

Developing Numeric Nutrient Criteria for Mississippi's Surface Waters



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ENVIRONMENTAL QUALITY

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I. Introduction

The United States Environmental Protection Agency (EPA) has published recommendations of water quality criteria for nutrients under section 304(a) of the Clean Water Act (66 FR 1671). EPA has stated that they developed the recommended criteria with the intention that these values serve as starting points for states to develop more refined, state specific, numeric nutrient criteria using EPA technical guidance for each water body type along with other scientifically defensible approaches. EPA emphasized that the states have several options available to them in developing and adopting water quality criteria for nutrients. One of the EPA recommended approaches is that wherever possible, the states develop nutrient criteria that fully reflect localized conditions and protect specific designated uses using the processes outlined in the EPA technical guidance manuals. In addition, EPA recommended that states develop a plan for nutrient criteria development that outlines the process for how and when they intend to adopt numeric nutrient criteria into their water quality standards.

The purpose of this plan is to provide EPA with a better understanding of Mississippi's approach to nutrient criteria development. The plan allows the State to take advantage of the flexibility to develop criteria that reflect local water conditions as opposed to EPA's national criteria recommendations. The Mississippi Department of Environmental Quality (MDEQ) considers this plan to be an interactive and adaptive plan and will continue to work with EPA Region IV to refine the plan as needed during the coming years. Because of the significance and magnitude of this undertaking, MDEQ has decided to revise this plan to reflect updated water quality data collection, assessment activities, and criteria development activities that have been completed. It is realistic to expect that as new information is considered, some steps may take longer or shorter than anticipated. Data collection, assessment activities, and criteria development activities may also be limited if sufficient funding and resources are not available.

MDEQ has also been acutely aware of on ongoing national efforts and new guidance released by the EPA including a guidance document regarding the use of combined criteria (EPA 2013) and recent recommendations on the sequencing of criteria development. Additionally MDEQ pays attention to the concerns of Mississippi's stakeholders, the foremost of which is how MDEQ intends to implement nutrient criteria once it has been adopted, and we have worked the past two years to alleviate these concerns. These efforts among others have led to a postponement in the initial timeline set forth in the previous plan and will be discussed further in this document.

MDEQ's updated Nutrient Criteria Development Plan will discuss past objectives and successes, current objectives, the status of nutrient criteria development per each water body type including Lakes and Reservoirs, Wadeable and Non-Wadeable Streams and Rivers, Coastal and Estuarine Waters, and Delta Waters, and a timeline regarding the adoption of nutrient criteria for each of these water bodies.

II. Progress and Objectives

The previous version of MDEQ's Nutrient Criteria Development Plan included the following objectives in its introduction: (1) establish a Nutrient Work Group or Groups comprised of Federal and State experts to review historical nutrient data, identify data gaps, help develop MDEQ's approach, recommend additional monitoring and data collection, recommend water body classification systems, review data, and analyze data; (2) periodically prepare reports which present MDEQ's progress of developing nutrient criteria; and (3) establish a nutrient technical advisory group to verify the scientific defensibility of the numeric nutrient criteria for Mississippi's water bodies, (4) establish an implementation workgroup to develop procedures for the implementation of nutrient criteria, and (5) MDEQ's submittal of scientifically defensible numeric nutrient criteria to EPA for review and approval in accordance with agreed-upon timelines. The purpose of this section is to provide an update on the progress of each of these objectives, introduce ancillary projects that have been completed during the course of nutrient criteria development thus far, and describe MDEQ's new objectives for nutrient criteria development going forward.

A. Nutrient Criteria Task Force

MDEQ established the Nutrient Task Force (NTF) in 2000 consisting of state and federal experts. The group met from 2000-2004 and reviewed historical data, identified data gaps, developed Mississippi's initial Nutrient Criteria Development Plan, and recommended additional monitoring and data collection. During this time they formed committees to focus on different water body types and recommended data needs in order to more thoroughly document nutrient conditions and characteristics to be able to derive scientifically defensible nutrient criteria. The NTF suggested that criteria should be developed for Lakes and Reservoirs, Streams and Rivers, and Coastal and Estuarine Waters.

B. Nutrient Criteria Technical Advisory Group

In 2010, MDEQ established the Mississippi Nutrient Technical Advisory Group (TAG). The mission of the TAG is to provide technical expertise and regional knowledge to MDEQ for the development of scientifically defensible nutrient criteria. The TAG consists of members representing multiple state and federal agencies and universities and assists the nutrient criteria development process in the following ways:

- Helps develop the analytical approach and process;
- Provides input on the scientific defensibility of proposed methods;
- Recommends additional methods or analyses;
- Provides input on available data and recommends additional potential sources;
- Provides input of the defensibility of the analyses and/or the conclusions drawn from the analyses; and,
- Recommends additional analyses, corrections, or modifications to strengthen the scientific defensibility.

The Mississippi Nutrient TAG has been meeting approximately quarterly throughout the criteria development process since its establishment and will continue to meet until the development process has been concluded.

C. Implementation Workgroup

MDEQ recognizes that implementation is an important part of the nutrient criteria development process. In 2013, MDEQ established an interdivisional implementation workgroup to work on implementation questions raised by MDEQ staff, partners, and stakeholders such as monitoring, permitting, and assessment implications. The Workgroup developed a survey to be sent out to stakeholders to assess their level of interest on these issues to ascertain what they felt was a priority and then formed subcommittees to begin developing responses to those questions. The outcome of this collaborative effort between MDEQ and the EPA has produced a preliminary document outlining how the state will implement nutrient criteria once they have been adopted. MDEQ will continue to work on solving these implementation concerns as the nutrient criteria process proceeds.

D. Technical Support Documents

MDEQ has developed several technical support documents showing the progress of data collection and analyses for nutrient criteria development. These documents are publicly available on MDEQ's website and are listed below:

Lakes/Reservoirs:

- Nutrient Assessments Supporting Development of Nutrient Criteria for Mississippi Lakes and Reservoirs (July 2007)
- Revised Draft Nutrient Thresholds to Protect Aquatic Life Uses in Mississippi Lakes and Reservoirs (June 2011)
- Revised Draft Nutrient Thresholds to Protect Aquatic Life Uses in Mississippi Lakes and Reservoirs (June 2013)
- Analysis Addendum: Water Column and Hypolimnetic Oxygen Depletion Responses to Chlorophyll Levels in Mississippi Lakes/Reservoirs (July 2015)

Streams/Rivers:

- Draft Nutrient Criteria to Protect Aquatic Life Uses in Mississippi Non-Tidal Streams and Rivers (June 2009)
- Revised Draft Nutrient Thresholds to Protect Aquatic Life Uses in Mississippi Non-Tidal Streams and Rivers (June 2011)

Coastal/Estuarine:

- Monitoring to Establish Reference Conditions for Nutrients and Algal Conditions in Estuarine and Coastal Water Bodies (April 2009)

E. Current Objectives

MDEQ's Nutrient Criteria Development Plan includes the following objectives for MS's continued development of numeric nutrient criteria:

- MDEQ will continue to receive technical support and guidance of the criteria development process by the MS Nutrient TAG;
- MDEQ will continue efforts to plan and document the implementation details for numeric nutrient criteria;
- MDEQ will continue to keep stakeholders informed throughout the process through stakeholder update sessions, as well as, through any other opportunity to provide updates to the public via newsletters, meetings, the MDEQ webpage, etc.; and,
- MDEQ will submit scientifically defensible numeric nutrient criteria that are appropriate and protective of MS's surface waters to EPA for review and approval in accordance with agreed-upon timelines.

