

FINAL REPORT
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Mississippi Department of Environmental Quality
Office of Pollution Control

Total Maximum Daily Load of
Biochemical Oxygen Demand in
Tallahala Creek
Near Laurel, Mississippi
Segment MS087M2
Pascagoula River Basin

Prepared by the
Water Quality Assessment Branch

August 11, 1999

Segment Identification

Name: Tallahala Creek

Waterbody ID#: MS087M2

Location: Immediately east of Laurel, Mississippi, beginning at the Highway 84 bridge and ending with the confluence of Tallahoma Creek north of Ellisville, Mississippi

County: Jones County, Mississippi

USGS HUC Code: 03170005-087

Length: Approximately 10.1 miles (beginning at river mile 54.5 and ending at river mile 44.4)

Use Impairment: Aquatic Life Support

Cause Noted: Organic Enrichment/Low DO (Biochemical Oxygen Demand)

NPDES Permits: George Gaddy Wastewater Treatment Plant Number 2 (MS0024163)
Masonite Corporation (MS0003042)
George Gaddy Wastewater Treatment Plant Number 1 (MS0020176)

Standards Variance: The dissolved oxygen level in segment MS087M2 has received a variance from the standard of 5.0 mg/l to 3.5 mg/l. This TMDL was developed based on maintaining the variance for segment MS087M2 of Tallahala Creek.

Waste Load Allocation (WLA): 4,545 lbs TBOD_u/day

Load Allocation (LA): 127 lbs TBOD_u/day

Margin of Safety (MOS): Accounted for in conservative modeling assumptions

Total Maximum Daily Load (TMDL): 4,672 lbs TBOD_u/day

Introduction

The identification of waterbodies not meeting their designated use and the development of total maximum daily loads (TMDLs) for those waterbodies are required by Section 303(d) of the Clean Water Act and the Environmental Protection Agency's (EPA) Water Quality Planning and Management Regulations (40 CFR part 130). The TMDL process is designed to restore and maintain the quality of those impaired waterbodies through the establishment of pollutant specific allowable loads. The pollutant of concern for this TMDL is biochemical oxygen demand (BOD) which is causing organic enrichment and low dissolved oxygen (DO) in portions of Tallahala Creek. Tallahala Creek, which runs to the east of the City of Laurel in the Pascagoula River Basin, has been studied extensively by the Mississippi Department of Environmental Quality (MDEQ). The most recent field studies and associated modeling are documented in an independent document, Tallahala Creek Water Quality Modeling Study (MDEQ, 1999). This TMDL is based on the findings of the Tallahala Creek Water Quality Modeling Study.

Target Identification

The minimum condition applicable to all waters in Mississippi is that dissolved oxygen concentrations shall be maintained at a daily average of not less than 5.0 mg/l with an instantaneous minimum of not less than 4.0 mg/l (MDEQ, 1995). However, for Tallahala Creek from river mile 54.5 to river mile 27.7 the DO shall not be less than 3.5 mg/l at flows greater than or equal to the 7-day, 10 -year low flow (7Q10) (MDEQ, 1995). This water quality variance was approved by EPA.

Predictive modeling of Tallahala Creek based on field data shows that the load of total biochemical oxygen demand (TBOD) allowable to meet the 3.5 mg/l criterion is approximately equal to the current permitted load, which is 4,672 lbs/day.

Deviation from Target

Tallahala Creek has had the DO standard variance since 1968. Since that time, major improvements have been made to the three wastewater facilities that have National Pollutant Discharge Elimination System (NPDES) permits to discharge into Tallahala Creek, segment MS087M2. Masonite Corporation, one of the wastewater dischargers, collects instream DO data above and below its discharge points. Prior to the treatment upgrades the BOD loading to the stream was such that the DO was frequently below the 3.5 mg/l standard. Masonite data from the last ten years show only a few isolated violations of the DO standard.

Low DO typically occurs during seasonal low flow periods of late summer and early fall. Elevated oxygen demand is of primary concern during dry periods because the effects of low flow, minimum dilution, and high temperatures combine to produce the worst case potential effect on water quality (EPA, 1997). The maximum impact of a BOD load is generally not at the location of the discharge, but at some distance downstream. The point of maximum impact is where the maximum DO deficit occurs and is referred to as the DO sag.

Source Identification

The sources of pollution accounted for in a TMDL are a load allocation (LA), which includes the stream's background load as well as load from nonpoint sources, a waste load allocation (WLA), which includes point sources, and a margin of safety (MOS). Determining the degree to which each source contributes to the problem is an aspect of TMDL development.

