriterion.	Greater than or equal to 50% and less than 75% of the stations within the reach are reflective of a condition in which both assemblages meet their respective biocriterion.	Less than 50% of the stations within the reach are reflective of a condition in which both assemblages meet their respective biocriterion.
Macro-invertebrate	Wisconsin Large River IBI (macro-invertebrate index) score of 50 or greater	Missouri River GRMIn score of 39 or greater					

Submersed Aquatic Vegetation Indicator Use: Submersed aquatic vegetation (SAV) was initially recommended by Yoder et al. (2011) as an indicator to be used in reaches 0-6, the reaches where SAV is most commonly found on the UMR. Specifically, the recommendation was that the submersed macrophyte index (SMI) be used as an "override" indicator to determine final condition class when the invertebrate and fish assessments disagreed, particularly in light of the relative insensitivity of the macroinvertebrate index.

However, for purposes of this assessment methodology, vegetation is viewed as a separate indicator which can potentially provide a supporting "additional" assessment to augment the "primary" assessment using fish and macroinvertebrates and to address uncertainty in the results of the primary assessment (as described previously). The reason for separation of vegetation from the "primary" assessment is that the spatial intensity of plant site selection is different than the fish and invertebrate site selection methodology. Due to the patchiness of plant communities in the Upper Mississippi, the plants must be sampled on a much more intensive scale to ensure an adequate representation of the reach-wide community. While the fish and macroinvertebrate assessment will be based on 15 randomly-selected sites throughout each reach, the plant assessment would be based on 100 randomly-selected sites throughout each reach. The co-occurrence of a site-based plant assessment at each of the fish/invertebrate sites is therefore unlikely and thus cannot be utilized to directly determine the overall aquatic life assessment at each of the 15 reach-wide sites.

It is recommended that a parallel effort to collect SAV be maintained, and that the associated, reach-wide, vegetation-based assessment be used as supporting information in the overall aquatic life use assessment framework. The applicable threshold value for SMI is shown in Table 6 below.

Table 6. Aquatic Life Use Threshold for Submersed Macrophyte Index (SMI) (per Yoder, et al. 2011)

Basis	**Indices**	**Biocriteria Score (percentile rank)**	**Biological Condition Gradient (BCG) Level**
SMI (reaches 0-6 only), Mid-point of quadrisection UMR	SMI (Vegetation Index)	44 (41st percentile)	NA

Total Suspended Solids: Ongoing monitoring and research on the UMR conducted as part of the UMRR-LTRM program and other projects (e.g., UMRCC 2003, Giblin at al. 2010, Giblin 2017) suggest that levels of total suspended solids (TSS) can be used as an aquatic life indicator which, similar to SAV, can provide a supporting assessment for the primary assessment using fish and macroinvertebrates. For purposes of this methodology, information on TSS will be used to address uncertainty in the results of the primary assessment. Similar to the SAV indicator, the TSS indicator will apply to UMR assessment Reaches 0 through 6 (i.e., from Upper St. Anthony Falls downriver to Lock and Dam 13).

Monitoring data from both fixed station sites and probabilistic sites will be collected in assessment Reaches 0 through 6 during the five-year assessment period. These data will be summarized as described in Table 7 and compared to the thresholds for TSS identified in Table 8. The condition class suggested by TSS levels will be used to help interpret the condition class determined by results of biological monitoring for fish and macroinvertebrates (the primary aquatic life assessment indicators).

The overall TSS value for each reach will be calculated using fixed site and probabilistic site data over a five-year increment. For fixed sites, an annual growing season median will be calculated for each reach (June-September each year; n=5). For probabilistic sites, the median of the fifteen sites will be calculated for the year that probabilistic sampling is conducted by month (July- September; n=3). To calculate the overall TSS value for the reach, the annual medians from fixed site sampling (n=5) will be pooled with the monthly medians from probabilistic sampling (n=3). The overall reach median will be generated from this pooled set (fixed and probabilistic sampling pool; n=8) to give the reach TSS value. This pooled TSS median value for the reach will be evaluated based on criteria identified in Table 8.

Table 7. Calculating Summary Statistics for TSS Results

Fixed Site Sampling Per Reach, Where X= Sampling Event (n=20[1])

	June	July	August	September	Summary Statistic
Year 1	X	X	X	X	Year 1 Median
Year 2	X	X	X	X	Year 2 Median
Year 3	X	X	X	X	Year 3 Median
Year 4	X	X	X	X	Year 4 Median
Year 5	X	X	X	X	Year 5 Median

Probabilistic Sampling per Reach, Where X=Sampling Event (n=45)

	July	August	September
Year X (any single year, 1 to 5)	XXXXXXXXXXXXXXX	XXXXXXXXXXXXXXX	XXXXXXXXXXXXXXX
Summary Statistic	July Median	August Median	September Median

Table 8. Aquatic life use thresholds for total suspended solids (TSS). The summary statistic for comparison to the threshold is the overall (five-year) TSS value from June-September. To calculate the overall TSS value for the reach, the median from fixed site sampling (by year; n=5) will be pooled with the monthly median from probabilistic sampling (n=3). The median will be generated from this pool (fixed/probabilistic sampling pool; n=8) to generate the reach TSS value for assessment.