III. Methodological Approaches and Progress

The overall goal of MDEQ is to establish scientifically defensible, protective nutrient criteria developed using a transparent, well-documented process. According to the Clean Water Act, criteria can take form as a load, concentration, or a narrative statement. Currently MDEQ's nutrient criteria is a purely narrative statement and we are working to translate this into a numeric concentration or load that will be protective of designated uses through the assistance of the TAG and the input of our stakeholders.

The overall approach for deriving numeric nutrient criteria is as follows:

- Compiling defensible datasets,
- Correct classification of water bodies,
- Data analysis to identify candidate endpoints, and
- Deciding on the most defensible and protective criteria from these endpoints

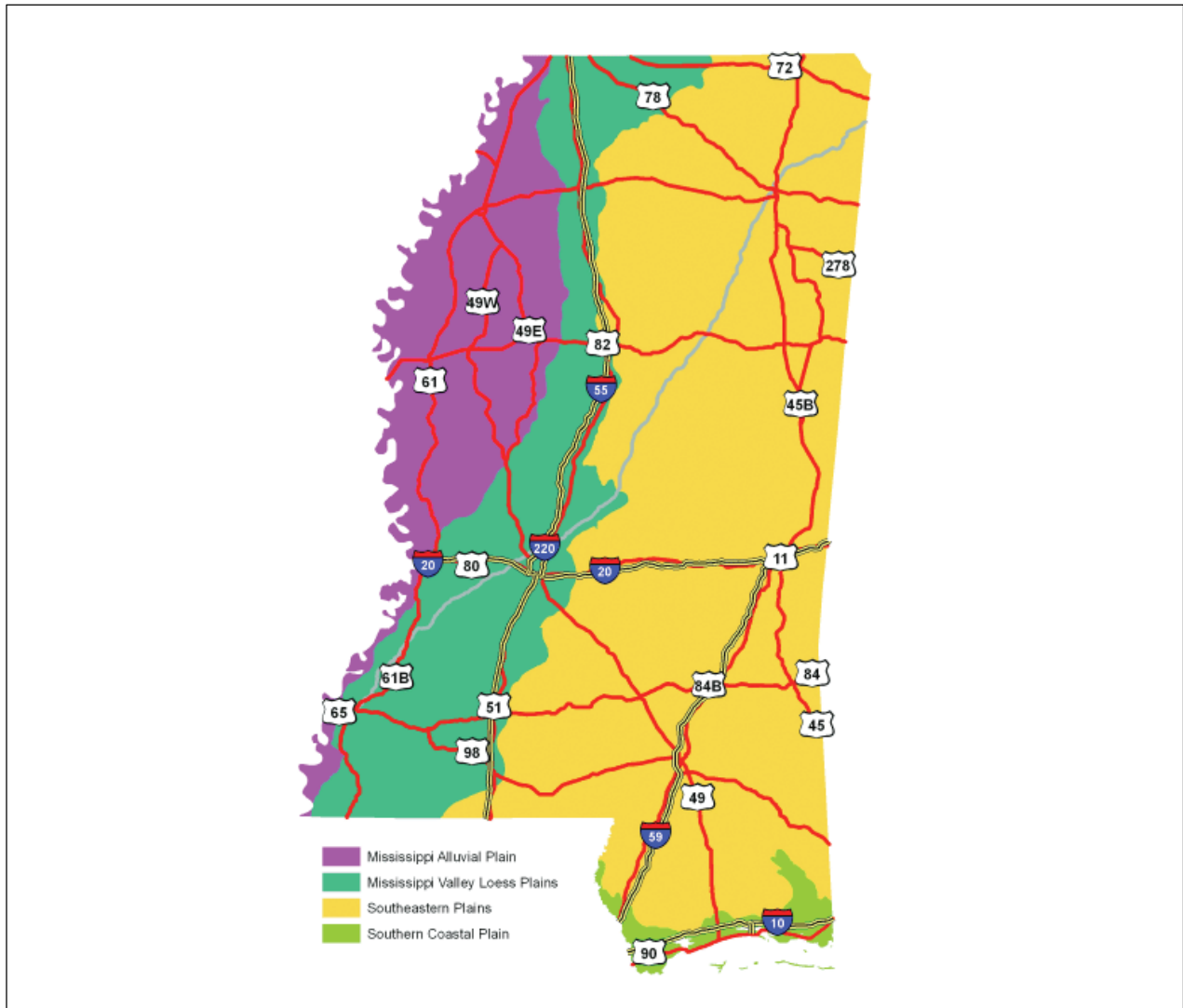
MDEQ has also taken into account EPA guidance (EPA 2000, 2001) and will continue to follow any forthcoming guidance released by the EPA to keep up with the latest scientific and policy developments.

A. Data Compilation

MDEQ screened existing MDEQ, STORET, USGS, USDA, USACE and other databases for information on water bodies with respect to nutrient-related parameters and information. This information will be used to establish a perspective on the condition of a given water body and to help establish trends in trophic conditions and, when possible, to inform the nutrient criteria development process. Data that are to be used in the criteria development process must meet certain data quality measures. Data used for nutrient criteria analysis all adhere to the MDEQ Quality Assurance Project Plan (QAPP) for the Section 106 monitoring and assessment program.

B. Classification

Mississippi is covered by EPA's aggregate ecoregions IX, X, and XII. Data are examined on the basis of Level III and Level IV sub-ecoregions (Figure 1). Where significant differences exist between sub-ecoregions, the nutrient criteria may be established at the sub-ecoregion level. Where no significant difference is found between sub-ecoregions, the data will be aggregated back to the ecoregion level. It is also possible that Omernik's ecoregion boundaries may be modified, or that further delineation within a Level IV sub-ecoregion may result based on analysis of the data. MDEQ may develop additional classification schemes as appropriate to characterize and classify Mississippi's waters for assessment and criteria development efforts.

Figure 1. Mississippi Level III ecoregions.

