TNRCC

November 2000

A Total Maximum Daily Load for Dissolved Oxygen in Lake Austin

For Segment 1403

Prepared by the:
Strategic Assessment Division, TMDL Team

printed on
recycled paper

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

A Total Maximum Daily Load for Dissolved Oxygen in Lake Austin

Introduction

Section 303(d) of the Clean Water Act requires all states to identify waters that do not meet or are not expected to meet applicable water quality standards. For each listed water body that does not meet a standard, states must develop a total maximum daily load (TMDL) for each pollutant that has been identified as contributing to the impairment of water quality in that water body. The Texas Natural Resource Conservation Commission (TNRCC) is responsible for ensuring that TMDLs are developed for impaired surface waters in Texas.

In simple terms, a TMDL is a quantitative plan that determines the amount of a particular pollutant that a water body can receive and still meet its applicable water quality standards. In other words, TMDLs are the best possible estimates of the assimilative capacity of the water body for a pollutant under consideration. A TMDL is commonly expressed as a load, with units of mass per time period, but may be expressed in other ways also. TMDLs must also estimate how much the pollutant load needs to be reduced from current levels in order to achieve water quality standards.

The Total Maximum Daily Load Program, a major component of Texas' statewide watershed management approach, addresses impaired or threatened streams, reservoirs, lakes, bays, and estuaries (water bodies) in or bordering the state of Texas. The primary objective of the TMDL Program is to restore and maintain the beneficial uses (such as drinking water, recreation, support of aquatic life, or fishing) of impaired or threatened water bodies. The ultimate goal of this TMDL is to increase the level of dissolved oxygen to Lake Austin through aeration; therefore, restoring the aquatic life use of this water body.

Section 303(d) of the Clean Water Act and the U.S. Environmental Protection Agency's (EPA) implementing regulations (40 Code of Federal Regulations, Part 130) describe the statutory and regulatory requirements for acceptable TMDLs. The TNRCC guidance document, *Developing Total Maximum Daily Load Projects in Texas* (GI-250), further refines the process for Texas. This TMDL document has been prepared in accordance with these guidelines, and is composed of the following six elements:

- Problem Definition
- Endpoint Identification
- Source Analysis
- Linkage Between Sources and Receiving Water
- Margin of Safety
- Pollutant Load Allocation

This TMDL for dissolved oxygen in Lake Austin was prepared by the TMDL Team in the Strategic Assessment Division of the Office of Environmental Policy, Analysis, and Assessment of the Texas Natural Resource Conservation Commission.

The TMDL was adopted by the Texas Natural Resource Conservation Commission on November 17, 2000. Upon adoption, the TMDL became part of the state Water Quality Management Plan. The Texas Natural Resource Conservation Commission will use this document in reviewing and making determinations on applications for storm water permits and in its nonpoint source pollution abatement programs.

Background Information

Texas Surface Water Quality Standards designate Lake Austin for contact recreation, aquatic life, and public water supply uses. Lake Austin was listed on the 1998 303(d) list for aquatic life use impairment due to low dissolved oxygen levels immediately below Mansfield Dam at the upstream end of the lake. The major inflow to the lake is the Colorado River which is regulated by Mansfield Dam and other reservoirs upstream. Water released from the dam is naturally low in dissolved oxygen, as the dam releases are from the hypolimnetic zone. The hypolimnion of a water body is the bottom zone of colder, non-circulating water in a thermally-stratified lake during the summer. This bottom zone of the reservoir is characterized by depleting dissolved oxygen, with no oxygen replenishment from photosynthesis or circulation with the atmosphere.

There are no major point sources in the area and of the eleven permitted dischargers in the Lake Austin watershed, all but one irrigate or use subsurface disposal. To resolve the low dissolved oxygen impairment caused by dam releases, the Lower Colorado River Authority (LCRA) has recently installed an aerator on one of the turbines for Mansfield Dam. Continued data collection will verify that the water body meets the dissolved oxygen criteria since installation of the aerator.