The background concentration of BOD in this segment of Tallahala Creek was measured above the discharge locations at the head waters of the study reach. The low DO sag occurs just downstream of the Laurel #1 and Masonite outfalls as shown in Figures 1 and 2, which display the results of the 1996 and 1997 field studies respectively. While nonpoint sources of pollution are recognized as contributing pollutant loads to Tallahala Creek, they are not traditionally associated with organic enrichment or low DO problems which occur during low flow critical conditions. Therefore, for the load allocation portion of this TMDL, the nonpoint sources affecting Tallahala Creek are represented in the background loads.

Figure 1. 1996 Field Study: Daily Maximum, Average, and Minimum Measured DO

Figure 2. 1997 Field Study: Daily Maximum, Average, and Minimum Measured DO

The WLA portion of the TMDL consists of the three facilities that discharge into this segment of Tallahala Creek. The two municipal facilities are George Gaddy Wastewater Treatment Plant Number 2 (Laurel #2), which is north of the city, and George Gaddy Wastewater Treatment Plant Number 1 (Laurel #1), which is south of the city. These wastewater treatment facilities are oxidation ditches. The third facility is an industrial wastewater treatment system at Masonite Corporation. Two outfalls, Pond 4 and Pond 5, are permitted for Masonite Corporation. The following table provides the NPDES Permit numbers for these facilities.

Table 1. NPDES Permit Numbers

Facility	NPDES Permit Number
Laurel #2	MS0024163
Masonite Corporation	MS0003042
Laurel #1	MS0020176

The concentration of BOD in each point source's discharge was analyzed from samples collected during the 1996 field study. However, MDEQ regulations require that predictive water quality modeling be based upon the critical condition, which would be when each of the three point sources were discharging at the maximum rate allowed by their permits; both in quantity and in strength. Also, at critical condition the 7Q10 flow, as determined by the U.S. Geological Survey (USGS), must also be used for the background stream flow. The flow for each of the Laurel facilities is established in its NPDES permit. The critical flow used in this TMDL for Masonite was estimated through a review of its permit application. The strength of the discharge was determined from the 5 day biochemical oxygen demand (BOD₅) loading rate given in the permits. The City of Laurel's NPDES permits have winter and summer limits for BOD₅. Seasonality was accounted for in this TMDL through the modeling of winter and summer conditions. Modeling showed that the summer limits, which are applicable May through October, are the most critical condition. The permitted loading rate for BOD₅ in the Masonite Corporation's effluent is given for Pond 4 and Pond 5 combined. For modeling purposes the permitted loading rate was evenly divided between the two outfalls.

The correlation between the BOD₅, which is in the permits, and the ultimate carbonaceous biochemical oxygen demand (CBOD_u), which is used in the model, was made through an ultimate to 5 day ratio based on samples collected during field studies. Also, the BOD₅ specified in the permit represents the total biochemical oxygen demand (TBOD). Modeling that amount as CBOD is a conservative assumption in that it puts more oxygen demand on the creek than the permit actually allows, thereby introducing a MOS into the modeling process. The ultimate nitrogenous biochemical oxygen demand (NBOD_u), which is modeled, was obtained by using another conservative assumption. That is, all of the ammonia allowed in the permit is assumed to be oxidized to produce NBOD_u, when in reality that reaction may not be completed and the oxygen demand would be less. The modeled flows, concentrations, and corresponding loads for each point source that discharges into Tallahala Creek are shown in Table 2.

Table 2. Model Input

Source	Flow (cfs)	CBOD ₅ (mg/l)	CBOD _u (lb/day)	NH ₃ -N (mg/l)	NBOD _u (lb/day)	DO (mg/l)
Background	4.4	3.9	91.6	1.5	35.2	6.4
Laurel #2	10.2	12.0	791.7	2.0	502.7	6.0
Masonite, Pond 4	1.7	19.0	452.4	1.4	56.7	6.0
Masonite, Pond 5	1.7	19.0	556.8	1.4	56.7	6.0
Laurel #1	11.4	15.0	1566.9	2.0	561.7	6.0

Allocation of Pollutant Loads

Tallahala Creek was modeled at the maximum loads allowed under current NPDES permit conditions. The lowest point on the DO sag curve predicted by the model was just above the 3.5 mg/l target value for DO. This indicates that all of the assimilative capacity would be used in the stream to maintain the water quality standard variance at critical condition. Figure 3 shows the model results. The modeling procedure is described in more detail in the Tallahala Creek Water Quality Modeling Study (MDEQ, 1999).

