Total Maximum Daily Load (TMDL)

For

BAYOU CASOTTE

IN THE COASTAL STREAMS BASIN OF MISSISSIPPI

UN-IONIZED AMMONIA and TOTAL TOXICS

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March 2007

In compliance with the provisions of the Federal Clean Water Act, 33 U.S.C §1251 et. seq., as amended by the Water Quality Act of 1987, P.L. 400-4, the U.S. Environmental Protection Agency (EPA) is hereby establishing a Total Maximum Daily Load (TMDL) to address un-ionized ammonia and total toxics for Bayou Casotte in the Mississippi Coastal Basin. Subsequent actions must be consistent with this TMDL.

As with all TMDLs, the State or EPA in coordination with the State, has the authority and prerogative to revise this TMDL if new information becomes available that warrants such action.

Gail Mitchell for — March 29, 2007

James D. Giattina, Director — Date
Water Management Division

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Bayou Casotte Total Maximum Daily Loads (TMDL)
For Un-ionized Ammonia and Total Toxics

Impaired Waterbody Information

Name	ID	County	HUC	Cause
Bayou Casotte	MS109E04M	Jackson	03170009	Un-ionized Ammonia and Total Toxics
Southeast corner of Pascagoula, MS. Flows to the south directly to Mississippi Sound				

Designated Uses and Water Quality Standards

Designated Uses for Bayou Casotte:	Fish and Wildlife: "Waters in this classification are intended for fishing and for propagation of fish, aquatic life, and wildlife. Waters that meet the Fish and Wildlife Criteria shall also be suitable for secondary contact recreation. Secondary contact recreation is defined as incidental contact with the water during activities such as wading, fishing and boating, that are not likely to result in full body immersion." (*State of Mississippi Water Quality Criteria for Intrastate, Interstate and Coastal Waters 2003*)
Water Quality Standards and Criteria for: (A) Un-ionized Ammonia in Saltwater (B) Toxic Substances (C) Mixing Zones	A. Aquatic Life and Human Health Standards (*State of Mississippi Water Quality Criteria for Intrastate, Interstate and Coastal Waters 2003*): (1) Aquatic Life—"the concentration of toxic substances shall not result in chronic or acute toxicity or impairment of the uses of aquatic life. Any levels in excess of these values will be considered to result in chronic or acute toxicity, or the impairment of the uses of aquatic life. Regardless of direct measurements of chronic or acute toxicity, the concentrations of toxic substances shall not exceed the chronic or acute values…" (2) Human Health—"the concentration of toxic substances shall not exceed the level necessary to protect human health through routes of fish (and shellfish) tissue consumption, water consumption, or other routes identified as appropriate for the waterbody." B. "Ammonia toxicity shall be evaluated according to EPA guidelines published in the *Ambient Water Quality Criteria for Ammonia (Saltwater)-1989 (EPA-440/5-88-004).* This material related to ammonia toxicity is hereby incorporated by reference including any subsequent amendments and editions (*State of Mississippi Water Quality Criteria for Intrastate, Interstate and Coastal Waters 2003*)." The EPA ammonia limits for salt water according to the EPA publication, *Ambient Water Quality Criteria for Ammonia (Saltwater)-1989* (EPA440/5-88-004, April 1989), set the acute and chronic criteria for un-ionized ammonia (specified as NH_3) as 0.233 and 0.035 mg/l, respectively. According to the 1989 EPA publication, "…saltwater aquatic organisms should not be affected unacceptably if the four-day average concentration of un-ionized ammonia does not exceed 0.035 mg/L more than once every three years on the average and if the one-hour average concentration does not exceed 0.233 mg/l more than once every three years on the average." C. "Application of mixing zones shall be made on a case-by-case basis and shall only occur in cases involving large surface waterbodies in which a long distance or large area is required for the wastewater to completely mix with the receiving waterbody. Toxicity and human health concerns within the mixing zone shall be addressed as specified in the *Technical Support Document for Water Quality-Based Toxics Control* (EPA-505/2-90-001, March 1991) and amendments thereof…mixing zones shall not be used as a substitute for waste treatment."

Recommended Critical Conditions for Converting Un-ionized Ammonia to Total Ammonia in Saltwater*

Criteria	PH	Temperature	**Salinity** parts per thousand (ppt)
Acute criteria: 0.233 mg/L	7.9	31° Celsius	32 ppt
Chronic criteria: 0.035 mg/L	7.9	31° Celsius	32 ppt

*****The pH, temperature and salinity values represent critical conditions during summer months (May – October). For winter months (November – April), MDEQ may either use these values or choose alternate values that represent critical conditions during the winter season.

Point Source Discharger

NPDES ID	Facility Name	County	Type of Outfall
MS0003115	Mississippi Phosphates Corporation	Jackson	Process Water and Storm Water

Allocations

Wasteload Allocation: Mississippi Phosphates Corporation NPDES Permit—MS0003115	Daily maximum effluent concentrations not to exceed 0.233 mg/L (Acute) Four day average effluent concentrations not to exceed 0.035 mg/L (Chronic)
Load Allocations: Allowable concentrations in storm water runoff and other waters draining to Bayou Casotte	Not to exceed the daily maximum acute concentration of 0.00559 mg/l. Not to exceed the four-day average chronic concentration of 0.00559 mg/l.

Margin of Safety

MOS	Implicit

EXECUTIVE SUMMARY

This Total Maximum Daily Load (TMDL) has been developed for Bayou Casotte in the Coastal Basin of Jackson County, Mississippi. The Bayou Casotte watershed is approximately 8.4 square miles and drains the southeast areas of the cities of Pascagoula and Moss Point into the Mississippi Sound. A TMDL identifies the maximum amount of a pollutant that may be discharged to a waterbody without causing exceedances of state water quality standards and impairment of the uses made of those waters. Bayou Casotte is on Mississippi's 2004 303(d) List of Impaired Waterbodies for impairments due to un-ionized ammonia and total toxics. The TMDL for un-ionized ammonia in Bayou Casotte will protect water quality standards and organisms from the toxic effects of un-ionized ammonia. Therefore, by addressing un-ionized ammonia through this TMDL, the impairment for total toxics will also be addressed.

Bayou Casotte, shown in the photograph below (Photo 1), is an estuary that empties into the Mississippi Sound and is a major shipping channel used by large ocean going vessels. Bayou Casotte is fed by two freshwater tributaries and the entire watershed is approximately 8.4 square miles. The impacted length of the Bayou addressed by this TMDL is approximately two estuarine miles.

Photo 1: Industrial uses in Bayou Casotte (USEPA 2005)

Two forms of reduced inorganic nitrogen exist in equilibrium in natural waters, un-ionized ammonia (NH_3) and ionized ammonia (NH_{4+}). Concentrations of each depend on the pH, salinity, and temperature of the waters in which they are found. Of the two, the un-ionized ammonia form (NH_3) is considerably more toxic to organisms and can cause significant harm to fish and other aquatic organisms. Based on the available data and information, including data collected by EPA Region 4 and Mississippi Department of Environmental Quality (MDEQ) in 2004, EPA has determined that un-ionized ammonia is the source of toxicity in Bayou Casotte. By limiting the presence of un-ionized ammonia in the waterbody the toxic effects of un-ionized

ammonia on aquatic life will also be limited and water quality standards will be attained in Bayou Casotte.

The water quality standards applicable to Bayou Casotte are defined in the *State of Mississippi Water Quality Criteria (MS-WQC) for Intrastate, Interstate, and Coastal Waters* (MDEQ, 2003). The use classification for Bayou Casotte is "Fish and Wildlife." The MS-WQC contains narrative water quality standards for toxic substances and un-ionized ammonia. Specific requirements for un-ionized ammonia are found in the MS-WQC Section II.10 C. The MS-WQC states that, "Ammonia toxicity shall be evaluated according to EPA guidelines published in *Ambient Water Quality Criteria for Ammonia (Saltwater)-1989* (USEPA, 1989)." According to this EPA publication, un-ionized ammonia concentrations (specified as NH_3) in salt water are given chronic and acute criteria, which are 0.035 mg/l and 0.233 mg/l respectively.

In 2004, EPA Region 4 and MDEQ conducted a mixing zone study and ambient monitoring to assess the extent of the un-ionized and toxicity impairments to Bayou Casotte. Out of 50 samples collected during the study, 33 samples exceeded the chronic un-ionized ammonia criterion of 0.035 mg/l. Three of fifty samples exceeded the acute un-ionized ammonia criterion of 0.233 mg/l (USEPA, 2004).

After reviewing the types of facilities that are permitted to discharge to Bayou Casotte under the National Pollution Discharge Elimination System (NPDES) program, EPA has determined that one facility, Mississippi Phosphates Corporation (MPC) causes and contributes un-ionized ammonia and toxicity to the Bayou. MPC is the only facility that discharges un-ionized ammonia into Bayou Casotte. Other businesses and homes located in the Bayou Casotte area discharge into the regional sewer system, and storm water runoff from other NPDES dischargers should not contribute un-ionized ammonia or toxics to the Bayou. Photo 1 is a photograph of Bayou Casotte, which shows some of the industrial activities in the watershed.

According to the National Effluent Limit Guidelines applicable to MPC, the facility may discharge treated process wastewater under catastrophic rainfall (25-year, 24-hour storm events) and chronic rainfall events. The need to discharge, based on the level of the surge capacity, is triggered by rainfall events. Actual discharges may not occur during the rainfall events, but after a rainfall event. Even though a rain event has ended, MPC may need to discharge continuously for days until the surge capacity returns to an acceptable water level. Based on the available data and information, including data collected by EPA and MDEQ during a mixing zone study conducted in 2004, EPA determined that there is little to no dilution available at MPC's current discharge location, particularly during low-tide conditions. Therefore, the wasteload allocation requires that the effluent quality meets chronic and acute criteria at the point of discharge. The wasteload allocation of the TMDL calls for a daily maximum of un-ionized ammonia that cannot exceed the acute criterion concentration, and a four-day average of un-ionized ammonia that does not exceed the chronic criterion concentration.