Determining UMRBA reach-level condition class for aquatic life use base on TSS:				
Source of data:	**Segment of River**	**Condition Class:**		
		Good	**Fair**	**Poor**
Fixed Station Monitoring median by year (n=5) ***and*** monthly median from Probabilistic Monitoring sampling (July-September) in one year of the five-year assessment period (n=3). Value will be calculated as the median of the pooled fixed and probabilistic values (n=8).	Above Lake Pepin	Overall summer median ≤ 32 mg/l.	Overall summer median > 32 mg/l but ≤ 40 mg/l.	Overall summer median > 40 mg/l
	Below Lake Pepin (i.e., below confluence with Chippewa River) to L&D 13	Overall summer median ≤ 16 mg/l.	Overall summer median > 16 mg/l but ≤ 30 mg/l.	Overall summer median > 30 mg/l

Use of Replicate Data in Aquatic Life Use Assessment: Resamples will be collected for fish and macroinvertebrate assemblages at a 10% rate (i.e., at two sites per reach). A primary purpose of resampling is to detect and examine any variation between results from a single sample site. Additionally, for the purpose of piloting monitoring and assessment, replicate data should be kept in consideration as the assessment is conducted. This means that, unless or until another approach is adopted, the assessor is given discretion to review all available data (initial and resample) and incorporate the sample for a site that appears to be most representative of condition. This flexible approach is intended to allow for the broadest incorporation of data as piloting and testing occurs. It is possible that a more prescriptive approach may be adopted based on knowledge gained during pilot testing.

[1] This assumes one fixed site per reach. Some reaches now have up to three fixed sites due to the presence of drinking water intakes. TSS would be available from all fixed sites, increasing both the n and the spatial spread of results.

Recreation Use Assessment

***Summary:** Use data for E. coli and chlorophyll-*a *to characterize recreational use attainment.*

The goal of recreation use monitoring is to assess the relative water quality condition for primary contact recreation use on the UMR. This assessment is based on the results of monitoring for two indicators of recreation use condition class: (1) indicator bacteria (*E. coli*) and (2) chlorophyll-*a*. Although levels of cyanotoxins (e.g., microcystin) are of concern for recreational uses, U.S. EPA criteria recommendations for cyanotoxins in recreational waters are currently in draft. When finalized, the U.S EPA recommendations for cyanotoxins may be used to update this methodology for recreation use assessments. Because the primary data source for recreation use assessments is the network of UMR fixed stations (Table 2), only reach-level (as opposed to both site-level and reach-level) condition class assessments will be developed for recreation use. The reach level condition class will be the lowest condition class suggested by either indicator bacteria or chlorophyll-*a* (Table 9).

Indicator 1: Indicator bacteria (E. coli)

Fixed Station Monitoring Network: Determination of the water quality condition of an assessment reach for recreation use is based in part on results of monitoring at UMR fixed stations and the extent to which levels of indicator bacteria (*E. coli*) meet or fail to meet a recreation season (April-October) threshold (126 cfu/100ml) as compared to the geometric mean or a statistical threshold value (410 cfu/100 ml), per U.S. EPA's 2012 *E. coli* criteria recommendations (U.S. EPA 2012). In addition, probabilistic monitoring will be used to generate supplemental data for levels of *E. coli* in each of the 14 UMRBA assessment reaches (see below).

If, over an assessment cycle of five years (N=35 samples per reach), the overall geometric mean of the samples per reach exceeds the threshold of 126 cfu/100, the water quality condition for supporting primary contact recreation uses will be assessed as "poor." If the geometric mean of the data does not exceed the threshold, but significantly greater than 10% of the samples collected over the five-year period exceed the statistical threshold value of 410 cfu/100ml, the water quality condition for supporting primary contact recreation uses will be assessed as "fair" (Table 9). Appendix 2 will be used to determine, for a given sample size, the number of threshold excursions that indicates a percentage significantly greater than 10%. The greater reliance and assessment severity accorded to the bacteria geometric mean is based on U.S. EPA guidance suggesting that, given sufficient data, the geometric mean is a more reliable measure of long-term water quality than is a single-sample-maximum (U.S. EPA 2006).

