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One Total Maximum Daily Load for Nitrate-Nitrogen in the Lower Sabinal River

For Segment 2110

Prepared by the:
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TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

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Executive Summary

In 2002, the Texas Commission on Environmental Quality (TCEQ) found that the Lower Sabinal River (Segment 2110) did not support the 10 mg/L drinking water criterion for nitrate-nitrogen. The endpoint for this TMDL is the running annual average of at least four quarterly samples, compared against the drinking water criterion to determine public water supply use support.

Regarding possible point sources, there is one municipal wastewater treatment facility (WWTF) and one concentrated animal feeding operation (CAFO) in the watershed. There are no other known dischargers in the watershed. The City of Sabinal WWTF evaporation ponds are considered a source of loading due to the unknown integrity of their liners. Pond liner seepage could enter the river system, and would have its greatest impact during low flow conditions. Since the impairment occurs during low flow, nonpoint sources are not likely. The CAFO does not have a surface runoff input to the river, except under extreme rainfall conditions.

The load allocation is based upon the City of Sabinal relocating their WWTF out of the 500-year floodplain and upgrading it from an Imhoff tank with evaporation ponds to a facility with a mechanical screen, looped aeration basin, two clarifiers, and an ultraviolet disinfection system**.** The TMDL takes into account point and nonpoint source loading, anticipated future growth, and a margin of safety.

Introduction

Section 303(d) of the federal 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 Commission on Environmental Quality (TCEQ) 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. 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 water quality management program, 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.

This TMDL is meant to reduce loadings of nitrate-nitrogen in the Lower Sabinal River in order to restore and maintain the public water supply use.

Document Preparation

Section 303(d) of the Clean Water Act (CWA) 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 TCEQ guidance document, *Developing Total Maximum Daily Load Projects in Texas* (GI-250), further refines the process for Texas. Following these guidelines, this TMDL document describes elements which are summarized in the following sections:

- Applicable Water Quality Standards & Endpoints
- Public Participation
- Source Analysis
- Loading Capacity
- Seasonality
- Pollutant Load Allocation
- Margin of Safety
- Implementation and Monitoring
- Reasonable Assurance

This TMDL was prepared by the TMDL Section in the Water Programs of the Chief Engineer's Office of the TCEQ.

The document was adopted by the commission on August 10, 2005. Upon EPA approval, the TMDL will become an update to the state Water Quality Management Plan.

The Lower Sabinal River at the crossing of State Highway 127

Background Information

The Lower Sabinal River, Segment 2110, lies within the Nueces River basin (Figure 1). It is a tributary of the Frio River, which in turn flows into the Nueces River above Lake Corpus Christi. The Upper Sabinal River is comprised mainly of intermittent pools, and serves as a major recharge source as it travels across the Edwards Aquifer recharge zone. The Lower Sabinal River runs from a point 100 meters upstream of State Highway 127, one mile north of the city of Sabinal in Uvalde County, to the confluence with the Frio River in Frio

County. The watershed for the entire Lower Sabinal River is 222.4 square miles and is composed of a mixture of live oak, Ashe juniper, and mesquite, with grasslands and limited row crop production. During the 1980s, much of the area was irrigated farm land. However, in recent years, many areas have reverted back to native grasslands and brush, and are often utilized for cattle production.

The city of Sabinal is located in the eastern portion of Uvalde County in south-central Texas, approximately 60 miles west of San Antonio on U.S. Highway 90. It has a wastewater service area of approximately 760 acres and serves just over 700 customers.

The segment is on the 2002 CWA Section 303(d) list due to a nitrate-nitrogen impairment identified at a sample station located at the U.S. Highway 90 bridge crossing, at the uppermost end of the segment near the United States Geological Service (USGS) gage station (#08198000, Sabinal River at Sabinal).

Designated Uses and Water Quality Standards

The Lower Sabinal River is a classified Water Quality Segment of the State of Texas with designated uses of contact recreation, high aquatic life use, and public water supply. Texas Water Quality Standards (Title 30 Texas Administrative Code Chapter 307) lists a criterion of 10 mg/L for nitrate nitrogen, in order "to prevent contamination of drinking water ... to ensure that they are safe for human consumption. These criteria apply to freshwaters which are designated or used for public drinking water supplies" (30 TAC 307.6(d)).

State antidegradation policy states that "existing uses and water quality sufficient to protect those existing uses will be maintained" (30 TAC 307.5(b)(1)). Additional guidance on TCEQ's antidegradation policy can be found in the document titled "Procedures to Implement the Texas Surface Water Quality Standards" (TNRCC 2003b.)

Problem Definition

The Lower Sabinal River (Segment 2110) was placed on the 2002 CWA Section 303(d) list for nonsupport of the drinking water criterion for nitrate-nitrogen. The impairment was identified from samples taken at the U.S. Highway 90 bridge crossing west of Sabinal (Station ID# 12993).

Endpoint Identification

The Lower Sabinal River was originally assessed and placed on the 2002 CWA Section 303(d) list for nonsupport of the 10 mg/L drinking water criterion for nitrate-nitrogen. In accordance with the *Texas Surface Water Quality Standards* (30 TAC 307.6(d)(8)), the endpoint of this TMDL will be a running annual average of at least four quarterly samples, compared against the drinking water criterion to determine public water supply use support.