EPA understands that MPC has expressed potential interest to MDEQ in relocating its outfall in order to provide greater dilution of its effluent, thereby allowing less stringent permit requirements. A technical report completed by a contractor for MPC was provided to EPA through MDEQ. Based on the review of the report, EPA believes that additional questions

remain regarding the amount of dilution that would be available to MPC if the outfall is relocated. Future permit requirements based on a relocation of the MPC outfall could be considered consistent with the wasteload allocation in this TMDL if it is demonstrated that acute and chronic criterion concentrations for un-ionized ammonia will be met at the edge of a mixing zone and zone of initial dilution (ZID), taking into account the following considerations: (1) whether the outfall is moved to a location where additional dilution is available under critical conditions and the amount of dilution available is studied and documented at the specific location; (2) whether the mixing zone is consistent with MDEQ's regulations which states that "…mixing zones shall not be used as substitute for waste treatment…"; and (3) whether the mixing zone/ZID is supported by scientifically defensible information, which includes information on the effects of wind fetch on the amount of mixing available at the proposed outfall location. Seasonal high winds in the Gulf of Mexico can concentrate the ammonia discharges in the Bayou, as reported by EPA in its publication entitled, "Bayou Casotte: Dye Dilution and Water Quality Study (USEPA 2004)". Figure 3 depicts how criteria are applied in a mixing zone and ZID.

Based on existing landuses in Mississippi and on available data, EPA has determined that there are no significant nonpoint sources of un-ionized ammonia and toxics in the Bayou Casotte watershed. EPA expects that ambient levels of un-ionized ammonia are likely significantly less than concentrations associated with chronic levels (0.035 mg/l). However, in light of the uncertainty regarding the specific ambient levels associated with nonpoint sources or background concentrations, EPA is using a conservative assumption as part of an implicit margin of safety regarding the current ambient concentrations of un-ionized ammonia. MDEQ has routinely used a conservative assumption for total ammonia (un-ionized ammonia plus ionized ammonia) equal to 0.1 mg/l in its process for developing water quality-based effluent limitations outside of the TMDL process. For pH, salinity and temperature values which represent critical conditions (see table below), a total ammonia concentration of 0.1 mg/l corresponds to an un-ionized ammonia concentration of 0.00559 mg/l. EPA has determined that an assumed ambient concentration for un-ionized ammonia of 0.00559 mg/l is appropriately conservative and is also below a level that could cause or contribute to excursions of the applicable water quality standards. Therefore, the load allocation of the TMDL identifies an allowable concentration of un-ionized ammonia associated with nonpoint sources (i.e., stormwater runoff and other waters draining to Bayou Casotte) equal to 0.00559 mg/l.

Table 1: Allocations and critical conditions forBayou Casotte

ALLOCATION TYPE	**ALLOCATIONS**		
WASTELOAD ALLOCATION: Mississippi Phosphates Corporation—MS0003115	Daily maximum effluent concentrations not to exceed 0.233 mg/l (Acute). Four-day average effluent concentrations not to exceed 0.035 mg/l (Chronic)		
	CRITICAL CONDITIONS*		
	pH	Temperature	Salinity (ppt)
	7.9	31° Celsius	32
LOAD ALLOCATION Allowable	Not to exceed daily maximum acute concentration of 0.00559 mg/l Not to exceed four-day average chronic concentration of 0.00559 mg/l		

concentrations in storm water runoff and other waters draining to Bayou Casotte	**CRITICAL CONDITIONS***		
	pH	Temperature	Salinity (ppt)
	7.9	31° Celsius	32

***The pH, temperature and salinity values represent critical conditions during summer months (May – October). For winter months (November – April), MDEQ may either use these values or choose alternate values that represent critical conditions during the winter season.

The TMDL accounts for seasonal variation and protect water quality in Bayou Casotte at all times. The margin of safety is implicit based on the conservative assumptions built into the wasteload and load allocations.

1.0 INTRODUCTION

1.1. Purpose of this Action

This document describes the Total Maximum Daily Load (TMDL) for un-ionized ammonia in the Bayou Casotte watershed in Jackson, Mississippi by the U.S. Environmental Protection Agency (EPA). Bayou Casotte is on Mississippi's 2004 Section 303(d) List for impairment due to un-ionized ammonia and total toxics. Based on available data, the toxicity in Bayou Casotte is due to the toxic effects of un-ionized ammonia in the waterbody exceeding the acute and chronic water quality criterion concentrations. Therefore, by addressing un-ionized ammonia through this TMDL, the impairment for total toxics will also be addressed.

1.2 What is a TMDL?

A TMDL identifies the maximum amount of a pollutant that may be discharged to a waterbody without causing exceedances of state water quality standards and impairment of the uses made of those waters. Section 303(d)(1)(A) of the Clean Water Act (CWA) as Amended by the Water Quality Act of 1987, Public Law 100-4, and the EPA's Water Quality Planning and Management Regulations [Title 40 of the Code of Federal Regulation (40 CFR), Part 130] require that each State identify those waters within its boundaries not meeting applicable water quality standards. The CWA also requires states to establish a priority ranking for waters on the 303(d) list of impaired waters and establish TMDLs for such waters.

The elements of a TMDL are described in 40 CFR 130.2 and 130.7 and Section 303(d) of the CWA, as well as in EPA guidance documents (USEPA, April 1991). A TMDL is defined as "the sum of the individual wasteload allocations for point sources and load allocations for nonpoint sources and natural background" (40 CFR 130.2) such that the capacity of the waterbody to assimilate pollutant loadings (the Loading Capacity) is not exceeded. A TMDL is also required to be developed with seasonal variations and include a margin of safety to address uncertainty in the analysis. The TMDL process can be used to establish water quality based controls to reduce pollution from nonpoint sources, establish permit requirements for point sources, and restore and maintain the quality of water resources. The TMDL process establishes the allowable loadings of pollutants, based on the relationship between pollution sources and in-stream water quality conditions, so that states can establish water-quality based controls to reduce pollution from both point and nonpoint sources and restore and maintain the quality of their water resources (USEPA, April 1991).

1.3 Bayou Casotte 303(d) Listings and TMDL History

Bayou Casotte (MS109E04M), located in the Coastal Basin in the Pascagoula area of Mississippi, was identified on the State's 1996 Section 303(d) list of impaired waterbodies for unknown toxicity, priority organics, non-priority organics, metals, un-ionized ammonia, other inorganics, nutrients, organic enrichment/low dissolved oxygen and total toxics. In 2002, EPA concurred with Mississippi Department of Environmental Quality's (MDEQ) assessment that TMDLs for non-priority organics, metals, other inorganics, nutrients, and organic enrichment/low dissolved oxygen were not needed because the applicable water quality standards are being attained. EPA approved a State-developed TMDL for phenol (the specific pollutant associated with the priority organics listing) on June 13, 2002. MDEQ delisted the unknown toxicity cause during the 1998 listing cycle, as it was a duplicate listing of the total toxics cause. Bayou Casotte is on the State's 2004 Section 303(d) list for un-ionized ammonia

and total toxics. The pollutants of concern addressed in this report are un-ionized ammonia and total toxics.

EPA first proposed the un-ionized ammonia and total toxics TMDL for Bayou Casotte for public review and comment in July 2001. The proposed 2001 TMDL included an ammonia wasteload allocation for Mississippi Phosphates Corporation (MPC) based upon an assumed effluent dilution ratio of 6:1 for the waterbody. Based on significant public comments received on the proposed TMDL, EPA determined that additional data and information were needed to better characterize the environmental conditions, including mixing characteristics, of Bayou Casotte. With significant support from MDEQ, EPA conducted an intensive monitoring and mixing zone study in Bayou Casotte in 2004. Based on the data collected, EPA determined there is little to no dilution available to the MPC effluent at the current discharge point, particularly during low-tide conditions (USEPA, May 2004).

1.4 Why is Un-ionized Ammonia a Concern?

Un-ionized ammonia is sometimes called free ammonia (NH_3) in contrast to ionized ammonia (NH_{4+}). These two forms of reduced inorganic nitrogen exist in equilibrium in natural waters, with concentrations dependent on the pH, salinity, and temperature of the waters in which they are found. In addition, the NH_3 form is a gaseous chemical, which can be transferred from water to air in stripping towers used in industrial operations. In contrast, the NH_{4+} form is an ionized form, which remains soluble in water. Temperature and pH are the two primary parameters that will determine whether there will be more un-ionized ammonia or ionized ammonia in the waterbody. In general, as temperature or pH increases in the waterbody, so does the proportion of un-ionized ammonia in the water. Of the two, the NH_3 is considerably more toxic to organisms and can cause significant harm to fish and other aquatic organisms. Therefore, the relative concentrations of NH_3 are of particular concern.

Toxic substances are poisonous through chemical interactions that may result in adverse impacts to humans or other living organisms. The impact of greatest concern in Bayou Casotte is from the potential toxic effects of un-ionized ammonia on aquatic life. Based on the available data and information, including data collected by EPA Region 4 and Mississippi Department of Environmental Quality (MDEQ) in 2004, EPA has determined that un-ionized ammonia is the source of toxicity in Bayou Casotte. By limiting the presence of un-ionized ammonia in the waterbody according to EPA regulations, the toxic effects of un-ionized ammonia on aquatic life will be limited. Therefore, by addressing un-ionized ammonia through this TMDL, the impairment for total toxics will also be addressed.

1.5 Effects of Hurricanes Katrina and Rita on Bayou Casotte

Hurricane Katrina and Hurricane Rita struck the U.S. Gulf Coast on August 29, and September 24, 2005, respectively. U.S. Geological Survey (USGS) real-time instruments in Gautier, Mississippi recorded wind speeds up to 140 miles per hour and rainfall totals of approximately two feet (USEPA, October 2005). Tidal surges in Bayou Casotte were reported to be as high as 20 feet during Hurricane Katrina. The storm surge from Hurricane Katrina resulted in a breach of the top of the cooling ditches surrounding the gypsum piles at MPC, thereby mixing the cooling ditches with ocean water and vice-versa. MPC released water into Bayou Casotte to reduce water levels in their holding ponds to prevent dyke structure failure. The water was

minimally treated prior to release. The release caused a large plume (Photo 2), believed to be from lime, to emanate from Outfall 003 of the facility. The aerial picture was taken by the Pictometry Company, Inc. between September 10-12, 2005 and was provided to the EPA Region 4 Geographical Information Systems (GIS) group.