Supplemental Network: Reach-based Probabilistic *E. coli* monitoring: Results of reach-based probabilistic monitoring will be used in a supplemental fashion for assessment. This will help determine the extent to which the recreation condition class based on fixed station data reflects bacteria levels and condition class in other portions of the assessment reach. Additionally, these results will contribute to a more robust data set regarding potential pathogen presence on the UMR and may inform modifications to future CWA monitoring. Due to the considerable lengths of the 14 UMRBA assessment segments (ranging from 20 to 118 miles; with an average of approximately 60 miles), the results from a single fixed station provide a limited ability to assess bacterial levels throughout the entire UMRBA assessment segment. Thus, results of reach-based probabilistic monitoring for *E. coli* will be used to supplement results of fixed station monitoring to improve the ability to identify water quality condition class for recreation uses. Proposed methods by which data from these networks may augment the fixed station-derived assessment are described in Table 9 and in the following paragraphs.

Results of sampling for indicator bacteria (*E. coli*) at the 15 probabilistic sites per assessment reach will be used to determine the degree to which results of fixed-station bacteria monitoring reflect levels of indicator bacteria throughout the respective assessment reach. Due to the limited duration of this monitoring (one recreation season out of five), it will provide a relatively low-confidence assessment of recreation condition class throughout a given assessment reach. For each of the 14 assessment reaches, 15 probabilistic sites will be monitored three times during one recreation season (April-October) of the five-year assessment cycle.

The percentage of *E. coli* samples that exceeds the statistical threshold value (STV) of 410 cfu/100 ml will be calculated for the three monitoring rounds of probabilistic monitoring in a given assessment reach. The percentage of samples exceeding the STV will be used as supplemental data with results of fixed station monitoring to determine the final recreation use condition class for the five-year assessment period. For example:

> *In round 1 of probabilistic bacteria monitoring in year 1 in Reach 7 (from Lock & Dam 13 downriver to Iowa River), four of the 15 sample sites had E. coli levels above the STV of 410 cfu/100ml. Two of the 15 sites in the second round, and three of 15 sites in the third round of year 1 had E. coli levels that exceeded the STV. A total of nine of the 45 samples (20%) exceeded the STV over the three rounds of monitoring. As shown in Appendix 2, if eight of 45 samples exceed an assessment threshold, there is 90% confidence that significantly greater than 10% of the samples exceed the threshold. Thus, in this example, the number of samples that exceeded the STV (nine of 45) indicates that the percentage of samples greater than the STV is significantly greater than 10%, thus suggesting only a "fair" condition class for recreation use. If results of fixed station bacterial monitoring in Reach 7 had indicated a "good" condition class, the results of probabilistic monitoring would then be used in a supplemental fashion to downgrade the reach-level assessment of the recreation use condition class from "good" to "fair."*

Methods for determining recreation use condition class based on results of fixed station and probabilistic monitoring are summarized in Table 9. Given the considerable spatial and temporal variability in levels of indicator bacteria in rivers, and given the nature of the assessment (developed following the recreation season), **the assessment of relative water quality condition in a UMR assessment reach for supporting recreation uses should be considered a long-term characterization of bacterial levels in the UMR and should not be interpreted as a recommendation on the short-term suitability or safety of the assessment reach for primary contact recreation**.

***Indicator 2: Chlorophyll-*a**

In addition to levels of indicator bacteria, levels of chlorophyll-*a* will be used to assess recreation use condition class. The assessment thresholds for chlorophyll-*a* for assessing recreation uses are based on recommendations from the Minnesota Pollution Control Agency. MPCA's recommended river eutrophication criterion for southern Minnesota of 35 ug/l chlorophyll-*a* (MPCA 2013) and an upper threshold of 60 ug/l (Heiskary and Wilson 2005) will be used to determine the reach-level recreation condition class.

Chlorophyll-*a* samples will be collected and analyzed during the recreation season (April to October) from the UMRBA fixed stations (Table 2) and from the 15 probabilistic sites per reach in one year of the five-year assessment period. Fixed station chlorophyll-*a* data will be combined for June to September periods over the five-year assessment cycle (approximately 20 samples), and the overall average value will be compared to the thresholds for "fair" condition class and poor condition class. The use of the June-September index period for calculating average levels of chlorophyll-a is based on the index period used by MPCA for their eutrophication criteria and is based on the typical occurrence of severe blooms of algae during these warm summer months. Data for chlorophyll-a will be collected outside of the June-September period; i.e., in April, May and October. These data will be reviewed to ensure that the June-September index period is, in fact, appropriate for assessing condition class for recreation uses on the UMR.