Figure 3. Model results for the critical condition in Segment MS087M2

There is no assimilative capacity for additional BOD loading in this waterbody segment. Any future increase in loading of BOD will be prohibited in this segment unless it is accompanied by a commensurate reduction in one of the existing permits. The allocation of the load should remain as is presently allowed by the NPDES permits for the facilities that discharge into this segment of Tallahala Creek. Laurel #2 is allocated 28% of the load. Masonite Corporation, with Pond 4 and Pond 5 combined, is allocated 24% of the load, and Laurel #1 is allocated 45% of the load. The remaining 3% of the load is reserved for the contribution from background and nonpoint source pollution.

Implementation Plan

As described in the Tallahala Water Quality Study, each of the facilities that discharge into Tallahala Creek have undergone extensive upgrades in wastewater treatment capability, which has resulted in a great improvement in the quality of the stream (MDEQ, 1997). Therefore, a recommendation for load reductions in this segment is not necessary. Further reduction scenarios modeled with the predictive computer model indicate that no significant improvement in the water quality of the stream segment could be achieved. The tightening of the permit limits would not eliminate the current need for the variance.

Follow-Up Monitoring Plan

Since no reductions are being recommended for the load to Tallahala Creek, follow up monitoring will not be necessary to determine the success or failure of such reductions. The wastewater treatment plants are all operating well within their permit limits as indicated by the monthly discharge monitoring reports. Masonite also reports the results of water quality sampling at eight stations in Tallahala Creek. Three of those stations are in segment MS087M2. The monitoring network currently in place sufficiently characterizes segment MS087M2 of Tallahala Creek at this time. Additional monitoring may be needed if the wastewater treatment facilities discharge at greater capacity or if other changes occur to the system.

Process for TMDL Revision

The Pascagoula Basin was the first basin addressed in MDEQ's implementation of the Basinwide Approach. The Basinwide Approach is an effort to conduct comprehensive water quality planning and to foster the implementation of those plans that will result in water quality improvement and protection on a basinwide scale. This approach is enacted through a five year rotating schedule of the following phases: planning, data gathering, data evaluation, plan development, and implementation in the five basin groups of the state. Modeling and the development of TMDLs are included in Phase III

of the rotation schedule, which will next be in year 2003 for the Pascagoula Basin. This TMDL will be reviewed at that time if changes have occurred which make review necessary.

References

- EPA. 1997. Technical Guidance Manual for Developing Total Maximum Daily Loads. Book 2: Streams and Rivers, Part 1: Biochemical Oxygen Demand/Dissolved Oxygen and Nutrients/Eutrophication. EPA 823-B-97-002.
- MDEQ. 1999. Tallahala Creek Water Quality Modeling Study. Office of Pollution Control, Water Quality Assessment Branch.
- MDEQ. 1997. A Comparative Investigation of the Water Quality of Tallahala Creek from 1989 to 1996. Office of Pollution Control, Biological Services Division.
- MDEQ. 1995. Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters. Office of Pollution Control.

Definitions of Terms

Allowable Loading or **available assimilative capacity** is that portion of the loading capacity of a waterbody that is available for allocating to a point source discharger(s) through regulation by MDEQ. It is the difference between the loading capacity and the total loading of pollutants from other sources, such as background, nonpoint sources, and exempt sources.

Ambient water quality means the physical, chemical, and biological characteristics of waters of the State.

Approved methods means sampling and laboratory testing methods approved by MDEQ, as specified in Chapter Two of MDEQ's regulations.

Assimilative capacity means the capacity of a body of water or soil-plant system to receive wastewater effluents or sludges without violating the provisions of the State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters and MDEQ's regulations.

Background shall mean the condition of waters in the absence of the activity or discharge under consideration based on the best scientific information available to MDEQ.

Calibrated and/or verified models are models whose reaction rates and inputs are significantly based on actual measurements using data from surveys on the receiving waterbody. Verified models are calibrated to one set of field data and confirmed by comparison to at least one additional set of field data taken under different physical circumstances.

Daily discharge means the "discharge of a pollutant" measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling. For pollutants with limitations expressed in units of mass, the "daily discharge" is calculated as the total mass of the pollutant discharged over the day. For pollutants with limitations expressed in other units of measurement, the "daily average" is calculated as the average measurement of the discharge of the pollutant over the day.

Daily maximum means the highest "daily discharge" during a calendar month.

Effluent standards and limitations means all State or Federal effluent standards and limitations on quantities, rates, and concentrations of chemical, physical, biological, and other constituents to which a waste or wastewater discharge may be subject under the Federal Act or the State law. This includes, but is not limited to, effluent limitations, standards of performance, toxic effluent standards and prohibitions, pretreatment standards, and schedules of compliance.