Photo 2: Post-Hurricane Katrina discharge from MPC's Outfall 003 due to emergency upset conditions, (September 10-12, 2005)

EPA Region 4 and MDEQ conducted a study during the period of September 26-30 2005, post-hurricanes, to determine the effects of the tidal surge and heavy rainfall on the water quality of the major bay systems on the Mississippi coast including Bayou Casotte. Findings from the EPA and MDEQ joint survey of coastal Mississippi following Hurricanes Katrina and Rita showed few detectable priority pollutant compounds in the studied bays and rivers. Overall, the data collected by EPA indicated that few water quality criteria were exceeded during the study. However, algal growth results in Back Bay of Biloxi and Bayou Casotte were comparatively greater than the rest of the coastal sampling sites (USEPA, October 2005*)*. The extent to which the hurricanes had a long-term effect on water quality and on the environmental conditions in Bayou Casotte is not clear. However, the hurricanes do not change the long-term toxic effects of releases of un-ionized ammonia in Bayou Casotte and do not affect the wasteload or load allocations. As of February 2006, many industries in the Pascagoula area are back in operation.

1.6 Environmental Setting

The listed segment of Bayou Casotte is in the Coastal Streams Basin Hydrologic Unit Code (HUC) 03170009 in south Mississippi. Bayou Casotte, shown in Figure 1, is an estuary that empties into the Mississippi Sound and is a major shipping channel used by large ocean going vessels. Two freshwater tributaries, the East Prong and West Prong, feed Bayou Casotte. The Bayou Casotte watershed (Figure 1) is approximately 8.4 square miles and drains the southeast areas of the cities of Pascagoula and Moss Point into the Mississippi Sound. The predominant land use is categorized as urban and lies within Jackson County. The impacted length of the

Bayou addressed by these TMDLs is approximately two estuarine miles. Six endangered species—the Kemp's Ridley Sea Turtle (*Lepidochelys kempii*), the Green Turtle (*Chelonia mydas*), the Loggerhead Turtle (*Caretta caretta*), (the Leatherback Sea Turtle (*Dermochelys coriacea*), the Pallid Sturgeon (*Scaphirhynchus albus*) and Gulf Sturgeon (*Acipenser oxyrinchus desotoi*)—have habitat ranges within Bayou Casotte and the surrounding coastal areas. Based on the species' recovery plans provided by the U.S. Fish and Wildlife Service's website, EPA believes that although Bayou Casotte is within these species' habitat ranges, these species are not likely to occupy the Bayou because it is not a preferred habitat and does not support their likely food sources. However, EPA considered the potential presence and use of Bayou Casotte by these species in the development of this TMDL.

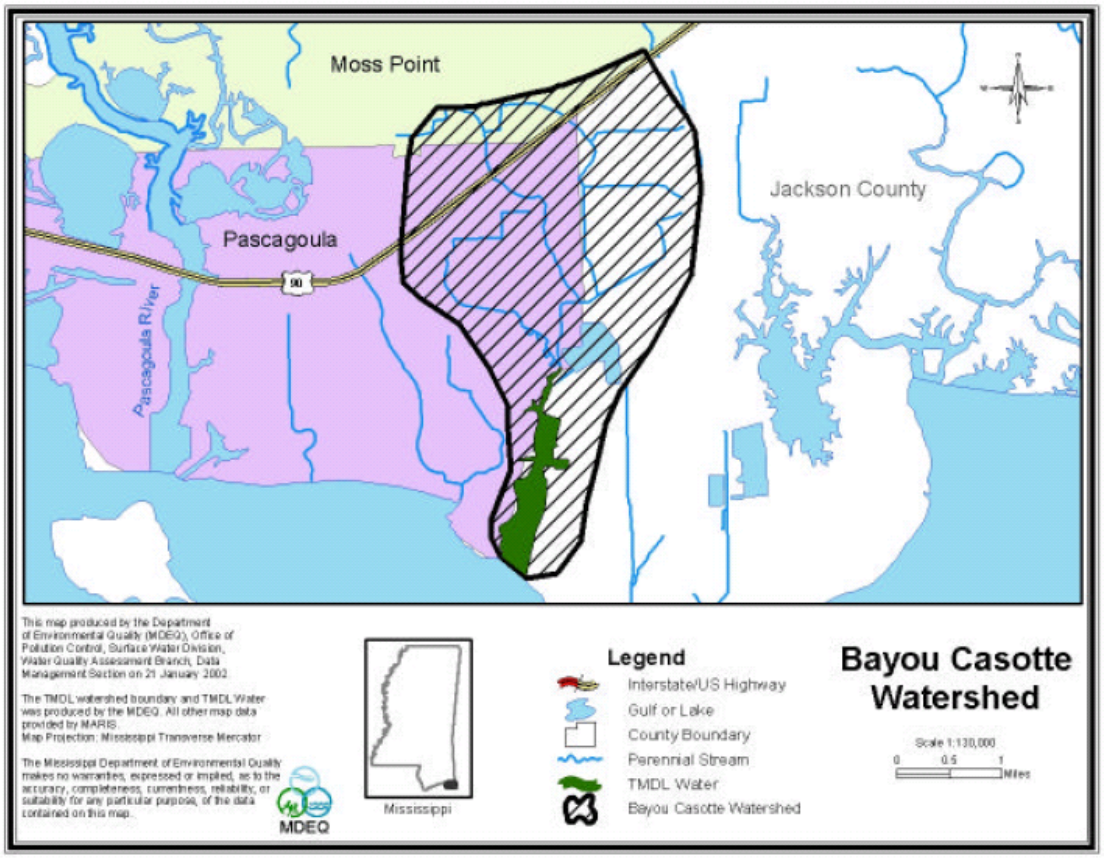


Figure 1: Map of Bayou Casotte watershed (Figure Courtesy of MDEQ)

The 5,349-acre drainage area of Bayou Casotte contains different landuse types, including urban, forest, agriculture, water, and wetlands. The landuse distribution information shown in Table 2 is based on the State of Mississippi's 1997 Automated Resource Information System. This data set is based on Landsat Thematic Mapper digital images taken between 1992 and 1993. Urban areas represent the largest percentage of landuses within the watershed.

Table 2. Landuse distribution in acres for the Bayou Casotte watershed

	Urban	Forest	Agriculture	Barren	Water	Wetland	Total
Area (acres)	2,176	1,935	209	204	356	469	5,349

% Area	41	36	4	4	7	9	100

1.7 Bayou Casotte Designated Use

Every state within the United States must establish water quality standards to protect designated uses of the waters within its jurisdiction. The water quality standards applicable to Bayou Casotte are defined in the *State of Mississippi Water Quality Criteria (MS-WQC) for Intrastate, Interstate, and Coastal Waters* (MDEQ, 2003). As Bayou Casotte does not carry other use specifications, the default use for Bayou Casotte is designated as "Fish and Wildlife." As specified in MS-WQC, "…waters in this classification are intended for fishing and for propagation of fish, aquatic life, and wildlife. Waters that meet the Fish and Wildlife Criteria shall also be suitable for secondary contact recreation. Secondary contact recreation is defined as incidental contact with the water during activities such as wading, fishing and boating, that are not likely to result in fully body immersion (MDEQ, 2003)." The MS-WQC includes criteria for protection of the Fish and Wildlife Support use classification, including un-ionized ammonia and toxicity.

1.8 Bayou Casotte Water Quality Criteria

The MS-WQC contains narrative water quality criteria for toxic substances and un-ionized ammonia. The following criteria address aquatic life and human health for toxic substances:

- Aquatic Life—"the concentration of toxic substances shall not result in chronic or acute toxicity or impairment of the uses of aquatic life. Any levels in excess of these values will be considered to result in chronic or acute toxicity, or the impairment of the uses of aquatic life. Regardless of direct measurements of chronic or acute toxicity, the concentrations of toxic substances shall not exceed the chronic or acute values…"

- Human Health—"the concentration of toxic substances shall not exceed the level necessary to protect human health through routes of fish (and shellfish) tissue consumption, water consumption, or other routes identified as appropriate for the waterbody."

Specific requirements for un-ionized ammonia are found in the MS-WQC Section II.10 C. The MS-WQC states that, "Ammonia toxicity shall be evaluated according to EPA guidelines published in *Ambient Water Quality Criteria for Ammonia (Saltwater)-1989* (USEPA, 1989). This material related to ammonia toxicity is hereby incorporated by reference including any subsequent amendments and editions (State of Mississippi Water Quality Criteria for Intrastate, Interstate and Coastal Waters 2003)." According to the EPA publication, *Ambient Water Quality Criteria for Ammonia (Saltwater)-1989* the chronic and acute un-ionized ammonia limits (specified as NH_3) for saltwater are 0.035 mg/l and 0.233 mg/l, respectively. According to the 1989 EPA publication, "…saltwater aquatic organisms should not be affected unacceptably if the four-day average concentration of un-ionized ammonia does not exceed 0.035 mg/L more than once every three years on the average and if the one-hour average concentration does not exceed 0.233 mg/l more than once every three years on the average."

The MS-WQC also specifies if and how mixing zones would be applicable in a waterbody. Section I.8 on Mixing Zones states the following:

"It is recognized that limited areas of mixing are sometimes unavoidable; however, mixing zones shall not be used as a substitute for waste treatment. Mixing zones constitute an area whereby physical mixing of a wastewater effluent with a receiving waterbody occurs. Application of mixing zones shall be made on a case-by-case basis and shall only occur in cases involving large surface water bodies in which a long distance or large area is required for the wastewater to completely mix with the receiving waterbody. The location of a mixing zone shall not significantly alter the designated uses of the receiving water outside its established boundary. Adequate zones of passage for the migration and free movement of fish and other aquatic biota shall be maintained. Toxicity and human health concerns within the mixing zone shall be addressed as specified in the *Environmental Protection Agency Technical Support Document for Water Quality-Based Toxics Control (*USEPA, March 1991) and amendments thereof. Under no circumstances shall mixing zones overlap or cover tributaries, nursery locations, locations of threatened or endangered species, or other ecologically sensitive areas."