The distinction between the "fair" and "poor" condition class assessments is based on the level of chlorophyll-*a* at which a "severe nuisance" bloom of algae is perceived by recreation users (>35 ug/l) versus the level at which a "very severe nuisance" bloom of algae is perceived (>60 ug/l) (Heiskary and Wilson 2005). An overall average value of chlorophyll-*a* between 35 and 60 ug/l will be indicative of a "fair" condition class while an overall average value greater than 60 ug/l will be used to identify "poor" condition class for recreation use (Table 9).

Sampling for chlorophyll-a at the 15 probabilistic sites per reach will be conducted three times during one recreation season of the five-year assessment period (a total of approximately 45 samples). The average value of chlorophyll-a will be calculated for each of the three rounds of probabilistic monitoring. If the average value of chlorophyll-*a* for any of the three rounds of monitoring exceeds 35 ug/l, the recreation condition class will be assessed as "fair" (Table 9).

*Table 9. Methods for assessing reach-level condition class for UMR recreation uses based on levels of indicator bacteria and levels of chlorophyll-*a*. Fixed station geometric means for indicator bacteria and overall average levels of chlorophyll-*a *are based on five years of monthly monitoring during the recreation season (April-October for indicator bacteria and June-September for chlorophyll-a). Probabilistic stations are sampled for indicator bacteria and chlorophyll-a three times during one year of a five-year assessment cycle.*

	Determining UMRBA reach-level condition class for recreation use:		
Source of data:	**Good**	**Fair**	**Poor**
Fixed Station Monitoring during recreation season with monthly sampling over 5 years	Overall geometric mean ≤ 126 cfu/100 ml & < 10% of samples exceed STV (410 cfu/100 ml) and the overall average chlorophyll-a level is less than 35 ug/l	Overall geometric mean ≤ 126 cfu/100 ml but significantly > 10% of samples exceed STV (410 cfu/100 ml) or the overall average chlorophyll-a level is between 35 and 60 ug/l	Overall geometric mean > 126 cfu/100 ml or the overall average chlorophyll-a levels is 60 ug/ or greater
Probabilistic Station Monitoring during recreation season at 15 sites sampled 3 times in 1 of 5 years	On average over the three rounds of sampling/year, the percentage of probabilistic samples exceeding the STV (410/100 ml) is not significantly > 10% and the overall average of chlorophyll for all three rounds of probabilistic samples is less than 35 ug/l	On average over the three rounds of sampling in 1 of 5 years, significantly greater than 10% exceed the STV of 410 cfu/100 ml, or the overall average level of chlorophyll of the probabilistic samples is 35 ug/l or greater for any of the three rounds of sampling	*Category not used with results of probabilistic monitoring.*
Overall Condition Class	***Fixed station geometric mean ≤ 126 cfu/100 ml & < 10% of samples exceed STV (410 cfu/100 ml), and average percentage of probabilistic samples exceeding the STV is not significantly > 10%, and the overall average level of chlorophyll-a is less than 35 ug/l***	***Fixed station geometric mean < 126 cfu/100 ml but significantly > 10% of samples exceed STV (410 cfu/100 ml) or average percentage of probabilistic samples exceeding the STV is significantly > 10% or the overall average chlorophyll-a level is between 35 and 60 ug/l***	***Fixed station geometric mean > 126 cfu/100 or the overall average chlorophyll-a level is 60 ug/l or greater***

Drinking Water Use Assessment

Summary: *Use the results of fixed site monitoring, as well as the presence of extraordinary treatment (i.e., beyond conventional), to characterize drinking water use attainment.*

For UMR assessment reaches with drinking water designated intake(s) present (i.e., Reaches 7-13), determination of the water quality condition class for this use will be based on results of monitoring of source (raw) water from year-round main-stem fixed station monitoring. As noted previously, fixed sites in proximity to drinking water intakes will be monitored for a suite of drinking-water relevant contaminants. In some cases, a single sampling site may be appropriate to characterize water quality for multiple intakes which are located in close proximity (e.g., in the Quad Cities). In addition, the drinking water condition class will be based on the need for extra-ordinary treatment of raw water at UMR water supply utilities. For purposes of this methodology, "conventional treatment" is defined as follows:

> *Water treatment that consists only of "coagulation, sedimentation, filtration, storage and chlorination, or other equivalent treatment processes." (IL EPA 2014:52)*

Similar to assessments of condition class for UMR aquatic life uses, determinations of condition for the designated drinking water use will be developed on a site-level and reach-level basis. Both site-level and reach-level condition classes for drinking water use will be based on three indicators of drinking water use condition:

1. Results of monitoring for individual parameters with Safe Drinking Water Act (SDWA) maximum contaminant levels (MCLs) (e.g., nitrate, arsenic, atrazine) as well as those with other established thresholds such as action levels or secondary standards (e.g., lead, copper, zinc)
2. Results of monitoring for the cyanotoxins microcystin and cylindrospermopsin
3. The use of extraordinary water treatment by a facility to meet applicable MCLs

While there is not a probabilistic monitoring design for this use, the results of monitoring from fixed and targeted monitoring sites will be used to develop a reach-level determinations of condition class.