C. Data Analysis Approach – Multiple Lines of Evidence

Mississippi will be deriving nutrient criteria based on a multiple lines of evidence approach as recommended by USEPA guidance (EPA 2000, 2001). In a multiple lines of evidence approach multiple approaches are considered in criteria development and the endpoints of each approach are weighed to derive the final criteria. In using this approach MDEQ will consider some or all of the following approaches to derive the criteria for each water body type.

1. Reference Approach

In the reference site approach the goal is to quantify conditions in sites minimally or least disturbed by human activity. A minimally disturbed condition represents conditions in the absence of significant human disturbance. The least disturbed reference condition approach compares background nutrient concentrations at similar minimum human land use (disturbance) between regions. The best attainable reference condition is a type of

least disturbed reference condition where the biological condition has attained the biological threshold in a region. Using a reference condition approach, water quality criteria are derived from data collected at least disturbed site, and an upper percentile of the data is taken to establish the numeric criteria. This has been approved by EPA to be an acceptable and scientifically defensible approach, and some states have used it to derive their criteria. The reference condition may also be estimated using regression models of land use versus nutrient concentrations, an approach referred to as modeled reference condition.

2. Stressor-Response Approach

In a stressor-response approach a link is found between the nutrient concentration and an indicator that corresponds to a particular aquatic life use either as a direct or indirect response. A direct response includes things such as turbidity or dissolved oxygen and an indirect response with nutrient concentrations would include the use of macroinvertebrate metrics and fish metrics. This relationship is then modeled using simple linear and non-linear regression and a nutrient concentration derived from that concentration coinciding with protection of the desired response condition.

3. Scientific Literature

The purpose of a scientific literature review is to identify approaches being used by other agencies or universities that may be used to inform the process in Mississippi. A literature review can also highlight criteria values defined in other areas through application of similar methods recommended by EPA for establishing numeric nutrient criteria.

4. Mechanistic Modeling

Mechanistic modeling can be a useful tool in the criteria development process by offering a way to control confounding factors while evaluating potential stressors. Although mechanistic modeling can be somewhat data intensive, they provide an important insight into the workings of a system and how it is responding to nutrients.

D. Mississippi's Leveraged Approach to Nutrients

To combat the problem of nutrient pollution, Mississippi is implementing a collaborative, leveraged approach to reduce nutrients. This approach leverages resources and outputs from over two dozen state and federal agencies, nongovernmental organizations, and academic institutions to ensure the highest level of technical input and broadest range of support possible. The approach involves increased coordination of MDEQ programs including Basin Management, Nonpoint Source, Total Maximum Daily Loads (TMDLs), Water Quality Monitoring, Water Quality Assessment, Water Quality Standards, and NPDES Permitting. This multi-program, multi-agency, and multi-stakeholder approach has created significant collaboration and leveraging opportunities for Mississippi. The focus of this collaborative, leveraged approach will be on the development of numeric nutrient criteria, improvement of nutrient TMDLs, and

development and implementation of nutrient reduction strategies across the state. In addition to these efforts at the state-level, Mississippi is also collaborating with and providing leadership in nutrient reduction initiatives at both the regional and national levels through the Gulf of Mexico Alliance and the Mississippi River/Gulf of Mexico Watershed Nutrient Task force (Hypoxia Task Force).

1. Gulf of Mexico Alliance (GOMA)

The Gulf of Mexico Alliance is a partnership of the five Gulf States (Florida, Alabama, Mississippi, Louisiana, and Texas), federal agencies, academic organizations, businesses, and other non-profits in the region. The goal of the Alliance is to significantly increase regional collaboration to enhance the environmental and economic health of the Gulf of Mexico. MDEQ has served in a leadership role within GOMA since 2007 as the lead for the GOMA Nutrients Team (2007-2014) and as the lead of the GOMA Water Resources Team (2014-present). Reducing nutrient pollution, mitigating hypoxia and its impacts, and supporting state efforts to develop and implement numeric nutrient criteria are all ongoing initiatives of the GOMA Water Resources Team. During June 2009, the Alliance released an updated five year plan, the Governor's Actions Plan for Healthy and Resilient Coasts (Action Plan 2). MDEQ supported implementation of Action Plan 2 (2009-2014) by integrating components of the plan into nutrient-related programs within the agency. The Alliance is working on developing its next five year plan (Action Plan 3) that is due to be released in the summer of 2016. MDEQ will continue supporting GOMA by working to implement Action Plan 3 in the years ahead.

2. The Mississippi River/Gulf of Mexico Watershed Nutrient Task Force

The Hypoxia Task Force (HTF), as it is commonly referred, consists of senior management from environmental, agricultural, and conservation agencies from states within the Mississippi River/Atchafalaya River Basin, EPA, USDA, NOAA, FWS, USACE and USGS. Mississippi has previously served as the State Co-chair of the Task Force and continues to participate on its Coordinating Committee. In 2008, the Task Force Released the Gulf Hypoxia Action Plan for Reducing, Mitigating, and Controlling Hypoxia in the Northern Gulf of Mexico and Improving Water Quality in the Mississippi River Basin 2008. The plan called for 11 specific actions to reduce nitrogen and phosphorus loadings in the Gulf by 45% and reduce the size of the hypoxic "dead zone." A key component of the action plan allowed for the development of State and Federal nutrient reduction strategies for those states with significant contributions of nitrogen and phosphorus to the Gulf. MDEQ has been actively working to implement nutrient reduction strategies into all water programs, specifically working within the Section 319 Non-Point Source Program to work with land owners and stakeholders to place nutrient related Best Management Practices (BMPs) on the land.

In 2015, as part of the HTF report to Congress, the task force agreed to adopt measures to track progress in reducing both point and nonpoint source inputs to the Gulf. This will be accomplished by continuing to implement state nutrient reduction strategies; expanding partnerships with universities, agriculture, cities, communities and others; targeting vulnerable lands, and quantifying nutrient load reductions achieved from federal

programs (ex: USDA RCPP, USDA MRBI, USFWS MS River Habitat Initiative and Landscape Conservation Cooperatives, and USEPA Water Pollution Control Programs).

3. Nutrient Reduction Strategy Development

Working with partners, MDEQ has developed a Statewide Nutrient Reduction Strategy along with additional strategies that are tailored to different regions in our state. In the Mississippi Alluvial Plain region also referred to as the Delta, the primary region of row-crop agriculture in the state, this effort was co-led by MDEQ and Delta F.A.R.M (Farmers Advocating Resource Management). MDEQ, working through the Gulf of Mexico Alliance's Nutrients Team, facilitated the development of a common template for Gulf of Mexico States to encourage a consistent, aligned approach to reduce excessive nutrients regionally. This template is now being implemented in Mississippi and Louisiana as both states use it to guide them in developing state-specific nutrient reduction strategies for their coastal watersheds. In Mississippi, this coastal nutrient reduction strategy effort was co-led by MDEQ and the Mississippi Department of Marine Resources (MDMR). In addition to the coastal and Delta regions, MDEQ, working through the Hypoxia Task Force, facilitated the development of a common framework for states within the Mississippi/Atchafalaya River Basin to reduce excessive nutrients and mitigate Gulf hypoxia.