2.0 SOURCE ASSESSMENT

Photo 3: Photo of Bayou Casotte in 2005 (USEPA 2005)

2.1 Assessment of Point Sources

After reviewing the types of facilities that are permitted to discharge to Bayou Casotte under the National Pollution Discharge Elimination System (NPDES) program, EPA has determined that only one facility, Mississippi Phosphates Corporation (MPC), causes and contributes un-ionized ammonia and toxicity to the Bayou. Other businesses and homes located in the Bayou Casotte area discharge into the regional sewer system and storm water runoff from other NPDES dischargers should not contribute to un-ionized ammonia or toxics. Photo 3 is a photograph of Bayou Casotte, which shows some of the industrial activities in the waterbody and waterway. Photo 4 is a photo showing a white plume discharge emanating from MPC. EPA believes that the plume was caused by the presence of large amounts of lime in the effluent. The photograph was taken in October 2002.

Photo 4: Discharge emanating from MPC's Outfall 003 due to emergency upset conditions, (October 2002)

The Wasteload Allocation (WLA) provided in this TMDL is based on the chronic and acute criteria for un-ionized ammonia in saltwater and the Effluent Limit Guidelines applicable to MPC, which define the conditions under which a phosphate manufacturing facility may discharge treated process wastewater. These conditions, specifically related to MPC, are described more fully in Appendix C so that the public may understand the basis for how the WLA may be translated into the permit requirements for MPC which will lead to the attainment of the toxicity and un-ionized ammonia water quality standards in Bayou Casotte.

2.1.1. Mississippi Phosphates Corporation (Permit# MS0003115)

MPC produces diammonium phosphate (DAP) fertilizer. Sulfuric acid and phosphoric acid are essential reactants in DAP production and are produced and consumed on-site. DAP is produced in a multi-stage production process, which begins with the digestion of imported phosphate rock with sulfuric acid. The reaction yields phosphoric acid and a byproduct known as gypsum. Phosphoric acid is then reacted with ammonia to produce the intermediate monoammonium phosphate (MAP) liquid and excess ammonia. Water vapor is subsequently removed and the MAP is cooled and granulated to form the final product, DAP.

2.2 Assessment of Nonpoint Sources

Based on existing landuses in Mississippi and on available data, it is not likely that there are any significant nonpoint sources of un-ionized ammonia and toxics in the Bayou Casotte watershed. However, given the lack of nonpoint source data, the TMDL will address nonpoint sources using conservative assumptions of potential loads to ensure that the watershed is protected under all conditions.

3.0 TMDL ENDPOINT AND WATER QUALITY ASSESSMENT

3.1 Selection of a TMDL Endpoint and Critical Condition

This TMDL establishes the total pollutant loads that Bayou Casotte can assimilate and still achieve applicable water quality standards. Proper application of this TMDL should result in the restoration of this waterbody to its designated uses.

The critical condition of a waterbody must be considered as part of the analysis of loading capacity [40 C.F.R. §130.7(c)(1)]. The critical condition can be thought of as the "worst case" scenario of environmental conditions in the waterbody in which the loading expressed in the TMDL for the pollutant of concern will continue to meet water quality standards. Critical conditions are the combination of environmental factors (e.g., low flow, temperature, etc.) that result in attaining and maintaining the water quality criteria and have an acceptably low frequency of occurring. Critical conditions are important because they describe the factors that combine to cause a violation of water quality standards and will help in identifying the actions that may have to be undertaken to meet water quality standards (USEPA, April 1991).

The concentration of un-ionized versus ionized ammonia in the Bayou is dependent on the pH, salinity and temperature of the water. The levels of ionized and un-ionized ammonia will fluctuate during a change in pH and temperature. The concentration of NH_3 (un-ionized ammonia) increases with increasing temperature and pH (USEPA, 1985). Un-ionized ammonia is also more toxic under conditions of decreased dissolved oxygen concentrations. Therefore, the critical conditions for Bayou Casotte are during the summer (warmer water temperatures and greater possibilities for decreased dissolved oxygen concentrations), catastrophic or chronic wet weather events (conditions under which contaminated process wastewater may or must be discharged), or periods of low-flow and low tide. Based on data collected by EPA, MDEQ and MPC from 1998 through 2000, the average water temperature in Bayou Casotte is warmest during the month of August. This data is presented in Appendix B. Critical conditions for chronic un-ionized ammonia are based on the average temperature, salinity and pH levels during the month of August (August 1-August 31) for the data presented in Appendix B. Although, the allocations for the TMDL are established for un-ionized ammonia, the critical conditions for pH, temperature and ammonia (see Table 3) can be used to convert un-ionized ammonia concentrations to total ammonia concentrations. As previously discussed, given the likely scenario that MPC may need to discharge continuously for days after a catastrophic or chronic storm event, it is appropriate and the most conservative approach to base the critical conditions on the acute and chronic criteria.

The TMDL will protect the waterbody for critical conditions during the summer season, which will be protective of water quality standards throughout the year. The summer season in Mississippi can be defined as beginning on May 1 and lasting through October 31 of any given calendar year. It is possible that critical conditions (i.e., temperature, pH and salinity values) for the winter season may also be established for Bayou Casotte and that these conditions for the months of November 1 through April 30 could be described in the NPDES permit.

Table 3: Recommended critical conditions for converting un-ionized ammonia to total ammonia*

Criteria	**pH**	**Temperature**	**Salinity** (ppt)
Acute Criteria: 0.233 mg/l	7.9	31° Celsius	32 ppt
Chronic Criteria: 0.035 mg/l	7.9	31° Celsius	32 ppt

*****The pH, temperature and salinity values represent critical conditions during summer months (May – October). For winter months (November – April), MDEQ may either use these values or choose alternate values that represent critical conditions during the winter season.

3.2 Instream Water Quality Data

Since 1998, a number of studies have been conducted to better characterize the environmental conditions in Bayou Casotte. EPA, MDEQ and MPC collected data (presented in Appendix B) on salinity, temperature, pH, and un-ionized ammonia from 1998 through 2000 in Bayou Casotte. As mentioned above, the critical conditions in Bayou Casotte are based on the mean temperatures, pH and salinity data collected during the month of August from 1998 through 2000. EPA Region 4 and MDEQ also performed other studies in 2001, 2004 and 2005. However, these studies were not designed to characterize the temperature, pH and salinity levels in Bayou Casotte, and therefore, the results from these studies were not used in the determination of critical conditions for these parameters.

In 2004, EPA Region 4 and MDEQ conducted a mixing zone study and ambient monitoring to assess the extent of the un-ionized ammonia and toxicity impairments to Bayou Casotte. Figure 2 indicates the sampling points along Bayou Casotte and the location of MPC. The results of the study show that chronic and acute un-ionized ammonia toxicity exists between stations T14 and T22. Thirty-three of the fifty samples collected during the sampling program exceeded the EPA chronic un-ionized ammonia criterion of 0.035 mg/l. Three of fifty samples exceeded the EPA acute un-ionized ammonia criterion of 0.233 mg/l. Only one of the 110 calculated un-ionized ammonia concentrations south of station T14 exceeded the chronic criteria

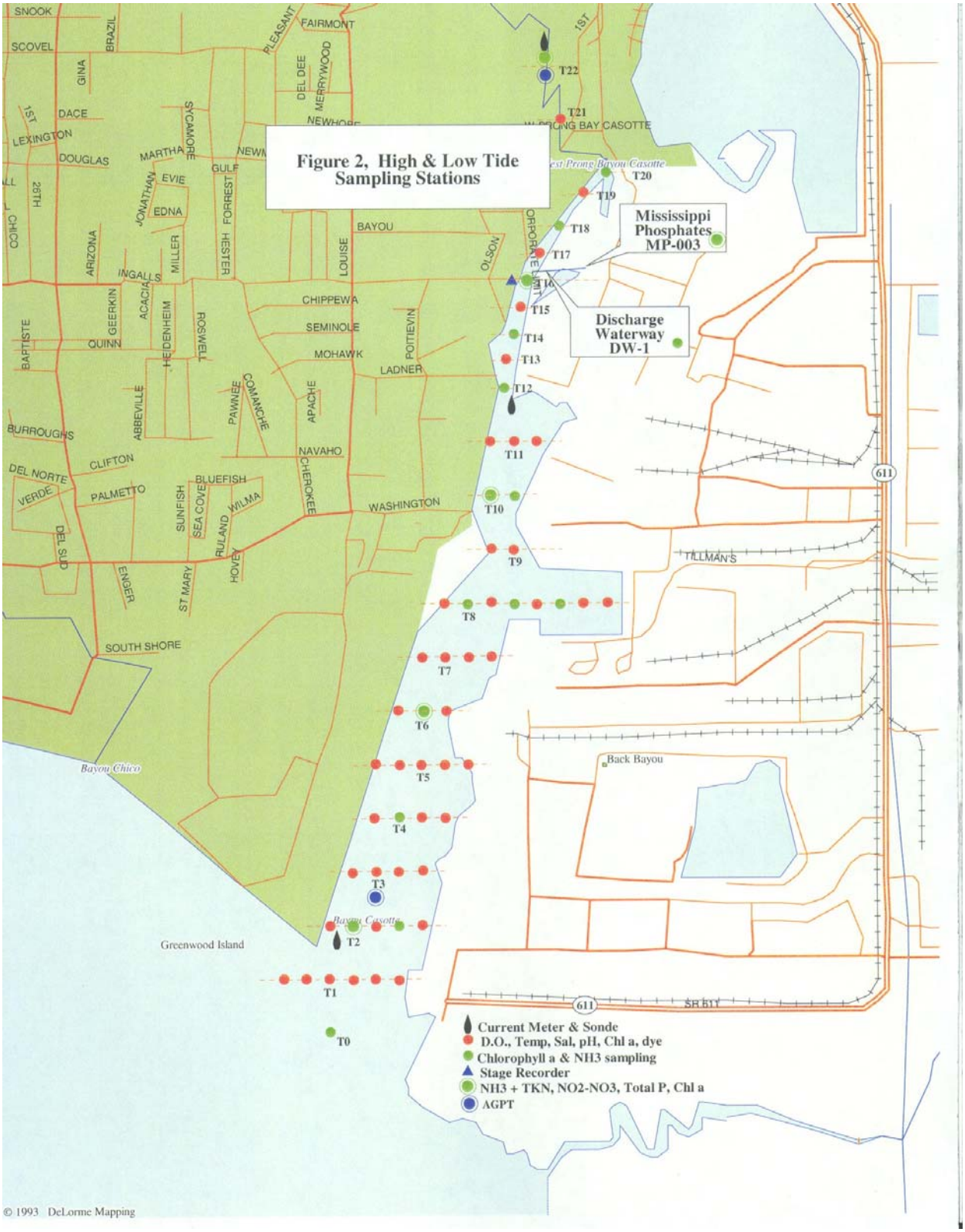


Figure 2: Location of Mississippi Phosphates Corporation and sampling locations (USEPA 2004)