Site-level determination: The relative water quality condition for supporting drinking water use at individual monitoring sites will be determined by comparison of contaminant concentrations to drinking water use assessment thresholds as listed in Appendix 3. For the purposes of this shared assessment, the assessment thresholds are the Safe Drinking Water Act (SDWA) maximum contaminant levels (MCLs), including action levels for copper and lead, as well as selected secondary drinking water standards. It is recognized that these MCLs have been developed for application to finished (treated) water under the SDWA. In this assessment context, however, they are utilized as a standard set of values which can be indicative of the relative condition of a surface water for supporting drinking water uses. In addition to the thresholds in Appendix 3, results of monthly monitoring for the cyanotoxins microcystin and cylindrospermopsin will be compared to guidelines from U.S. EPA (2015) to determine drinking water condition class.

The drinking water condition class for an assessment site would be identified as “good” if, during the five-year assessment period, all three of the following conditions are met:

1. all annual averages for drinking water contaminants at a monitoring site are below their respective threshold values, and
2. there are *no* results of nitrate above the 10 mg/l MCL, of microcystin above the 0.3 ug/l assessment threshold or of cylindrospermopsin above the 0.7 ug/l assessment threshold, and
3. conventional treatment technology is sufficient for water utilities in proximity to a targeted monitoring site to meet MCLs in finished drinking water.

If, for any parameter, an annual average exceeds its drinking water assessment threshold during any one year in the five-year period, the condition class will be assessed as “poor.” For nitrate and the cyanotoxins microcystin and cylindrospermopsin, the occurrence of one excursion beyond the respective assessment threshold over the five-year period will indicate a “fair” condition class, and more than one excursion over the five-year assessment period will indicate a “poor” site-level condition class. This site-level approach and the approaches for identifying the “fair” condition class for nitrate, microcystin, and cylindrospermopsin are summarized in Table 10.

Any treatment technology for a raw water source that is needed in addition to conventional treatment to meet MCLs and maintain public health is considered *extra-ordinary* treatment. The use of extra-ordinary treatment at any UMR water utility will result in a site-level condition class assessment for drinking water use of “fair.”

<u>Reach Level Assessment:</u> Due to (1) the lack of a probabilistic monitoring design for assessing the condition class for drinking water use, and (2) the sometimes clustered occurrence of water supply utilities and their intakes in urban areas, the development of a probabilistic-based reach-level assessment of condition class for drinking water use is not possible. Thus, the reach-level assessment of condition class for drinking water use will be based on the lowest site-level condition class within that reach. This assessment approach is summarized in Table 11.

Table 10. Methods for determining site-level condition class for UMR drinking water uses. Data will be generated by monthly monitoring at fixed stations over the five-year assessment period (Table 2) and at UMR water treatment facilities (Table 3). All indicators are applied independently to determine condition class. This table is adapted from Ohio EPA (2015) and WDNR (2014). Condition class determinations will be made only in the UMRBA assessment reaches that are designated for drinking water uses in state water quality standards: Reaches 7-13 (i.e., downriver from Lock & Dam 13 at Clinton, Iowa).

Indicator	**Condition Class:**		
	Good	**Fair**	**Poor**
Nitrate	No excursions* above the 10 mg/l MCL	One excursion above the 10 mg/l MCL	Two or more excursions above the 10 mg/l MCL
Pesticides	Annual average does not exceed WQ threshold	Running quarterly average is greater than the WQ threshold	Annual average exceeds WQ threshold
Other contaminants	Annual average does not exceed WQ threshold	Maximum sample value is greater than the WQ threshold	Annual average exceeds WQ threshold
Microcystin	No excursions above the assessment threshold of 0.3 ug/l**	One excursion above the assessment threshold of 0.3 ug/l	More than 1 excursion above assessment threshold of 0.3 ug/l
Cylindrospermopsin	No excursions above the assessment threshold of 0.7 ug/l**	One excursion above the assessment threshold of 0.7 ug/l	More than 1 excursion above assessment threshold of 0.7 ug/l
Level of treatment	Conventional treatment sufficient to meet MCLs in finished water	Extra-ordinary treatment needed to meet MCLs in finished water	*Category not used*

**Excursions must be at least 30 days apart in order to capture separate or extended source water quality events.*
***Drinking water guidelines for microcystin-LR and cylindrospermopsin are taken from U.S. EPA (2015).*