Effluent, unless otherwise provided, means treated wastewater flowing out of the treatment facilities.

Empirical model means a mathematical formulation whose various reaction rates and input parameters are determined through empirical formulations based on literature reviews. The simplest empirical model is a dilution model.

Feasible alternatives are those alternatives that are available and capable of being carried out after taking into consideration cost, existing technology, and logistics in light of overall project purposes.

Federal Act means the Federal Clean Water Act and the applicable regulations promulgated under that statute.

Instream means the resulting condition in the waterbody after mixing with the wastewater(s) at the appropriate critical flow/mixing condition.

Load allocation (LA) means the portion of a receiving water's loading capacity attributed to or assigned to nonpoint sources (NPS) or background sources of a pollutant.

Loading capacity. Loading capacity and Total Maximum Daily Load are equivalent terms.

Man-induced conditions which cannot be controlled or abated are conditions that have been influenced by human activities, and have the characteristics as follows:(a) would remain after removal of all point sources, (b) would remain after imposition of best management practices for non-point sources, and (c) cannot be restored or abated by physical alteration of the waterbody; or there is no reasonable relationship between the economic, social, and environmental costs and the benefits of restoration or physical alteration.

Monthly average means the average of "daily discharges" over a calendar month, calculated as the sum of all "daily discharges" measured during a calendar month divided by the number of "daily discharges" measured during the month. The monthly average for fecal coliform bacteria is the geometric mean of "daily discharges" measured during the calendar month. In computing the geometric mean for fecal coliform bacteria, the value one (1) shall be substituted for sample results of zero.

NPDES permit means an individual or general permit issued by the MDEQ Permit Board pursuant to regulations adopted by the Commission under Mississippi Code Annotated (as amended) §§ 49-17-17 and 49-17-29 for discharges into State waters.

Natural background means the condition of waters in the absence of man-induced alterations based on the best scientific information available to MDEQ. The establishment of natural background for an altered waterbody may be based upon a similar unaltered waterbody or on historical pre-alteration data.

Pollution means such contamination, or other alteration of the physical, chemical, or biological properties, of any waters of the State, including change in temperature, taste, color, turbidity, or odor of the waters, or such discharge of any liquid, gaseous, solid, radioactive, or other substance, or leak into any waters of the State, unless in compliance with a valid permit issued by the Permit Board.

Publicly Owned Treatment Works (POTW) is a waste treatment facility owned and/or operated by a public body or a privately owned treatment works which accepts discharges which would otherwise be subject to Federal Pretreatment Requirements.

Technology based effluent limitation (TBEL) means a minimum waste treatment requirement, established by MDEQ, based on treatment technology. The minimum treatment requirements may be set at levels more stringent than that which is necessary to meet water quality standards of the receiving waterbody as set out specifically in other sections of these regulations.

Total Maximum Daily Load or TMDL means the calculated maximum permissible pollutant loading to a waterbody at which water quality standards can be maintained.

Treatment works means any plant or other works, used for the purpose of treating, stabilizing, or holding wastes.

Waste means sewage, industrial wastes, oil field wastes, and all other liquid, gaseous, solid, radioactive, or other substances which may pollute or tend to pollute any waters of the State.

Wasteload allocation (WLA) means the portion of a receiving water's loading capacity attributed to or assigned to point sources of a pollutant.

Water Quality Standards are the criteria and requirements set forth in State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters. Water quality standards are standards composed of designated present and future most beneficial uses (classification of waters), the numerical and narrative criteria applied to the specific water uses or classification, and the Mississippi antidegradation policy.

Water quality based effluent limitation (WQBEL) means an effluent limitation, which may be more stringent than a technology based effluent limitation, determined as necessary by MDEQ to ensure that water quality standards in a receiving body of water will not be violated.

Water quality criteria are elements of State water quality standards, expressed as constituent concentrations, levels, or narrative statements, representing a quality of water that supports the present and future most beneficial uses.

Waters of the State means all waters within the jurisdiction of this State, including all streams, lakes, ponds, wetlands, impounding reservoirs, marshes, watercourses, waterways, wells, springs, irrigation systems, drainage systems, and all other bodies or accumulations of water, surface and underground, natural or artificial, situated wholly or partly within or bordering upon the State, and such coastal waters as are within the jurisdiction of the State, except lakes, ponds, or other surface waters which are wholly landlocked and privately owned, and which are not regulated under the Federal Clean Water Act (33 U.S.C.1251 et seq.).

Zone of mixing or Mixing Zone constitutes an area whereby physical mixing of a wastewater effluent with a receiving waterbody occurs.