4.0 ALLOCATIONS

A Total Maximum Daily Load (TMDL) is the amount of a pollutant that can be assimilated by the receiving waterbody without exceeding the applicable water quality standard. It is expressed as the sum of wasteload allocations (WLAs) and load allocations (LAs). The TMDLs must also include a margin of safety (MOS). The MOS is either implicit or explicit and accounts for the uncertainty in the relationship between pollutant loads and the water quality response of the receiving water body. The data collected by EPA Region 4 and MDEQ in May 2004 indicate that there is chronic and acute un-ionized ammonia toxicity in portions of Bayou Casotte. Based on this data EPA believes that the un-ionized ammonia is the primary source of toxicity to organisms in Bayou Casotte. Therefore, the total toxics impairment for Bayou Casotte will be addressed through the un-ionized ammonia TMDL. In addition, allocations will be established to ensure protection of both the chronic and the acute effects of un-ionized ammonia toxicity.

4.1 Calculating Total Ammonia

The allocations in this TMDL are expressed in terms of the maximum allowable un-ionized ammonia concentrations under critical conditions. These allocations can also be converted to total ammonia and as discussed in Section 4.5, the NPDES permit requirements for MPC may be expressed in terms of total ammonia. The 1989 EPA publication, *Ambient Water Quality Criteria for Ammonia* (USEPA, 1989), provides the formula and methodology needed to convert the percentage of NH_3 (which is referred to as UIA in the EPA publication) from the solution pH and pK_a (i.e., the negative log of stoichiometric dissociation). Stoichiometry quantifies the relationships between reactants and products in a chemical reaction. Dissociation in this case refers to the separation into ions that occurs when a soluble ionic substance dissolves in water.

$$\% \text{ UIA (un-ionized ammonia) in saltwater} = [1+10^{(X + 0.0324\,(298-T) + 0.0415\,P/T - pH)}]^{-1}$$

The stoichiometric dissociation constant is defined as:

$$K_a = \frac{[NH_3]\,[H^+]}{[NH4^+]}$$

The brackets represent molal concentrations. K_a is a function of the temperature and ionic strength of the solution.

EPA's *Ambient Water Quality Criteria for Ammonia (Saltwater)-1989* (USEPA, 1989) provides the following description of how the percentage of un-ionized ammonia is calculated:

> Whitfield (1974) developed theoretical models to determine the pK_a of the ammonium ion in seawater. He combined his models with the infinite dilution data of Bates and Pinching (1949) to define general equations for the pK_a of ammonium ions as a function of salinity and temperature.
>
> Whitfield's models allow reasonable approximations of the percent un-ionized ammonia in seawater and have been substantiated experimentally by Khoo et al. (1977). Hampson's (1977) program for Whitfield's full seawater model has been used to calculate the un-ionized ammonia fraction of measured total ammonia concentrations in toxicity studies conducted by EPA and also in the derivation of most other acute and chronic ammonia values which contribute to the criteria. The equations for this model

are:

$$\% \text{ UIA} = 100\ [1+10^{(X + 0.0324\ (298-T) + 0.0415\ P/T - pH)}]^{-1}$$ where:

P= 1 ATM for all toxicity testing reported to date;

T= temperature in Kelvin (°K);

X= pK^{s}_{a} or the stoichiometric acid hydrolysis constant of ammonium ions in saline water based on I, where

I= 19.9273 S (1000-1.005109 S) $^{-1}$ (molal ionic strength of sea water)

S= salinity (g/kg).

4.2 Wasteload Allocation

The WLA portion of the TMDL assesses and attributes pollutant contributions from point sources to the waterbody. An important component of TMDL development is to establish relationships between source loadings and in-stream water quality. Since MPC is the only NPDES permitted facility discharging un-ionized ammonia in the watershed, the WLA in this TMDL covers discharges from MPC. The WLA is based on the EPA water quality standard for un-ionized ammonia and toxic substances and the Phosphate Manufacturing Effluent Guideline requirements, applicable to MPC. The allocations established by this TMDL do not allow any facilities to discharge ammonia to Bayou Casotte other than MPC. This TMDL would need to be revised in order to allow any additional discharges of ammonia to Bayou Casotte.

MPC discharges treated process wastewater under catastrophic rainfall (25-year, 24-hour storm events) and chronic rainfall events. After such rain events have ended, MPC may need to continue discharging for several days until the surge capacity returns to an acceptable water level. EPA's 2004 mixing zone study determined that little to no dilution exists in Bayou Casotte during low-tide. As a result, the established wasteload allocation requires that chronic and acute criteria are met at the point of discharge. The daily maximum concentration of un-ionized ammonia discharged by MPC is not to exceed the acute criteria concentration, and the four-day average concentration of un-ionized ammonia discharged is not to exceed the chronic criteria. Based on the 1989 EPA publication, *Ambient Water Quality Criteria for Ammonia (Saltwater)*, the acute and chronic end-of-pipe criteria applicable to MPC is 0.233 mg/l and 0.035 mg/l, respectively. The wasteload allocation is presented in Table 4. Total ammonia concentrations during critical conditions can be determined using the pH, salinity and temperature conditions presented in Table 4.

Table 4. Wasteload allocation for un-ionized ammonia

FACILITY	ALLOCATIONS		
Mississippi Phosphates Corporation— MS0003115	Daily maximum effluent concentrations not to exceed 0.233 mg/l (Acute). Four-day average effluent concentrations not to exceed 0.035 mg/l (Chronic)		
	CRITICAL CONDITIONS*		
	pH	Temperature	Salinity (ppt)
	7.9	31° Celsius	32

*The pH, temperature and salinity values represent critical conditions during summer months (May – October). For winter months (November – April), MDEQ may either use these values or choose alternate values that represent critical conditions during the winter season.

4.3 Load Allocation

Based on the available data, including water quality data and landuse information, EPA has determined that there are no significant nonpoint sources of un-ionized ammonia and toxics in the Bayou Casotte watershed. EPA expects that ambient levels of un-ionized ammonia associated with nonpoint sources and/or natural conditions are likely significantly less than concentrations associated with chronic levels (0.035 mg/l). However, in light of the uncertainty regarding the specific ambient levels associated with nonpoint sources or background concentrations, EPA is using a conservative assumption as part of an implicit margin of safety regarding the current ambient concentrations of un-ionized ammonia. MDEQ has routinely used a conservative assumption for total ammonia (un-ionized ammonia plus ionized ammonia) equal to 0.1 mg/l in its process for developing water quality-based effluent limitations outside of the TMDL process. For pH and temperature values which represent critical conditions (see table below), a total ammonia concentration of 0.1 mg/l corresponds to an un-ionized ammonia concentration of 0.00559 mg/l. EPA has determined that an assumed ambient concentration for un-ionized ammonia of 0.00559 mg/l is appropriately conservative and is also below a level that could cause or contribute to excursions of the applicable water quality standards. Therefore, the load allocation of the TMDL identifies an allowable concentration of un-ionized ammonia associated with nonpoint sources (i.e., stormwater runoff and other waters draining to Bayou Casotte) equal to 0.00559 mg/l. Consistent with the averaging periods that are applicable for the chronic and acute water quality criteria for ammonia, the load allocation for un-ionized ammonia of 0.00559 mg/l is expressed in terms of a daily maximum concentration and a four-day average concentration, as presented in Table 5.

Table 5. Load allocations for un-ionized ammonia

Allowable Concentrations in Storm Water Runoff and Other Waters Draining to Bayou Casotte		
Not to exceed daily maximum acute concentration of 0.00559 mg/l Not to exceed four-day average chronic concentration of 0.00559 mg/l		
CRITICAL CONDITIONS*		
pH	Temperature	Salinity (ppt)
7.9	31° Celsius	32

*****The pH, temperature and salinity values represent critical conditions during summer months (May – October). For winter months (November – April), MDEQ may either use these values or choose alternate values that represent critical conditions during the winter season.

4.4 NPDES Permit Considerations Based on MPC's Current Discharge Location

NPDES permits for un-ionized ammonia are typically written in terms of total ammonia since un-ionized ammonia cannot be analytically assessed. Total ammonia is the sum of un-ionized ammonia (NH_3) plus the ionized form (NH_{4+}). The toxicity of total ammonia depends on the amount of NH_3, the percentage of which increases with higher pH and temperature. Therefore, the toxicity of total ammonia is greater in water with higher pH (alkaline waters) and at higher temperatures. The wasteload allocations specified in this TMDL set limits that will be protective of the waterbody during the critical season, summer, which will be protective of water quality standards throughout the year. The summer season in Mississippi can be defined as beginning on May 1 and lasting through October 31 of any given calendar year. It is possible that critical conditions (i.e., temperature, pH, and salinity values) for the winter season may also be established for Bayou Casotte and that these conditions for the months of November 1 through

April 30 could be described in any future NPDES permit. The NPDES permit for MPC will be the legal mechanism that will contain the enforceable conditions under which the chronic and acute criteria for un-ionized ammonia will be applied, monitored, and reported by MPC. The acute wasteload allocation can be applied as a daily maximum concentration of total ammonia that is not to be exceeded and the chronic wasteload allocation can be applied as a weekly average concentration of total ammonia that is not to be exceeded.