Table 11. Determining reach-level condition class for drinking water uses within a UMRBA assessment reach. The basis for this assessment is the lowest site-level condition class within a reach during the five-year assessment period.*

Source of Data	**Assessment Statistic:**	**Determining UMRBA reach-level condition class for drinking water use:**		
		Good	**Fair**	**Poor**
Results of monthly monitoring for parameters with SDWA MCLs (Appendix 3) or other assessment thresholds over a five-year period and information on water treatment methods	Site-level condition class determination	All site-level determinations for a given assessment reach suggest “good” water quality condition	The lowest site-level condition class within an assessment segment over the five-year period is “fair.” Or, use of extraordinary treatment technology to meet MCLs.	The lowest site-level condition class within an assessment segment over the five-year period is “poor.”

**Condition class determinations will be made only for the UMRBA assessment reaches that are designated for drinking water uses in state water quality standards: Reaches 7-13 (i.e., downriver from Lock & Dam 13 at Clinton, Iowa).*

Fish Consumption Use Assessment

> ***Summary:*** *Use the results of fish tissue sampling from probabilistic sites, as well as the presence of fish consumption advisories, to determine fish consumption use attainment.*

The goals of UMR CWA fish consumption use monitoring are to (1) determine, based on results of fish contaminant monitoring, whether the condition class of the fish consumption use in each of the 14 UMRBA assessment reaches is good, fair, or poor, (2) identify longitudinal patterns and trends over time in levels of fish contaminants, and (3) provide data to the individual states in the UMR for purposes of their Section 305(b) assessments and Section 303(d) listings as well as for their fish consumption advisory processes. Both site-level determinations and reach-level assessments of condition class will be developed. In addition, separate reach-level fish consumption condition classes will be developed for the predator species and the bottom-feeding species monitored for fish contaminants.

To accomplish these goals, samples of skin-on fillets from three to five bottom-feeding fish and from top predator fish species will be collected from three to five randomly-chosen sites of the 15 probabilistic sites per reach during one year of the five-year assessment period, resulting in no fewer than 10 fish of each species group (trophic level) collected per assessment reach. All samples will be analyzed for PCBs and mercury. Results of these analyses will be used to determine the condition class for fish consumption use. The results of probabilistic monitoring of fish contaminant levels can identify reach-based spatial (longitudinal) patterns in fish contaminant levels in the UMR. In addition, repeating the probabilistic monitoring of levels of fish contaminant monitoring in the 14 UMRBA assessment segments at five-year intervals may allow the detection of trends in contaminant levels over time.

<u>Site-level determination</u>: The identification of water quality condition class for fish consumption uses will be determined by comparing the average trophic level tissue concentrations of mercury and PCBs to the respective assessment thresholds identified in Table 12. The UMR water quality condition thresholds for fish consumption use are based on (1) information in Chapter 6 (Determination of impairment based on fish consumption advisories) of the UMRBA report *Upper Mississippi River fish consumption advisories: state approaches to issuing and using fish consumption advisories on the Upper Mississippi River* (UMRBA 2005), (2) information from Ohio EPA (2010), and (3) from the Great Lake Consortium for Fish Consumption Advisories (Tom Hornshaw, Illinois EPA).

The overall site-level condition for fish consumption use will be determined by the lowest condition class level at a site regardless of the contaminant or the fish species sampled. The overall site-level condition class will be used to develop the reach-level condition class. In addition to the overall site-level condition class, a separate site-level condition class assessments will be developed for predator fish species (e.g., Walleye (*Sander vitreus*), black basses (*Micropterus* spp.)) and for the bottom feeder trophic level (Common Carp, *Cyprinus carpio*) with the lowest condition class determining the reach-level trophic condition class. Determining trophic level-specific condition classes is necessary to track the relative impacts on condition class of mercury (primarily a contaminant of predator fish species) versus PCBs which are primarily contaminants of bottom-feeding fish species. These trophic level condition classes will be reported separately from the reach-level condition class. Note that while Common Carp is a bottom-feeding species that is readily available river-wide, discussion with state fish contamination experts suggest that it will be necessary to select differing predator species among reaches as no single predator species appears to be abundant enough to allow for collection throughout the UMR.

Reach-level assessment: The reach level assessment of condition class for fish consumption use will be based on the following: (1) the lowest site-level condition class within that reach (Table 12) and (2) the existence of active state-issued fish consumption advisories for any portion of the assessment reach (Table 13). The lowest condition class suggested by either the site-level condition class or by the existence of a fish consumption advisory will determine the overall reach condition class for the fish consumption use.