Mississippi has now developed nutrient reduction strategies for the Delta, coastal, and uplands portions of the state. These strategies have been consolidated to establish a comprehensive, state-level approach to reduce nutrient loadings from nonpoint and point sources, whether in a predominately agricultural environment, areas of higher municipal and industrial uses, or more natural coastal environments.

E. Outreach and Stakeholder Buy-in Process

MDEQ has assembled Mississippi's Nutrient Criteria Stakeholder Group which includes representatives from municipalities, environmental groups, and other organizations throughout Mississippi with an interest in nutrient criteria activities. The Stakeholder Group has met approximately four times a year since its establishment and has met in various parts of the state in order to ensure that MDEQ is effectively reaching interested parties. These meetings provide an opportunity for stakeholders to be informed of the process that MDEQ is using to develop nutrient criteria. It is also an opportunity for stakeholders to provide comments and feedback about the process to the State and allows the State to maintain transparency throughout the process.

F. Administrative Process

The administrative process for regulatory changes will be as follows:

- Publish a public notice in newspapers across the State announcing the intent to modify MDEQ's Water Quality Standards and welcoming public comment on draft numeric nutrient criteria;
- Hold a minimum 60 day public comment period;
- Hold a public hearing at the end of the public comment period;
- Compile all comments received and prepare a responsiveness summary for those comments;
- Perform any additional analyses or efforts needed based on comments received;
- Make any needed changes to the draft criteria resulting from comments received or additional information obtained while in the process of responding to comments;
- Present proposed criteria to the Mississippi Commission on Environmental Quality for adoption;
- Upon adopted by the Commission, publish a notice of final rulemaking;
- Obtain a certification from the Attorney General of Mississippi;
- Obtain concurrence from U.S. Fish and Wildlife; and,
- Submit to EPA Region 4 for approval.

IV. Lakes and Reservoirs

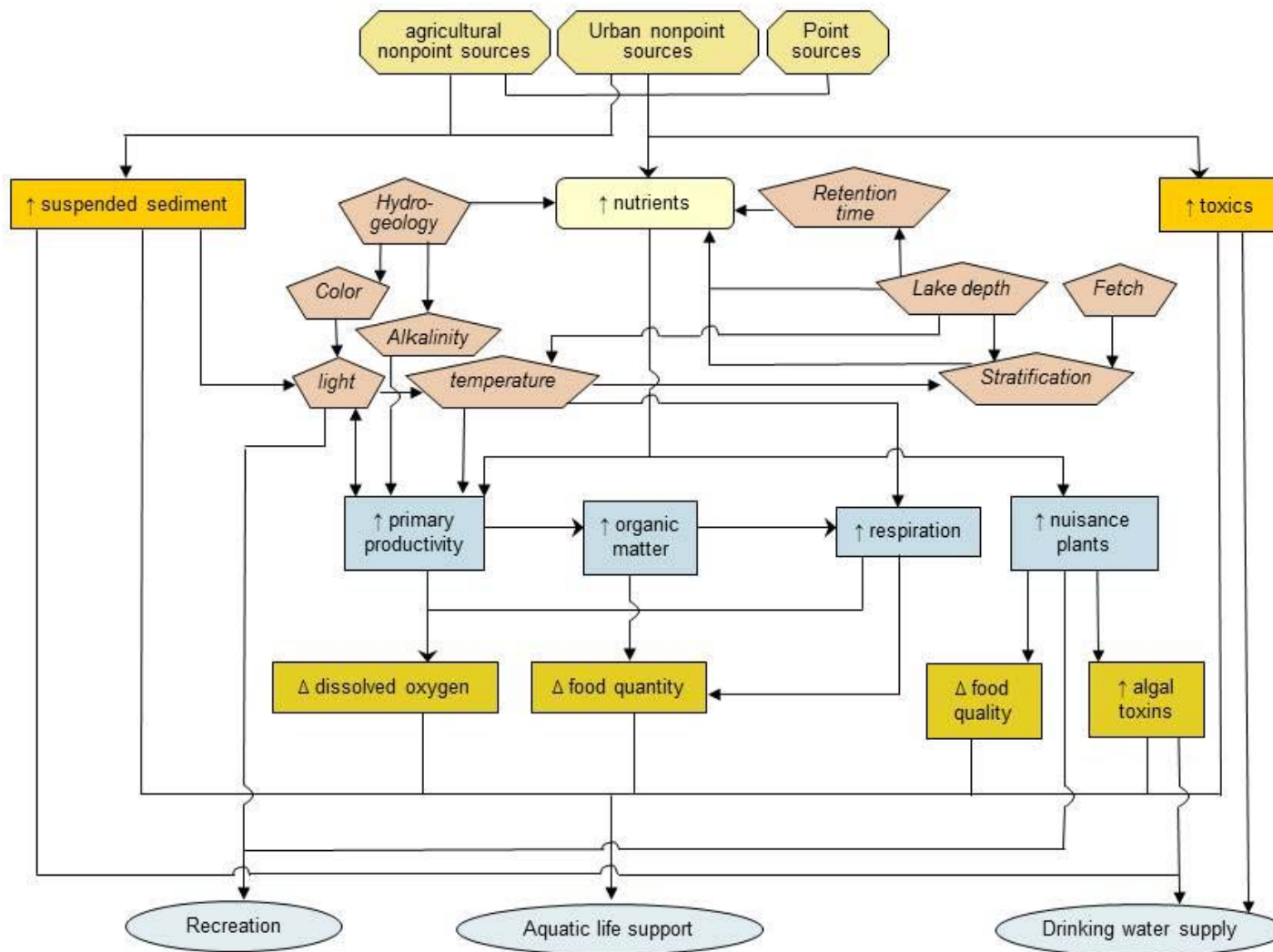
A. Background

Nutrient concentrations convey little information about the condition of aquatic ecosystems or their capacity to support designated uses. It is the response to nutrient concentrations that are relevant in aquatic ecosystems. Therefore, effects-based criteria represent the preferred approach for the development of numeric nutrient criteria. These numeric nutrient criteria should reflect local conditions and protect specific designated uses as described in the EPA technical guidance manuals (EPA 2000, 2001). In addition to an effects-based approach, other scientifically defensible methods and appropriate water quality data may be considered.

The introduction of nutrients into a lake environment causes the growth of primary producers to increase, which can lead to changes such as reduced oxygen and clarity, as well as food quality and quantity. This can result in changes to the biological community in the lake and impair the designated use for the lake.