4.5 NPDES Permit Considerations Based on MPC's Potential New Discharge Relocation

EPA understands that MPC has expressed potential interest to MDEQ in relocating its outfall in order to provide greater dilution of its effluent, thereby allowing less stringent permit requirements. A technical report completed by a contractor for MPC was provided to EPA through MDEQ. Based on the review of the report, EPA believes that additional questions remain regarding the amount of dilution that would be available to MPC if the outfall is relocated. Future permit requirements based on a relocation of the MPC outfall could be considered consistent with the wasteload allocation in this TMDL if it is demonstrated that acute and chronic criterion concentrations for un-ionized ammonia will be met at the edge of a mixing zone and zone of initial dilution (ZID), taking into account the following considerations: (1) whether the outfall is moved to a location where additional dilution is available under critical conditions and the amount of dilution available is studied and documented at the specific location; (2) whether the mixing zone is consistent with MDEQ's regulations which states that "…mixing zones shall not be used as substitute for waste treatment…"; and (3) whether the mixing zone/ZID is supported by scientifically defensible information, which includes information on the effects of wind fetch on the amount of mixing available at the proposed outfall location. Seasonal high winds in the Gulf of Mexico can concentrate the ammonia discharges in the Bayou, as reported by EPA in its publication entitled, "Bayou Casotte: Dye Dilution and Water Quality Study (USEPA 2004)". Figure 3 depicts how criteria are applied in a mixing zone and ZID.

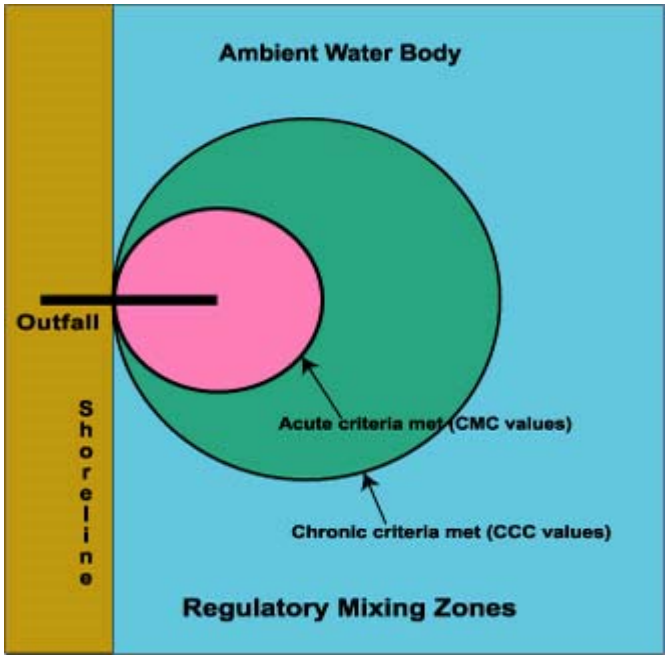


Figure 3: Diagram representing a mixing zone/ZID and the application of the acute and chronic criteria

Should MPC decide to relocate their outfall location and pursue a mixing zone/ZID, the facility should submit their request to MDEQ for review and approval, which would require a change to the facility's current NPDES permit, which would be subject to EPA review. The NPDES administrative procedures require that the public be notified and allowed to comment on NPDES draft permits. Since Mississippi is the NPDES permitting authority, the state is required to provide the public with the opportunity to provide comments on any future permit.

4.6 Incorporation of a Margin of Safety (MOS)

All TMDLs are required by 40 CFR 130.7(1) to have a margin of safety (MOS). This citation reads, in part: "…TMDLs shall be established at levels necessary to attain and maintain the applicable narrative and numerical WQS with seasonal variations and a margin of safety which takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality." This TMDL incorporates the MOS by utilizing conservative assumptions in the TMDL development process. Under most environmental conditions (as described in Appendix C), MPC should not be discharging any loads of ammonia to Bayou Casotte. During the conditions when discharges are allowed, ammonia concentrations in Bayou Casotte are expected to be either less than or equal to the applicable water quality criteria. In addition, the loads from non-point sources are required by the load allocation to be at levels that are less than those required by the applicable chronic and acute criteria for ammonia. Therefore, the ammonia concentrations in Bayou Casotte are expected to be either less than or equal to the applicable water quality criteria.

4.7 Seasonality

This TMDL accounts for seasonal variability by requiring allocations that ensure year-round protection of water quality standards, including during critical conditions.

4.8 Public Participation

The 2001 Bayou Casotte TMDL for un-ionized ammonia and total toxicity was proposed for public review and comment on July 2, 2001. The original public-notice period of 60 days was extended until February 1, 2002 to allow more time for public comments. After completing additional environmental studies in Bayou Casotte in 2005, EPA re-proposed the TMDL for public review and comment during a 60-day period (August 25-October 23, 2006). As part of this process, the public was notified by publication in the statewide newspaper, *The Clarion-Ledger*, and a newspaper in the area of the watershed, *The Mississippi Press*. The TMDL was also distributed to those members of the public who requested to be included on a TMDL mailing list. In addition, the TMDL was available for review and comment on EPA Region 4's website (http://www.epa.gov/Region4/water/tmdl/mississippi/).

All comments received during the public notice period are part of the public record for this TMDL. All comments were fully considered prior to the establishment of this TMDL by EPA Region 4 and are included in EPA's Responsiveness Summary for this TMDL.

APPENDIX A – CHRONIC AND ACUTE UN-IONIZED AMMONIA DATA (MAY 2004)

Sampling Station					Bayou Casotte Un-ionized Ammonia						
			High Tide						Low Tide		
	5/5/2004	5/6/2004	5/7/2004	5/8/2004	5/9/2004		5/5/2004	5/6/2004	5/7/2004	5/8/2004	5/9/2004
	mg/l	mg/l	mg/l	mg/l	mg/l		mg/l	mg/l	mg/l	mg/l	mg/l
		Tidal Cycles						Tidal Cycles			
	1	2	3	4	5		1	2	3	4	5
T22	0.017	0.028	0.026	0.035	0.050		0.023	0.043	0.043	0.017	0.004
T21											
T20	0.006	0.035	0.030	0.051	0.035		0.125	0.064	0.189	0.026	0.149
T19											
T18	0.012	0.037	0.040	0.048	0.027		0.234	0.063	0.099	0.044	0.202
T17											
T16	0.012	0.042	0.118	0.066	0.003		0.170	0.360	0.273	0.054	0.160
T15											
T14	0.020	0.047	0.016	0.051	0.004		0.022	0.077	0.095	0.051	0.057
T13											
T12	0.012	0.015	0.024	0.017	0.003		0.007	0.005	0.004	0.027	0.012
T11											
T10	0.002	0.005	0.003	0.011	0.003		0.005	0.004	0.004	0.016	0.003
T9	0.002	0.037	0.003	0.005	0.003		0.005	0.003	0.004	0.024	0.003
T8	0.002	0.003	0.003	0.006	0.002		0.005	0.003	0.004	0.008	0.002
T7	0.002	0.003	0.003	0.006	0.003		0.005	0.003	0.004	0.005	0.002
T6	0.003	0.002	0.003	0.006	0.002		0.005	0.003	0.004	0.004	0.002
T5	0.003	0.002	0.003	0.004	0.002		0.004	0.003	0.003	0.004	0.002
T4	0.003	0.002	0.004	0.003	0.002		0.004	0.003	0.003	0.004	0.002
T3		0.002	0.003	0.003	0.002		0.004	0.003	0.003	0.004	0.002
T2	0.003	0.002	0.003	0.003	0.002		0.004	0.003	0.003	0.003	0.002
T1	0.004	0.002	0.003	0.003	0.003		0.004	0.003	0.004	0.003	0.002
				A = Acute limit for unionized ammonia set at 0.233 mg/l							
				C = Chronic limit for unionized ammonia set at 0.035 mg/l							

This table is taken from the *Bayou Casotte Dye Dilution and Water Quality Study (USEPA, May 2004)*, which was conducted by U.S. EPA Region 4 and MDEQ. During the study, two separate sampling programs were conducted. One program consisted of daily high and low tide ammonia sampling in concert with in-situ measurements of pH, Temperature and salinity. Samples were collected at stations T22, T20, T18, T16, T14, T12, T10, T9, T8, T7, T6, T5, T4, T3, T2, and T1. The data shows that chronic and acute un-ionized ammonia toxicity was mostly isolated to the segment of Bayou Casotte from station T14 to T22 (see Figure 2 in the report). This segment stretches from just south of the effluent receiving tidal creek to the most northerly station nearer the headwaters. Thirty-three of the fifty samples collected during the sampling program exceeded the EPA chronic un-ionized ammonia criterion of 0.035 mg/l. Three of fifty samples exceeded the EPA acute un-ionized ammonia criterion of 0.233 mg/l. Only one of the 110 calculated un-ionized ammonia concentrations south of station T14 exceeded the chronic criteria.

A map showing the locations of the sampling sites is provided in the TMDL report (Figure 2, Page 20).