Table 12. UMRBA assessment thresholds (mg/kg or ppm) for levels of toxic contaminants in fish tissue. Average levels of PCBs and mercury for each trophic level (predator and bottom-feeding species) are compared to the assessment thresholds to determine fish consumption condition class.

Contaminant	**Water Quality Condition Class**			**Rationale**
	Good	**Fair**	**Poor**	
PCBs	≤0.2	>0.2 but ≤ 2.0	>2.0	A PCB concentration of 0.2 mg/kg in fish tissue is a threshold of concern and is a level at which restricted consumption advisories may be issued. A concentration of PCBs greater than 2.0 mg/kg is considered a "do not eat" threshold by many states
Mercury	≤0.2	>0.2 but ≤ 1.0	>1.0	A methyl-mercury concentration of 0.2 mg/kg in fish tissue is a threshold of concern and is a level at which restricted consumption advisories may be issued. A concentration of methyl-mercury greater than 1.0 mg/kg is considered a "do not eat" threshold by many states.

Table 13. Determining reach-level condition class for fish consumption use in UMRBA assessment reaches based on existence of active state-issued fish consumption advisories.

	Water Quality Condition Class		
	Good	**Fair**	**Poor**
Fish Consumption Advisory Level:	No more restrictive advisory than one meal per week	Most restrictive advisory is a one meal per month for any species	Most restrictive advisory is a "do not eat" advisory for any species

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APPENDICES

Appendix 1

Comparison of ORSANCO's assessment approach to UMRBA approach.

Assessed Use	ORSANCO	UMRBA	Comparability
Aquatic life	Combination of physical/chemical data and biological (fish) monitoring, but biological monitoring is basis of assessment.	Combination of physical/chemical data and biological (fish) monitoring, but biological monitoring is basis of assessment.	Similar approach, but differences in biotic indexes may give a different picture of ALU support.
Recreation	Use either geometric means or single-sample maximum criteria for either fecal coliforms (200 & 400 cfu/100 ml) or E. coli (130 & 240 cfu/100 ml).	In general, a similar approach for indicator bacteria; ORSANCO does not use chlorophyll or microcystin.	Differing approach: due to use of chlorophyll & microcystin.
Drinking water	Use chemical data from bi-monthly & clean metals monitoring and questionnaires sent to DW utilities to assess impacts caused by source water conditions. Impairments indentified is >10% of samples exceed HH criteria or if source water quality causes MCL violations in finished water.	Use more than 1 excursion of WQ criteria for nitrate and microcystin, and use annual average for pesticides; also factor-in level of treatment technology used.	Differing approach: ORSANCO relies on 10% rule; UMRBA uses annual averages and >1 excursion during assessment cycle.
Fish consumption	Use concentrations of PCBs, dioxins, and mercury in fish and water to assess this use. Collects between 45 to 60 fish samples annually. Measure PCBs, dioxins, and mercury in water. PCB & dioxin impairment based on water concentrations; Hg assessment based on tissue samples.	Based on Table 3 in the Recommended Monitoring Plan, it would appear that UMR fish consumption assessments will be based on tissue-based contaminant concentrations and not on water column concentrations of, for example, PCBs and mercury.	UMRBA does not include a water column component in assessing this use. Regardless, variations in impairment thresholds will likely cause assessment differences.

Appendix 2

Sample size and number of exceedances required to determine an impaired designated use (10% exceedance) to maintain a greater than 90 percent confidence level as reported by Lin et al. (2000).

Minimum number of exceedances required to maintain a >90% confidence that a designated use is impaired (10% exceedance).					
Sample Size (n)	Number of observations exceeding required to define an impaired use	Confidence Level	Sample Size (n)	Number of observations exceeding required to define an impaired use	Confidence Level
10	3	0.930	56	10	0.951
11	3	0.910	57	10	0.945
12	4	0.974	58	10	0.940
13	4	0.966	59	10	0.933
14	4	0.956	60	10	0.927
15	4	0.944	61	10	0.920
16	4	0.932	62	10	0.913
17	4	0.917	63	10	0.905
18	4	0.911	64	11	0.948
19	5	0.965	65	11	0.943
20	5	0.957	66	11	0.938
21	5	0.948	67	11	0.932
22	5	0.938	68	11	0.926
23	5	0.927	69	11	0.920
24	5	0.915	70	11	0.913
25	5	0.902	71	11	0.906
26	6	0.960	72	12	0.947
27	6	0.953	73	12	0.942
28	6	0.945	74	12	0.937
29	6	0.936	75	12	0.931
30	6	0.927	76	12	0.926
31	6	0.917	77	12	0.920
32	6	0.906	78	12	0.913
33	7	0.958	79	12	0.907
34	7	0.952	80	13	0.946
35	7	0.945	81	13	0.942
36	7	0.937	82	13	0.937
37	7	0.929	83	13	0.931
38	7	0.920	84	13	0.926
39	7	0.911	85	13	0.920
40	7	0.900	86	13	0.914
41	8	0.952	87	13	0.908
42	8	0.946	88	13	0.901
43	8	0.939	89	14	0.941
44	8	0.932	90	14	0.937
45	8	0.924	91	14	0.932
46	8	0.916	92	14	0.927
47	8	0.907	93	14	0.921
48	9	0.954	94	14	0.915
49	9	0.948	95	14	0.910
50	9	0.942	96	14	0.903
51	9	0.936	97	15	0.941
52	9	0.929	98	15	0.937
53	9	0.922	99	15	0.932
54	9	0.914	100	15	0.927
55	9	0.906			