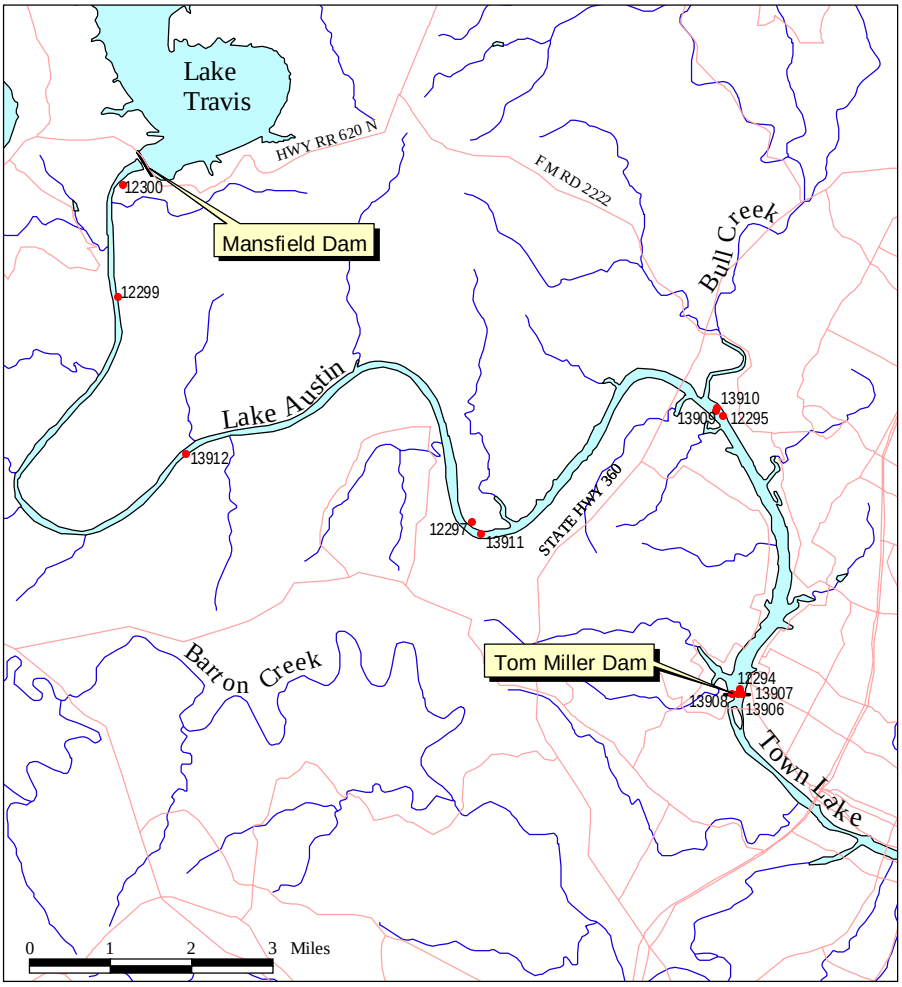
EPA guidance (*Draft Guidance for Water Quality-based Decisions: The TMDL Process, Second Edition, EPA 841-D-99-001, 1999*) on the development of TMDLs offers flexibility in addressing particular situations and unusual circumstances, allowing States the discretion to adopt different approaches where appropriate. In preparing this TMDL for dissolved oxygen, the TNRCC has modified the typical loading allocation approach of a TMDL, which limits the amount of a pollutant that can be added to an impaired water body.

The guidance states that the allowable pollutant load "must be expressed in a manner ... that represents attainment and maintenance of water quality standards." The guidance allows for the use of a surrogate target for situations where "no .... quantifiable pollutant load can be used to .... express the TMDL."

Problem Definition

Lake Austin (Segment 1403) is listed on the Clean Water Act Section 303(d) list for dissolved oxygen impairment immediately below Mansfield Dam. Language from the 1999 303(d) list reads:

"In the upper three miles of the segment, dissolved oxygen concentrations are occasionally lower than the standard established to assure optimum conditions for aquatic life (L/PS). The low oxygen concentrations occur during the summer months when water is released from the bottom of Lake Travis."



Lake Austin Dissolved Oxygen Total Maximum Daily Load

Lake Austin is located on the Colorado River in Travis County in Austin, Texas (see map). The lake is one of a series of seven reservoirs built on the Colorado River for flood control, power generation and water supply. Formed by Tom Miller Dam built in 1939, the lake is maintained at a constant level of 492 feet above mean sea level by water released from the bottom of Lake Travis immediately upstream. The lake is 20 miles long and less than 1/4 mile wide. The shoreline is characterized by steep rock bluffs, many over 300 feet high, and sandy flood plains. The shoreline is relatively smooth with one large inlet at Bull Creek and two smaller coves near the lower dam. The major

inflow to the lake is the Colorado River. Several small creeks discharge into the lake during wet periods but cease flowing during dry weather.

The water released from Mansfield Dam is very cold and somewhat restricts contact recreation in the upper half of Lake Austin. The lower half of the lake, however, is extensively utilized for swimming, boating, and water skiing. The lower half of the lake is heavily developed with private homes, apartments, marinas, and parks.