APPENDIX B – CRITICAL CONDITION DATA (MAY 2004)

Data Entity Collecting	Sampling Station Number	Date	Salinity (ppt)	Temperature (C)	PH
MPC	1	8/7/1998	31.7	31.7	8
MPC	2	8/7/1998	32.3	30.8	8.2
MPC	3	8/7/1998	32.3	30.8	8.1
MPC	4	8/7/1998	31.8	31.3	7.6
MPC	5	8/7/1998	32.3	30.8	8.1
MPC	6	8/7/1998	32.3	30.8	8.1
MDEQ	109CAS02	8/25/1998	27.2	31.5	8.1
MPC	1	8/31/1998	31.7	31.7	8
MPC	2	8/31/1998	32.3	30.8	8.2
MPC	3	8/31/1998	32.3	30.8	8.1
MPC	4	8/31/1998	31.8	31.3	7.6
MPC	5	8/31/1998	32.3	30.8	8.1
MPC	6	8/31/1998	32.3	30.8	8.1
MPC	1	8/6/1999	31.7	31.7	8
MPC	2	8/6/1999	32.3	30.8	8
MPC	3	8/6/1999	32.3	30.8	8
MPC	4	8/6/1999	31.8	31.3	7.7
MPC	5	8/6/1999	32.3	30.8	8.1
MPC	6	8/6/1999	32.3	30.8	8
MDEQ	109CAS02	8/3/2000	29.4	29.7	7.9
MPC	1	8/10/2000	31.7	31.7	7.8
MPC	2	8/10/2000	32.3	30.8	7.8
MPC	3	8/10/2000	32.3	30.8	7.8
MPC	4	8/10/2000	31.8	31.3	7.6
MPC	5	8/10/2000	32.3	30.8	7.9
MPC	6	8/10/2000	32.3	30.8	7.6
Crescent	BC-2	8/17/2000	31.7	31.3	7.7
Crescent	BC-3	8/17/2000	31.6	31.7	7.3
Crescent	BC-5	8/17/2000	32.3	30.8	7.9
Crescent	BC-2	8/30/2000	31.8	31.4	7.8
Crescent	BC-3	8/30/2000	31.8	31.7	7.6
Crescent	BC-5	8/30/2000	32.3	30.8	7.9

The data are taken from the Bayou Casotte Dye Dilution and Water Quality Study (USEPA, May 2004**)**

APPENDIX C – EFFLUENT LIMIT GUIDELINES APPLICABLE TO MPC AND EXPLANATION OF DISCHARGE CONDITIONS

Mississippi Phosphates Corporation (Permit# MS0003115)

Production Process

MPC produces diammonium phosphate (DAP) fertilizer. Sulfuric acid and phosphoric acid are essential reactants in DAP production and are produced and consumed on-site. DAP is produced in a multi-stage production process, which begins with the digestion of imported phosphate rock with sulfuric acid. The reaction yields phosphoric acid and the byproduct known as gypsum. Phosphoric acid is then reacted with ammonia to produce the intermediate monoammonium phosphate (MAP) liquid and excess ammonia. Water vapor is subsequently removed and the MAP is cooled and granulated to form the final product, DAP.

Wastewater Management

MPC currently manages two by-product storage stacks of gypsum (gypstacks), designated as the East Gypstack and West Gypstack. The East Gypstack began receiving gypsum in 2002 and became the sole destination for gypsum byproduct for the facility. The gypsum waste is mixed with water and delivered as a slurry to Gypstack settling ponds via wastewater-piped transport and is maintained within a complex water management system, along with any precipitation which comes into contact with the exposed material. After solids have settled, the facility reuses the water in production operations. This wastewater is known as the facility's *process* wastewater. Process wastewater is generated from emission control scrubbers and from the phosphoric acid process. Process wastewater will contain un-ionized ammonia. Process wastewater and contaminated precipitation may accumulate in the settling ponds and as discussed below, may be treated and discharged to Bayou Casotte, only as a result of chronic or catastrophic rainfall events. The circumstances under which MPC may discharge process wastewater are further described below.

Non-process wastewater, also referred to as non-contact cooling wastewater, should not be contaminated with un-ionized ammonia except through incidental contact. All of the sources of non-process wastewaters and the circumstances through which contamination of non-process wastewater may occur are described in the NPDES permit for MPC. According to the permit, *non-process* wastewater means "…any water including precipitation runoff which, during manufacturing or processing, comes into incidental contact with any raw material, intermediate products, finished product, byproduct or waste product by means of: (1) precipitation runoff; (2) accidental spills; (3) accidental leaks caused by the failure of process equipment and which are repaired of the discharge of pollutants there from contained or terminated within the shortest reasonable time which shall not exceed 24 hours after discovery or when discovery should reasonably have been made, whichever is earliest; and (4) discharges from safety equipment, and from equipment washings for the purpose of safe entry, inspection and maintenance provided that all reasonable measures have been taken to prevent, reduce, eliminate and control to the maximum extent feasible such contact and provided further that all reasonable measures have been taken that will mitigate the effects of such contact once it has occurred." Good facility maintenance and housekeeping will prevent and minimize the risk of contaminating non-process wastewater.

Storm water runoff is collected in the storm water system for which MPC has 14 permitted storm water outfalls. Some of the storm water runoff is discharged directly to the storm water outfalls while some other storm water is mixed with contaminated process wastewater. Uncontaminated storm water should not have un-ionized ammonia in the discharge. Storm water mixed with process wastewater is handled and discharged with treatment under certain conditions.

Permitted Outfalls

MPC discharges treated process water and storm water to a narrow and shallow manmade discharge canal, which is tidally influenced and flows into Bayou Casotte. The Bayou at this location is a few hundred feet wide and approximately 15 feet deep. Just south of the discharge, Bayou Casotte becomes a wider shipping channel. This portion of the bayou is approximately 1,000 feet wide and 42 feet deep (USEPA 2004). Figure 2 (in the TMDL report) depicts the location of MPC and shows sampling points along Bayou Casotte.

MPC has three designated process related waste streams at the facility with outfalls designated as 001-003. Water collected and discharged through outfall 001 contains contaminated non-process related wastewater, non-contact cooling water, storm water runoff, and backwash from the process areas. This water is manually treated to adjust for pH and moves in an earthen channel and combines with outfall 002 in a concrete-lined channel to form Outfall 003. Outfall 002 receives contaminated process wastewater from the onsite wastewater treatment plant, originating from the Gypstack water management system. Outfall 002 should only be used during chronic or catastrophic rainfall events, which will be further discussed below. Outfalls 001 and 002 combine to form Outfall 003 in the concrete-lined channel, which discharges directly to Bayou Casotte.

Conditions for Wastewater Discharges

Process Wastewater

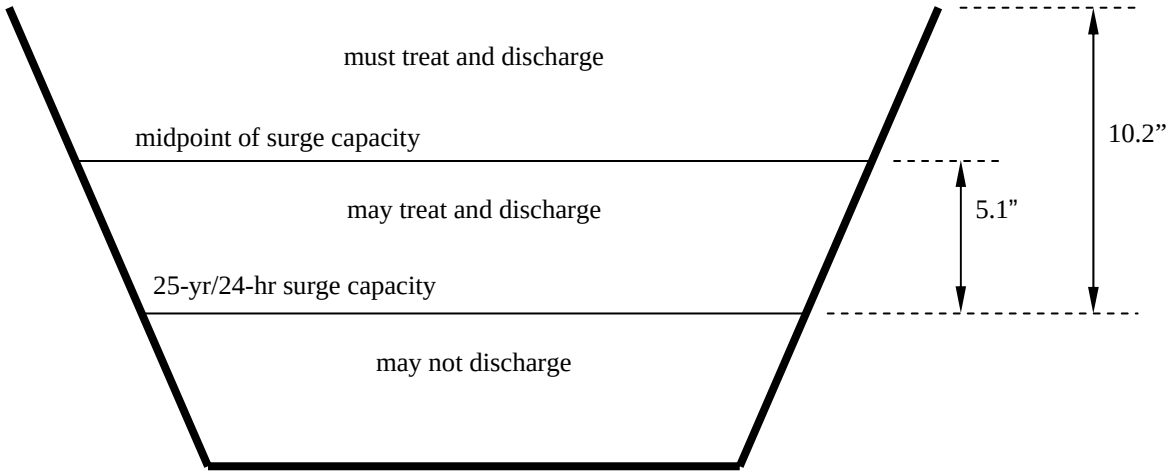
According to Phosphate Manufacturing Effluent Guideline requirements (40 C.F.R. Part 418 Subpart A), applicable to MPC, MPC must design and operate its water recirculation system and Gypstack settling ponds (containing *process* wastewater*)* to maintain a surge capacity equal to a catastrophic 25-year, 24-hour rainfall event. A catastrophic storm is defined as a 10.2-inch rainfall occurring within 24 hours. The facility is responsible for monitoring and tracking the changes in available surge storage capacity. The available surge storage capacity is the amount of space which can safely accommodate additional rainfall. The amount of storage capacity for wastewater decreases as rainfall accumulates. As the total water level in the ponds rise, the facility reaches a critical point equal to half of the required surge capacity (i.e., 5.1 inches) at which it must treat and discharge its wastewater to prevent stack failure. MPC has three conditions under which it manages Gypstack water levels based on surge capacity demands and permit requirements. These conditions are described below and illustrated in Figure 1 of Appendix C.

(1) No discharge allowed: MPC's water level is greater than the required surge capacity of 10.2 inches.

(2) May discharge: Treated process wastewater may be discharged whenever the water level rises into the required surge capacity, but is only allowed as a result of chronic or catastrophic precipitation.

(3) Must discharge: Process water must be treated and discharged whenever chronic or catastrophic precipitation causes the water level to exceed the midpoint of the surge capacity (5.1 inches).

Figure 1. Diagram Illustrating MPC's Gypsum Stack Settling Pond Holding Capacity



Water levels should never rise into the upper, stabilizing portion of the Gypstack banks, known as the freeboard. If this occurs, it can damage the integrity of the pond and potentially cause the dike to fail, which could cause an uncontrolled release of untreated wastewater. The freeboard is part of the structure of the pond; however, it is not part of the holding capacity of the pond. Precipitation, production uses, and a variety of environmental factors cause the water level to fluctuate. The need to discharge is based on the amount of available surge capacity and should be triggered only by chronic or catastrophic precipitation events. Discharges are continuous until the surge capacity is returned to an acceptable level; which could take several days.