Because water quality standards are comprised of designated uses, water quality criteria, and an anti-degradation requirement, an alternative approach to reference systems is to start with the designated uses, identify ecological endpoints that can be associated with these designated uses and then develop a conceptual model showing the linkage among designated uses, ecological endpoints, nutrient concentrations, and factors affecting the expression or response of the endpoint to nutrient concentrations, which can be seen below in Figure 2.

Figure 2. Conceptual Diagram for Lakes and Reservoir



There are several key factors aside from identified endpoints that must be addressed in defining and developing nutrient criteria including geographic region, water body types, seasonality, and designated uses. The Clean Water Act requires that States designate a use for each water body and develop criteria that will protect and support the highest attainable designated use. The designated uses for lakes and reservoirs will be considered as the foundation for the development of numeric nutrient criteria. Additionally, lakes in different areas in the State may have different nutrient concentrations depending on native soil types, surface and groundwater hydrology, land use, ecoregions, physiographic areas, and watersheds and basins. Different water body types (e.g., oxbows, large reservoirs, etc.) can have different critical conditions at which nutrient concentrations impair designated uses. If the nutrients and critical conditions vary greatly between water body type, each category will require different criteria. Finally, any ecological endpoints such as chlorophyll concentrations, fish production, recreation, etc. have definite seasonal components that might require different nutrient criteria for these seasons. While there are additional variables that might be considered, these factors represented an initial starting point in the analyses of criteria for lakes and reservoirs.

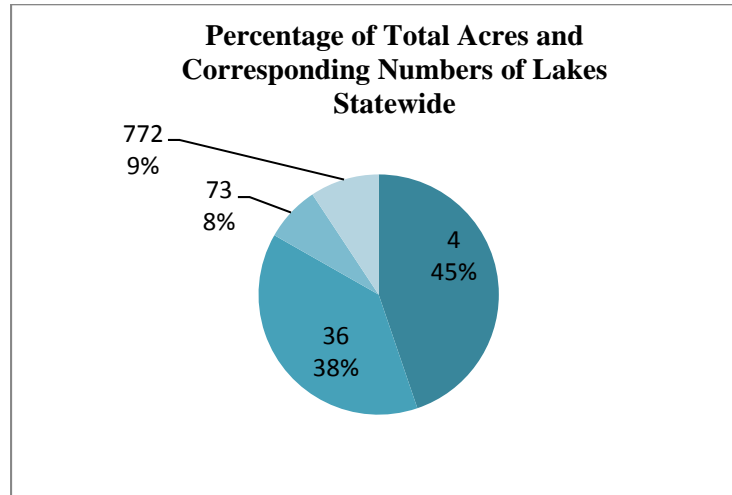
B. Classification

The initial classification of Mississippi lakes was to determine which lakes are Waters of the U.S. or Waters of the State, and thus subject to the Clean Water Act. Mississippi lakes that are subject to the Clean Water Act have been put into classes based on size (surface area greater than 500 acres, between 500 and 100 acres, and less than 100 acres), type [large reservoir (>4000 acres), reservoir, oxbow], successional stage, whether or not they are fertilized, and whether or not they are on Mississippi's §303(d) list.

C. Data Collection

Information from USGS's Geographic Names Information System and various other sources indicated there were 938 named lakes/reservoirs/ponds in Mississippi. One hundred thirteen lakes comprise over 90 % of the total surface area of lentic water bodies in Mississippi. In addition, 84% of the total surface area of Mississippi lentic water bodies was represented by the 40 largest lakes and reservoirs (i.e., >500 ac), as depicted in Figure 3 below.

Figure 3. Surface Area of Mississippi Lakes (darkest blue > 4000 ac, second darkest between 500 and 4000 ac, third darkest between 100 and 500 ac, and lightest blue < 100 ac).



MDEQ's first priority was to develop criteria on the largest water bodies (i.e., >500 acres). Following the development of criteria for these water bodies, the applicability of these criteria for lakes between 100 and 500 acres was assessed. Narrative criteria will likely be applied to all other lake and reservoir water bodies below this intermediate size (less than 100 acres) because these water bodies comprise less than 10% of the lentic surface area in the State.

MDEQ collected lake data from 2002-2004, assessing 48 lakes and reservoirs all larger than 500 acres and was conducted according to a QAPP that was approved by UPEPA Region 4. In 2009, MDEQ re-established the Ambient Lakes Monitoring Program as part of the Statewide Ambient Network. MDEQ collects samples from approximately 20 public lakes (greater than 100 acres in size) annually. Lakes are monitored for traditional physical, chemical, and biological water quality parameters using the protocol that was developed for nutrient criteria development.

D. Data Analysis

The initial report developed by MDEQ (MDEQ 2007) followed the EPA nutrient criteria guidance and used multiple different kinds of analyses, including classification analyses, reference distribution approaches, the consideration of scientific literature, and stressor response analyses. This report recommended the use of a fish assemblage based response indicator entitled MSFish that was developed by the MS Department of Wildlife, Fisheries, and Parks to rate the quality of fishing experience in lakes and reservoirs. However, further recommendations from the TAG indicated that the use of MSFish might not provide sufficient support. MDEQ released revised reports in 2011, 2013, and an analysis addendum in 2015 (MDEQ 2011a, 2013a, 2015) using chlorophyll-a and dissolved oxygen as indicators to derive candidate criteria in addition to those derived from the MSFish index.