Data analyzed for Lake Austin were collected as surface to bottom profiles following methods in the TNRCC Surface Water Quality Monitoring Procedures Manual (GI-252). Each profile is considered one sample, and only data in the mixed surface layer is considered, i.e. the area with a temperature of within 0.5 degrees of the surface temperature. In the 1998 305(b) Assessment, several Lake Austin monitoring sites were combined for improved analysis of water body characteristics. The uppermost station (12300) represents the upper three miles of the lake, and the remainder of the stations were combined for the remainder of the lake (see map).

Of the 142 samples analyzed, 13 violations were measured. The significant dissolved oxygen violations all occurred in the upper portion of Lake Austin. During 28 sampling events, Site 12300 accumulated five violations at an 18% violation rate, with readings of 3.1, 2.74, 3.7, 3.51, and 4.71 mg/L. Table 1 displays the number of dissolved oxygen criterion violations from upstream to downstream.

Table 1: Lake Austin Dissolved Oxygen Data

Station ID	Samples	Violations
12300	28	5
12299	2	0
13912	8	2
12297	28	1
13911	8	2
13910	8	1
13909	8	1
12295	1	0
12294	27	1
13908	8	0
13906	8	0
13907	8	0

Endpoint Identification

Lake Austin is designated in the Texas Surface Water Quality Standards for contact recreation, aquatic life, and public water supply uses:

Table 2: Lake Austin Uses and Criteria

Uses			Criteria						
Recreation	Aquatic Life	Domestic Water Supply	Cl	SO_4	TDS	DO	pH range	Fecal Coliform	Temperature
Contact Recreation	High	Public Water Supply	82	60	375	5.0	6.5-9.0	200	90

The aquatic life use criterion for dissolved oxygen is 5.0 mg/L; thus, the endpoint will be set at meeting this criterion. Water released from the dam does not meet this standard, as it is naturally low in dissolved oxygen due to release of dam waters from the hypolimnetic zone of Lake Travis. Attaining the dissolved oxygen standard in the upper end of Lake Austin is not probable without structural intervention to counteract the deleterious effects of hypolimnetic water releases.

Source Analysis

The Lake Austin watershed is predominantly characterized by non-point sources of pollution, as there are no major point sources in the area. Of the eleven permitted dischargers in the Lake Austin watershed, all but one irrigate or use subsurface disposal. The one permitted discharge to the lake is located at the lower end of the lake and therefore does not affect the area of concern for dissolved oxygen.

Upon examination of the data, most violations occurred during the summer months (July, August and September) corresponding to the stratified season of Lake Travis. The source of Lake Austin's headwater is Lake Travis via penstocks in Mansfield Dam approximately 45 meters below conservation pool. The approximate penstock and conservation pool elevations are 163 and 208 meters above mean sea level, respectively. During summer stratification, the penstock elevation is in the hypolimnion. The hypolimnion of a water body is characterized by depleting dissolved oxygen, with no oxygen replenishment from photosynthesis or circulation with the atmosphere. As stratification develops, microbial respiration induces anoxia. Based on this information, the violations of the dissolved oxygen standard are due to natural processes rather than oxygen demand by pollutants.

Linkage Between Sources and Receiving Water

Aeration of anoxic water released into Lake Austin can mitigate the seasonal trend of low dissolved oxygen. The TMDL analysis has suggested the need for a reversal of anoxic conditions to raise the dissolved oxygen in the lake by 1.5-2.5 mg/L, based on the low readings at Site 12300. Monitoring on a seasonal basis can determine the effectiveness of enhancing the dissolved oxygen regime in Lake Austin.

Margin of Safety

Since the modification of dam releases tends to be unique to each reservoir, defining a margin of safety is difficult. The margin of safety cannot be implicitly included in the qualitative Pollutant Load Allocation. Margin of safety can only be provided through ongoing monitoring to determine the effectiveness of modifying dam releases. The effective uptake of dissolved oxygen will be determined during testing of the system and through instream sampling.

Pollutant Load Allocation

The approach chosen for establishing this TMDL does not fit with the typical mathematical equation of WLA + LA+ MOS = TMDL prescribed by EPA regulations. Since point source and nonpoint source loadings are not causing the low dissolved oxygen problem, this TMDL does not assign specific loads to pollutant sources. Instead, this TMDL will increase dissolved oxygen levels to ensure that water quality standards can be restored and maintained at least 90% of the time.