Appendix 3

UMRBA assessment thresholds to determine support of drinking water uses. Values taken from U.S. EPA website **http://water.epa.gov/drink/contaminants/** unless otherwise noted.

Contaminant	Safe Drinking Water Act Maximum Contaminant Level or Other Value as Noted	Notes
Alachlor	2 ug/l	
Antimony	6 ug/l	
Arsenic	10 ug/l	This is a *total* arsenic value.
Atrazine	3 ug/l	
Barium	2000 ug/l	
Benzene	5 ug/l	
Benzo(a)Pyrene	0.2 ug/l	
Beryllium	4 ug/l	
Cadmium	5 ug/l	
Carbofuran	40 ug/l	
Carbon Tetrachloride	5 ug/l	
Chlordane	2 ug/l	
Chloride	250 mg/l	This is a secondary standard.
Chlorobenzene	100 ug/l	
Chromium VI	100 ug/l	This is a *total* chromium value.
Copper	1,300 ug/l	This is an *action level*, rather than an MCL.
Cyanide	200 ug/l	
Dalapon	200 ug/l	
Dibromochloropropane (DBCP)	0.2 ug/l	
o-Dichlorobenzene	600 ug/l	
p-dichlorobenzene	75 ug/l	
1,2-Dichloroethane	5 ug/l	
1,1-Dichloroethylene	7 ug/l	
cis-1,2-Dichloroethylene	70 ug/l	
trans-1,2-Dichloroethylene	100 ug/l	
Dichloromethane	5 ug/l	
1,2-Dichloropropane	5 ug/l	
Dinoseb	7 ug/l	
2,3,7,8-TCDD (Dioxin)	0.00003 ug/l	
Diquat	20 ug/l	
2,4-D	70 ug/l	
Endothall	100 ug/l	
Endrin	2 ug/l	
Ethylbenzene	700 ug/l	
Ethylene dibromide	0.005 ug/l	
Di(2-ethylhexyl)adipate	400 ug/l	
Bis(2-ethylhexyl)phthalate	6 ug/l	
Fluoride	4,000 ug/l	
Glyphosate	700 ug/l	
Heptachlor	0.4 ug/l	
Heptachlor epoxide	0.2 ug/l	
Hexachlorobenzene	1 ug/l	
Hexachlorocyclopentadiene	50 ug/l	

Contaminant	Safe Drinking Water Act Maximum Contaminant Level or Other Value as Noted	Notes
Lead	15 ug/l	This is an *action level*; the former MCL of 50 ug/l was rescinded when the action level put into place.
Gamma-BHC (Lindane)	0.2 ug/l	
Mercury (II)	2 ug/l	This is an inorganic mercury value.
Methoxychlor	40 ug/l	
Microcystin	1 ug/l	
Nitrate as N	10 mg/l	
Nitrite as N	1 mg/l	
Oxamyl (Vydate)	200 ug/l	
Pentachlorophenol (PCP)	1 ug/l	
Phenols	1 ug/l	Value taken from Illinois water quality standards (IAC 302.304).
Picloram	500 ug/l	
Polychlorinated Biphenyls	0.5 ug/l	
Selenium	50 ug/l	
Silver	100 ug/l	This is a secondary standard.
2,4,5-TP (Silvex)	50 ug/l	
Simazine	4 ug/l	
Styrene	100 ug/l	
Tetrachloroethylene	5 ug/l	
Thallium	2 ug/l	
Toluene	1,000 ug/l	
Toxaphene	3 ug/l	
1,2,4-trichlorobenzene	70 ug/l	
1,1,1-trichloroethane	200 ug/l	
Trichloroethylene	5 ug/l	
Trihalomethanes (total)	80 ug/l	
Vinyl chloride	2 ug/l	
Xylenes (total)	10 mg/l*	
Zinc	5 mg/l	This is a secondary standard.