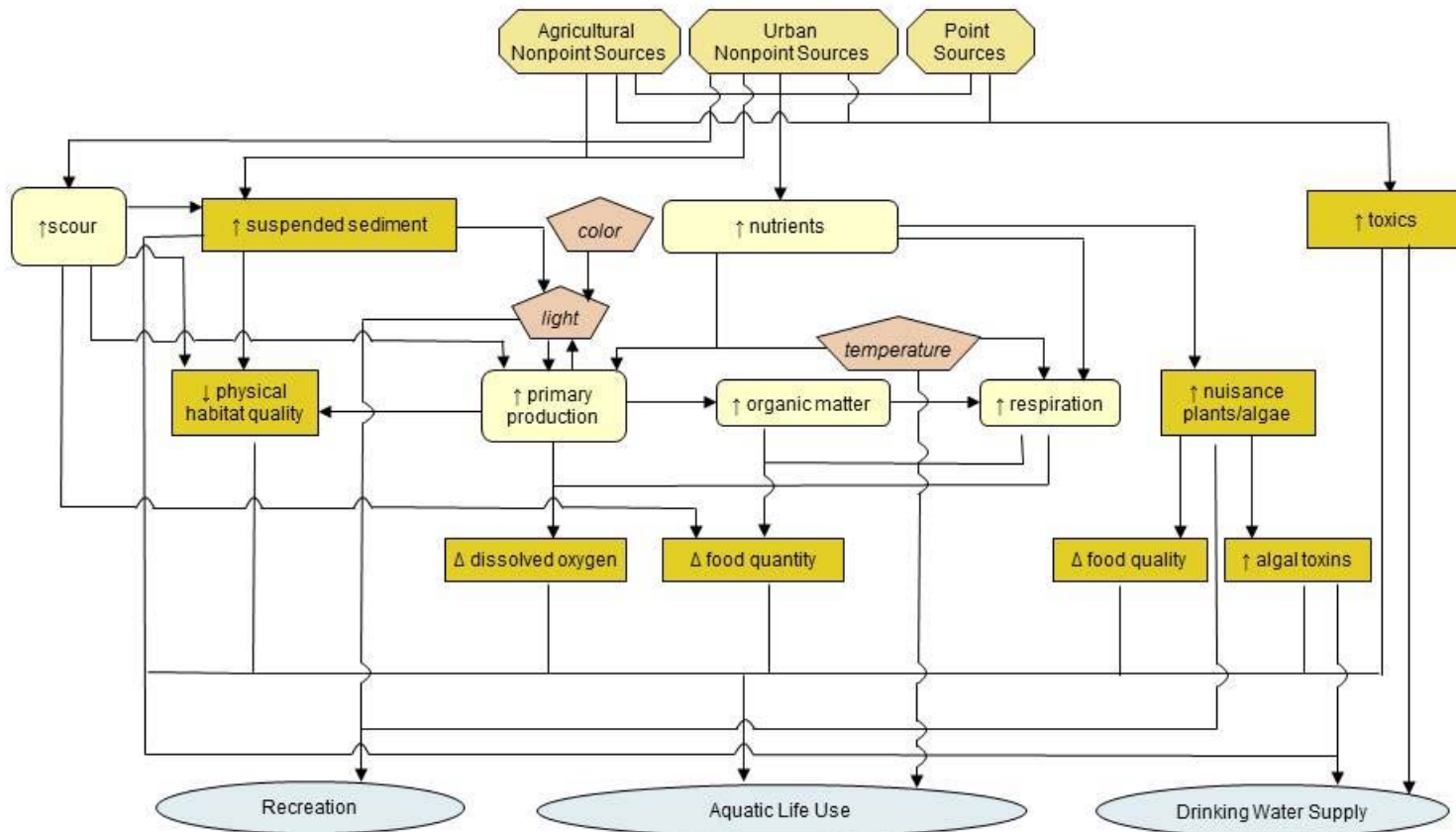
V. Streams and Rivers

A. Background

Nutrient concentrations convey little information about the condition of aquatic ecosystems or their capacity to support designated uses. It is the response to nutrient concentrations that are relevant in aquatic ecosystems. Therefore, effects-based criteria represent the preferred approach for the development of numeric nutrient criteria. These numeric nutrient criteria should reflect local conditions and protect specific designated uses as described in the EPA technical guidance manuals (EPA 2000, 2001). In addition to an effects-based approach, other scientifically defensible methods and appropriate water quality data may be considered.

The causal diagram in Figure 4 shows how the addition of nutrients into rivers and streams can be potentially impactful to the systems. Nutrients can enrich plant, algal, and microbial assemblages that can affect the physical and chemical habitat of streams as well as their food quality which leads to an impact on insect and fish assemblages. Nutrients can be influenced by a number of factors, including light, flow and temperature.

Figure 4. Conceptual Diagram for Streams and Rivers



Upon evaluation of all parameters listed above, MDEQ will determine those indicators that are believed to be scientifically credible in establishing numeric nutrient criteria. Data evaluation to determine parameter applicability will include various statistical analyses to identify causal parameters that accurately represent the nutrient characteristics of the given water bodies and response variables that clearly respond to the dynamics of the causal variables.

B. Classification

The streams of the state were classified into bioregions including: East Bioregion, Southeast Bioregion, West Bioregion (ecogroups 1 and 5), South Bluff Bioregion, and Non-Wadeables for aquatic life use assessment purposes. Delta Waters will be examined separately and will be discussed in Section VII of this document. Nutrient data were explored to identify potential classes and results indicated that the bioregions made a sensible first approximation than using level III ecoregions because they provided better resolution of nutrient differences and also provided a sensible link between the nutrient criteria and existing aquatic life use assessment classes.

C. Data Collection

Stream data were collected by MDEQ, and the state also compiled data from STORET and USGS. The data included water chemistry including nutrients, some water column and benthic chlorophyll a data, and macroinvertebrate assemblage information, which MDEQ collects as part of its routine ambient monitoring.

D. Data Analysis

The initial report developed by MDEQ (MDEQ 2009a) followed the EPA nutrient criteria guidance and used multiple different kinds of analyses, including classification analyses, reference distribution approaches, the consideration of scientific literature, and stressor response analyses. MDEQ released a revised report in 2011 based on TAG feedback (MDEQ 2011b) expanding on the same analytical approaches and providing minor analytical supporting analyses such as propensity score analysis.

VI. Coastal and Estuarine Waters

A. Background

MDEQ believes that it is of utmost importance that criteria for coastal water bodies be related to a measurable impairment of a designated use. Estuaries and coasts are the most downstream of all state waters, and are therefore the ultimate nutrient “sink”.

The general approach will be, once again, based on EPA guidance and will:

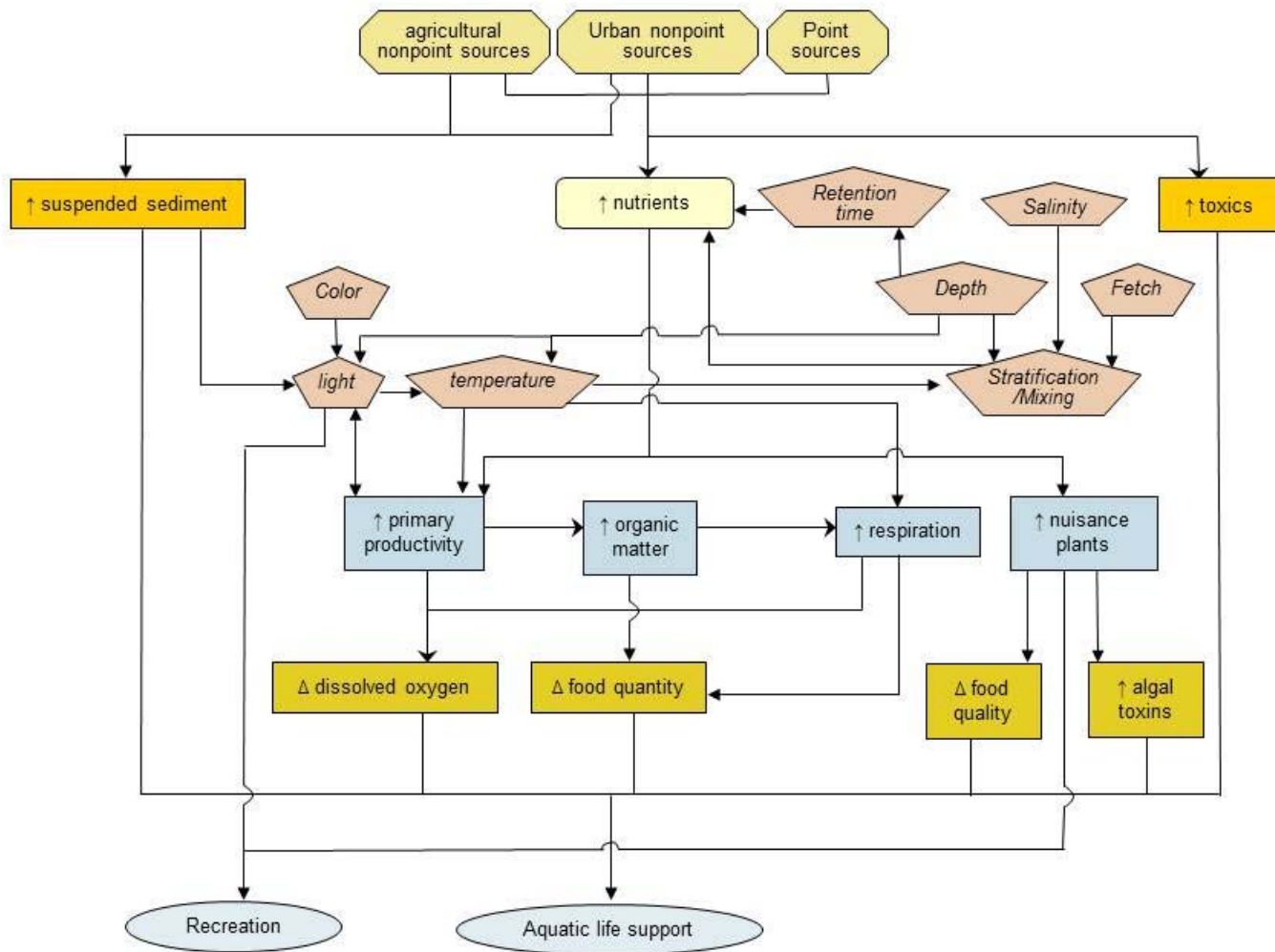
- Compile and review historical data from Mississippi coasts and estuaries to assess status and trends in nutrient concentrations and associated biotic effects;
- Determine what additional data are needed to develop effects-based nutrient criteria for coasts and estuaries and pursue collection;
- Formulate analytical approaches for using historical and additional data to develop nutrient criteria for coastal and estuarine water bodies and pursue those analyses;
- Consider development of mechanistic models for large estuaries; and
- Participate in Gulf Alliance Partnership workshops and meetings to coordinate nutrient criteria development activities.

Designated uses for coastal and estuarine water bodies include shellfish harvesting, recreation, fish consumption, and aquatic life support. Effects-based indicators linking nutrients with these designated uses will be included in additional data collection efforts. The approaches being considered for linking nutrients with effect-based indicators include empirical stressor-response relationship modeling, mechanistic models, and existing condition reference approaches.

The causal diagram in Figure 5 shows how the addition of nutrients into estuaries and other coastal waters can be potentially impactful to these systems. Nutrients can enrich plant, algal, and microbial assemblages that can affect the physical and chemical habitat of estuaries as well as their food quality which leads to an impact on biota. Nutrients can be influenced by a number of factors, including light, flow, residence time/flushing, salinity and temperature.

The Mississippi Nutrient Technical Advisory Group will be advising on the efforts for criteria development in estuaries to be protective of the highest attainable coastal and estuarine designated use.

Figure 5. Conceptual Diagram for Coastal and Estuarine Waters



B. Classification

Within regions, coastal and estuarine systems will be classified according to various factors such as size (e.g., small bays), hydrologic and/or salinity regime, seasonal responses, and other factors that might affect the response of coastal and estuarine systems to nutrient loading and concentration and attainment of designated uses. Classifications will become more apparent upon analysis of the data.

C. Data Collection

Estuarine data were collected by MDEQ, and the state also compiled data from STORET and USGS. The data included water chemistry including nutrients, water column chlorophyll a data, and some benthic invertebrate assemblage information, which MDEQ collects as part of its routine ambient monitoring.

D. Data Analysis

MDEQ is following the EPA nutrient criteria guidance and using multiple different kinds of analyses, including classification analyses, existing condition reference distribution approaches, the consideration of scientific literature, mechanistic models, and stressor response analyses. MDEQ has released a report as part of work supported by GOMA on a mechanistic model of nutrient source, fate, transport, and effects in Saint Louis Bay (MDEQ 2013b).