Non-process Wastewater and Storm Water

Uncontaminated wastewater and uncontaminated storm water may be discharged continuously. As previously mentioned, the terms of MPC's NPDES permit outlines how uncontaminated non-process wastewater should be handled if it becomes contaminated through incidental contact.

GLOSSARY

303(d). A section of the Clean Water Act of 1972 requiring states to identify and list water bodies that do not meet the State's water quality standards.

Algal Growth Potential (AGP). The AGP test is a series of assays used to determine the maximum amount of algal growth that the nutrients in a water sample can support. The AGP assay indicates the potential for algal blooms.

Allocations. That portion of a receiving water's loading capacity attributed to one of its existing or future pollution sources (nonpoint or point) or to natural background sources. A wasteload allocation [WLA] is that portion of the loading capacity allocated to an existing or future point source, and a load allocation [LA] is that portion allocated to an existing or future nonpoint source or to natural background levels. Load allocations are best estimates of the loading, which can range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting loading.

Ambient water quality. Natural concentration of water quality constituents prior to mixing of either point or nonpoint source load of contaminants. Reference ambient concentration is used to indicate the concentration of a chemical that will not cause adverse impact on human health.

Aquatic ecosystem. Complex of biotic and abiotic components of natural waters. The aquatic ecosystem is an ecological unit that includes the physical characteristics (such as flow or velocity and depth), the biological community of the water column and benthos, and the chemical characteristics such as dissolved solids, dissolved oxygen, and nutrients. Both living and nonliving components of the aquatic ecosystem interact and influence the properties and status of each component.

Assimilative capacity. The amount of contaminant load that can be discharged to a specific waterbody without exceeding water quality standards or criteria. Assimilative capacity is used to define the ability of a waterbody to naturally absorb and use a discharged substance without impairing water quality or harming aquatic life.

Background levels. Levels representing the chemical, physical, and biological conditions that would result from natural geomorphological processes such as weathering or dissolution.

Clean Water Act (CWA). The Clean Water Act (formerly referred to as the Federal Water Pollution Control Act or Federal Water Pollution Control Act Amendments of 1972), Public Law 92-500, as amended by Public Law 96-483 and Public Law 97-117, 33 U.S.C. 1251 et seq. The Clean Water Act (CWA) contains a number of provisions to restore and maintain the quality of the nation's water resources. One of these provisions is section 303(d), which establishes the TMDL program.

Criterion Continuous Concentration (CCC). This is an estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed indefinitely without resulting in an unacceptable effect.

Criteria Maximum Concentration (CMC). This is an estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed briefly without resulting in an unacceptable effect

Critical condition. The critical condition can be thought of as the "worst case" scenario of environmental conditions in the waterbody in which the loading expressed in the TMDL for the pollutant of concern will continue to meet water quality standards. Critical conditions are the combination of environmental factors (e.g., flow, temperature, etc.) that results in attaining and maintaining the water quality criterion and has an acceptably low frequency of occurrence.

Designated uses. Those uses specified in a state's water quality standards for each waterbody or segment whether or not they are being attained.

Dike. An embankment of earth and rock built to prevent floods.

Discharge. Flow of surface water in a stream or canal, or the outflow of groundwater from a flowing artesian well, ditch, or spring. Can also apply to discharge of liquid effluent from a facility or to chemical emissions into the air through designated venting mechanisms.

Dissolved oxygen (DO). The amount of oxygen dissolved in water. This term also refers to a measure of the amount of oxygen available for biochemical activity in a waterbody, an indicator of the quality of that water.

Effluent. Municipal sewage or industrial liquid waste (untreated, partially treated, or completely treated) that flows out of a treatment plant, septic system, pipe, etc.

Effluent Guidelines: Technical EPA documents which set effluent limitations for given industries and pollutants.

Effluent Limitation: Restrictions established by a state or EPA on quantities, rates, and concentrations in wastewater discharges.

Endpoint. An endpoint (or indicator/target) is a characteristic of an ecosystem that may be affected by exposure to a stressor. Examples of endpoints or targets are numeric criteria that are part of a state's traditional water quality standards.

Estuary: Region of interaction between rivers and near-shore ocean waters, where tidal action and river flow mix fresh and salt water. Such areas include bays, mouths of rivers, salt marshes, and lagoons. These brackish water ecosystems shelter and feed marine life, birds, and wildlife.

Existing use. Use actually attained in the waterbody on or after November 28, 1975, whether or not it is included in the water quality standards (40 CFR 131.3).

Freeboard: Vertical distance from the normal water surface to the top of a confining wall. 2. Vertical distance from the sand surface to the underside of a trough in a sand filter.

Impaired Segments Waterbodies (i.e., stream reaches or lakes) that have been placed on the Section 303(d) list because they exceed water quality standards for one or more pollutant(s).

Loading, Load, Loading rate. The total amount of pollutants entering the system from one or multiple sources; measured as a rate in weight per unit time.

Load allocation (LA). The portion of a receiving waters loading capacity attributed either to one of its existing or future nonpoint sources of pollution or to natural background sources. Load allocations are best estimates of the loading, which can range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting the loading. Wherever possible, natural and nonpoint source loads should be distinguished (40 CFR 130.2(g)).

Loading capacity (LC). The greatest amount of loading a water can receive without violating water quality standards.

Margin of safety (MOS). A required component of the TMDL that accounts for the uncertainty about the relationship between the pollutant loads and the quality of the receiving waterbody (CWA section 303(d)(1)(C)). The MOS is normally incorporated into the conservative assumptions used to develop TMDLs (generally within the

calculations or models). If the MOS needs to be larger than that which is allowed through the conservative assumptions, additional MOS can be added as a separate component of the TMDL.

Mg/l. Milligram per liter.

Mixing Zone: A limited area or volume of water where initial dilution of a discharge takes place and where numeric water quality criteria can be exceeded but acutely toxic conditions are prevented.

Monitoring. Periodic or continuous surveillance or testing to determine the level of compliance with statutory requirements and/or pollutant levels in various media or in humans, plants, and animals.

Narrative criteria. Nonquantitative guidelines that describe a desired water quality goal or goals.

National Pollutant Discharge Elimination System (NPDES). The national program for issuing, modifying, revoking and reissuing, terminating, monitoring, and enforcing permits, and imposing and enforcing pretreatment requirements, under Sections 307, 402, 318, and 405 of the Clean Water Act. Facilities subjected to NPDES permitting regulations include operations such as municipal wastewater treatment plants and industrial waste treatment facilities.

Nonpoint source. Pollution that originates from diffuse sources over a relatively large area. Nonpoint sources can be divided into source activities related to either land or water use including failing septic tanks, improper animal-keeping practices, forest practices, and urban and rural runoff.

Numeric targets. A measurable value determined for the pollutant of concern, which, if achieved, is expected to result in the attainment of water quality standards in the listed waterbody.

Point source. Pollutant loads discharged at a specific location from pipes, outfalls, and conveyance channels from either municipal wastewater treatment plants or industrial waste treatment facilities. Point sources can also include pollutant loads contributed by tributaries to the main receiving water stream or river.

Pollutant. A contaminant that is discharged to a waterbody, resulting in the impairment of that waterbody. Types of pollutants include dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into water (CWA Section 502(6))..

Pollution. Generally, the presence of matter or energy whose nature, location, or quantity produces undesired environmental effects. Under the Clean Water Act, for example, the term is defined as the man-made or man-induced alteration of the physical, biological, chemical, and radiological integrity of water.

Public comment period. The time allowed for the public to express its views and concerns regarding action by EPA or states (e.g., a *Federal Register* notice of a proposed rule-making, a public notice of a draft permit, or a Notice of Intent to Deny).

Receiving waters. Creeks, streams, rivers, lakes, estuaries, ground-water formations, or other bodies of water into which surface water and/or treated or untreated waste are discharged, either naturally or in man-made systems.

Surface runoff. Precipitation, snowmelt, or irrigation water in excess of what can infiltrate the soil surface and be stored in small surface depressions; a major transporter of nonpoint source pollutants.

Surface water. All water naturally open to the atmosphere (rivers, lakes, reservoirs, ponds, streams, impoundments, seas, estuaries, etc.) and all springs, wells, or other collectors directly influenced by surface water.

Total Maximum Daily Load (TMDL). The sum of the individual wasteload allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources and natural background, plus a margin of safety (MOS) (TMDL = WLA + LA + MOS). TMDLs can be expressed in terms of mass per time, toxicity, or other appropriate measures that relate to a state's water quality standard.

Wasteload allocation (WLA). The portion of a receiving waters' loading capacity that is allocated to one of its existing or future point sources of pollution. WLAs constitute a type of water quality-based effluent limitation (40 CFR 130.2(h)).

Wastewater treatment. Chemical, biological, and mechanical procedures applied to an industrial or municipal discharge or to any other sources of contaminated water to remove, reduce, or neutralize contaminants.

Water quality. Elements of state water quality standards expressed as constituent concentrations, levels, or narrative statement, representing a quality of water that supports a particular use. When criteria are met, water quality will generally protect the designated use.

Water quality criteria. Levels of water quality expected to render a body of water suitable for its designated use, composed of numeric and narrative criteria. Numeric criteria are scientifically derived ambient concentrations developed by EPA or states for various pollutants of concern to protect human health and aquatic life. Narrative criteria are statements that describe the desired water quality goal. Criteria are based on specific levels of pollutants that would make the water harmful if used for drinking, swimming, farming, fish production, or industrial processes.

Water quality standard. State or federal law or regulation consisting of a designated use or uses for the waters of the United States, water quality criteria for such waters based upon such uses, and an antidegradation policy and implementation procedures. Water quality standards protect the public health or welfare, enhance the quality of water and serve the purposes of the Clean water Act.

Watershed. A drainage area or basin in which all land and water areas drain or flow toward a central collector such as a stream, river, or lake at a lower elevation.

Zone of Initial Dilution: The acute mixing zone is the area of initial dilution, sometimes referred to as the zone of initial dilution (ZID), where acute criteria are met at the edge of this zone. Beyond the acute mixing zone and of a larger area is the chronic mixing zone where chronic criteria must be met.

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