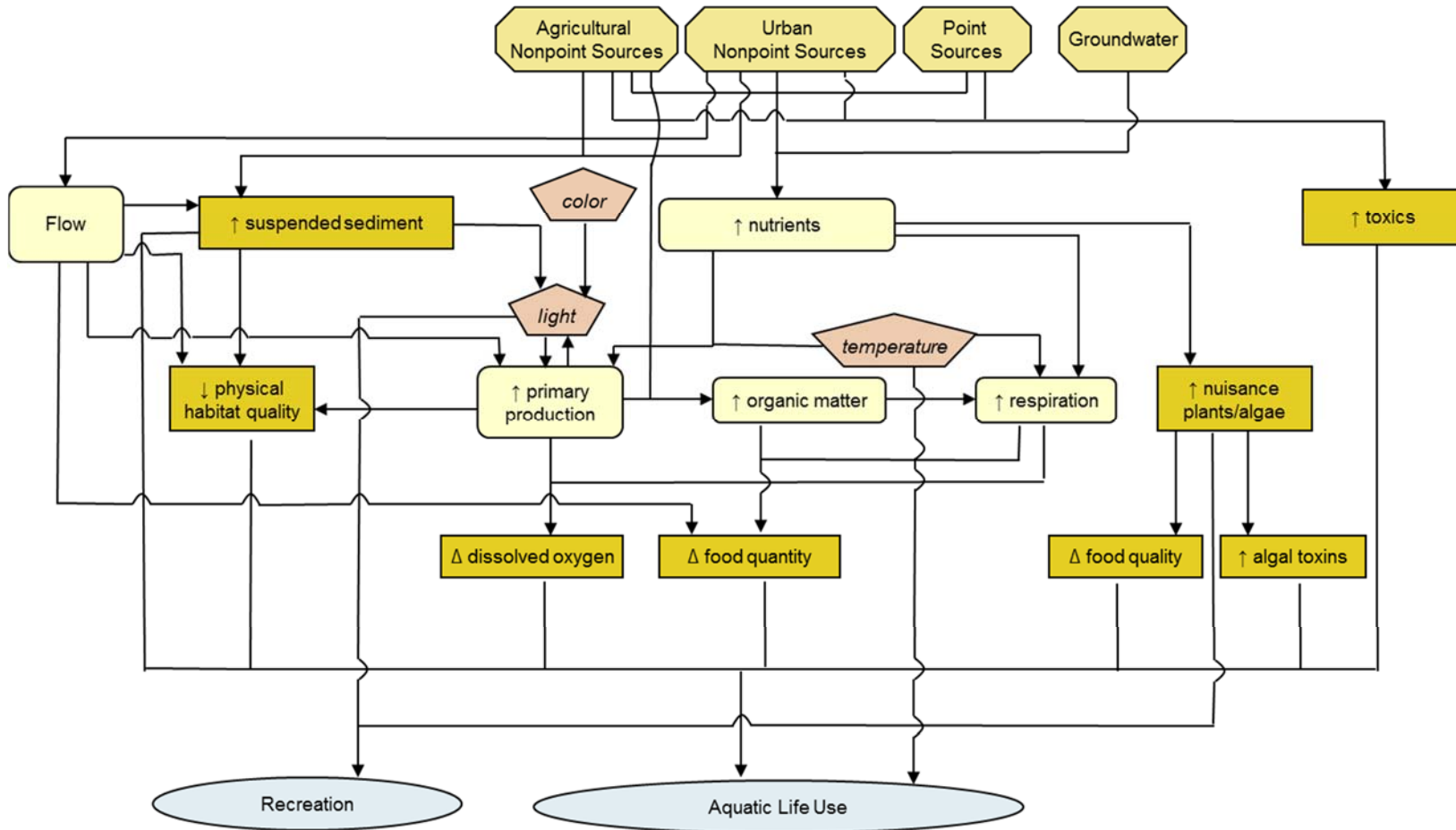
VII. Delta Waters

MDEQ has decided upon preliminary investigation and data analysis of streams that the Delta Waters of the state should be separated and looked at individually, as it is a unique region with its own individual properties. Thus far the state has begun to perform initial data collection and exploratory analysis, the identification of data gaps, and is working on developing a plan regarding how to move forward with deriving nutrient criteria for the Delta including what additional data collection may be needed, classification, and analysis approaches.

MDEQ's TAG has created a preliminary conceptual model (Figure 6 below) for the Delta to explore potential endpoints and stressors that cause nutrient pollution in the Delta, and has held meetings to discuss assessment endpoints and classification ideas.

MDEQ is collecting data on the Delta in support of upcoming analysis. This data/information collection is composed of water chemistry including nutrients and biotic responses including chlorophyll and invertebrates.

Figure 6. Preliminary Conceptual Diagram for Delta Streams



VIII. Mississippi's Large Rivers

MDEQ plans to establish site-specific numeric nutrient criteria for the state's large rivers. The timeline for these criteria will be based on factors such as agency need, available resources, and/or collaboration opportunities.

IX. Criteria Development Schedule

MDEQ has updated its previous development schedule to reflect our revised plan for nutrient criteria development based on a new approach communicated from EPA called sequencing. This approach introduced the idea of establishing nutrient criteria for large residence time receiving waters (e.g., lakes, reservoirs, and coastal waters) first to ensure protection of downstream waters, with streams and rivers being established at a later date to provide additional time if needed to explore nutrient criteria options for these waters. MDEQ has decided to implement this approach into the criteria development efforts. The following timeline identifies provides MS's timeline for development of nutrient criteria for the various water body types within MS.

Table X. Mississippi's Schedule for Numeric Nutrient Criteria Development

Criteria Development Activity	Target Date	Technical Support	Stakeholder Outreach
Numeric Nutrient Criteria for Mississippi's Lakes and Reservoirs (Non-Delta) are public noticed and the public comment period begins	No later than June 30, 2016	Development of scientifically-defensible numeric nutrient criteria for Mississippi's surface waters remains a priority for MDEQ. The agency will continue to work through the criteria development process for each water body type while receiving technical support from the members of the Mississippi Nutrient Technical Advisory Group (TAG)	Transparency and stakeholder education and outreach also continue to be priorities of MDEQ. The agency will continue to provide numeric nutrient criteria stakeholder update sessions to keep individuals informed of our efforts throughout the criteria development process. MDEQ will also continue to provide the latest information available through the MDEQ Water Quality Standards Program's website.
Numeric Nutrient Criteria for Mississippi's Coastal and Estuarine Waters are public noticed and the public comment period begins	No later than one year after EPA approval of Mississippi's Numeric Nutrient Criteria for Lakes and Reservoirs (Non-Delta)		
Numeric Nutrient Criteria for Mississippi's Wadeable Streams (Non-Delta) are public noticed and the public comment period begins	No later than one year after EPA approval of Mississippi's Numeric Nutrient Criteria for Coastal and Estuarine Waters		
Numeric Nutrient Criteria for Mississippi's Delta Waters are public noticed and the public comment period begins	No later than one year after EPA approval of Mississippi's Numeric Nutrient Criteria for Mississippi's Wadeable Streams (Non-Delta)		
Numeric Nutrient Criteria for Mississippi's Large Rivers	Site-Specific Numeric Nutrient Criteria will be developed for each Large River as resources allow		

X. Conclusion

The primary goal of MDEQ's Water Quality Standards Program has been to develop appropriate and protective numeric nutrient criteria for MS's waters using a scientifically defensible, transparent, and well-documented process. MDEQ has worked diligently to develop numeric nutrient criteria for Mississippi's waters since its developing its first Nutrient Criteria Development Plan in 2002.

Since 2010, MDEQ has continued a strong commitment of resources towards the development of numeric nutrient criteria. The MS Nutrient TAG was established in 2010 and has met on a quarterly basis since its creation. In addition, MDEQ has been very proactive with stakeholder outreach regarding MS's nutrient criteria development efforts. MDEQ has hosted numerous Nutrient Criteria Stakeholder Updates Sessions since June 2012. In addition, MDEQ has presented continuous updates to stakeholders on nutrient criteria development activities at multiple events annually over the past few years supporting our efforts to promote transparency and to solicit and encourage feedback from stakeholders throughout the criteria development process.

All technical support documents developed by MDEQ pertaining to numeric nutrient criteria have also been made available to the public through the MDEQ website. The agency has requested and received feedback during all interactive sessions with stakeholders and has incorporated those comments, suggestions, etc. into criteria development efforts along the way. By continually inviting questions and asking for feedback along the way, and then providing follow up to those comments, suggestions, and concerns at subsequent sessions, we are hopeful that the final recommended values will be well received.

Significant in-house and contract resources have been applied to this effort, and MDEQ plans to maintain this level of commitment until completion.

XI. References

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