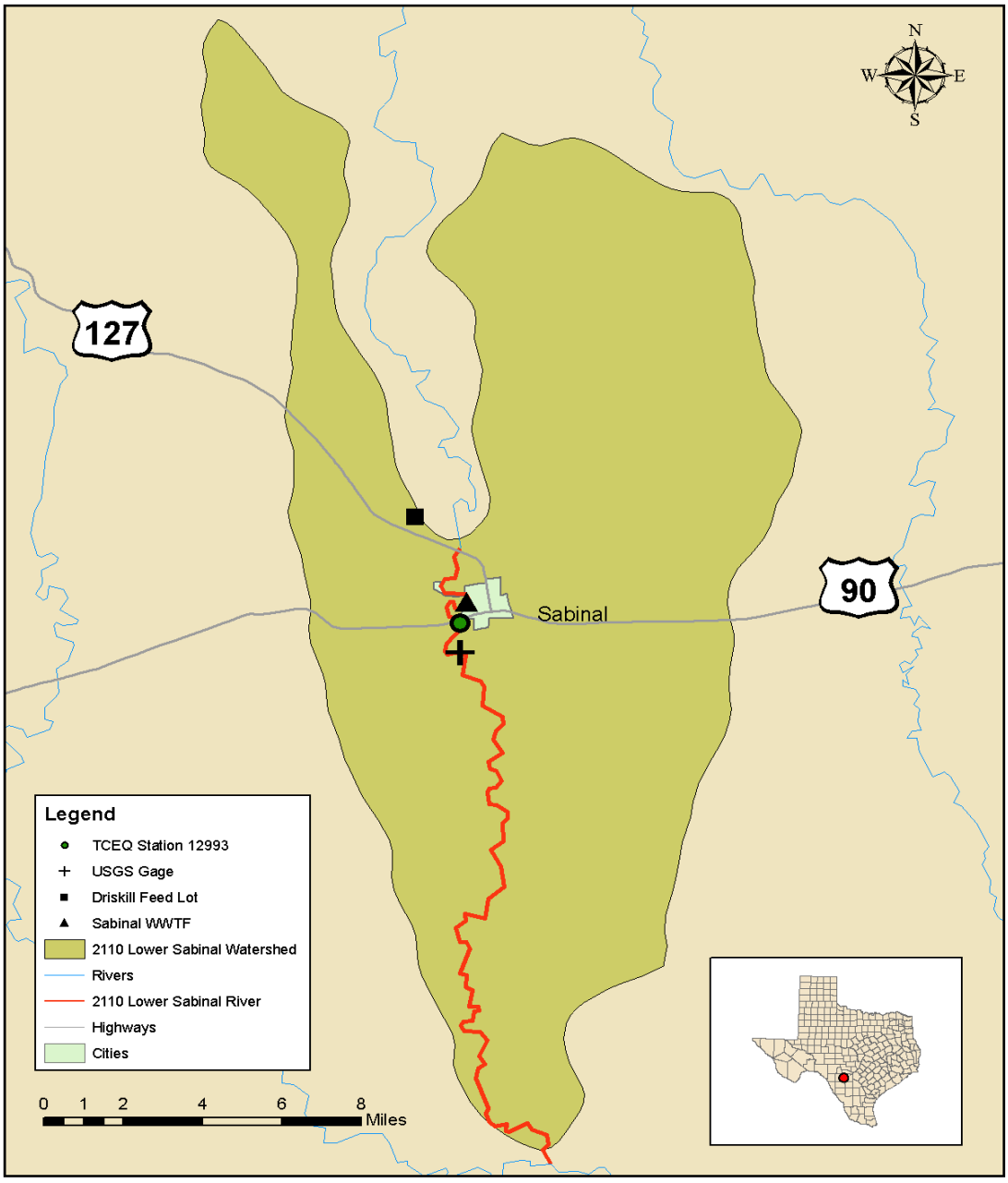

Figure 1. Study Area

Loading Capacity — Linkage Between Sources and Receiving Waters

Nitrogen compounds, such as nitrate, nitrite, and ammonia, are common components of all effluent streams discharged from municipal WWTFs. Often, ammonia-nitrogen is regulated by a limit in the discharge permit. Also, nitrogen compounds are some of the main ingredients in agricultural and lawn fertilizers, which is why they are commonly found in storm water runoff from urban and agricultural production areas.

Oxidation pond at the Sabinal WWTF

There is only one permitted discharger upstream of the sampling station for the impaired segment. The City of Sabinal WWTF was constructed in the 100-year flood plain of the Lower Sabinal River in 1967. Since the original construction, the facility has been inundated numerous times with flood waters. Due to the scouring nature of these floods, it is likely that the clay liners originally installed in the oxidation ponds have since been washed away. The Sabinal streambed and surrounding soils are Conalb loam and have moderate permeability. This permeability would provide a conduit for seepage down through the riverbed fill to the water table feeding the Lower Sabinal River. A requirement of the current Sabinal WWTF permit is to have the lining tested to verify its integrity. Without this certification, the WWTF is considered a major source of nitrogen input to the Lower Sabinal River.[1]

Seasonality

Seasonality does not appear to play a major role in determining nitrate-nitrogen concentrations in the Lower Sabinal River. Historically, sampling is conducted during low flow conditions (see figure 2). This is when the impairment has been shown to exist. This seems to point to an ongoing loading, even at ambient conditions. However, this sampling does not rule out the possibility that the impairment does not exist at high flow conditions. High flow sampling just has simply not been conducted.

Margin of Safety

A margin of safety (MOS) is required in a TMDL to account for uncertainty about the pollutant load and its association with water quality. The MOS may be an explicit component that leaves a portion of the assimilative capacity of a water body unallocated, or

[1] At the time of this writing, the City of Sabinal is securing funding to relocate the WWTF to a new location above the 500-year floodplain. The proposed facility will convert from an Imhoff tank and lagoon system to a system with a mechanical screen, looped aeration basin, two clarifiers, and an ultraviolet disinfection system.

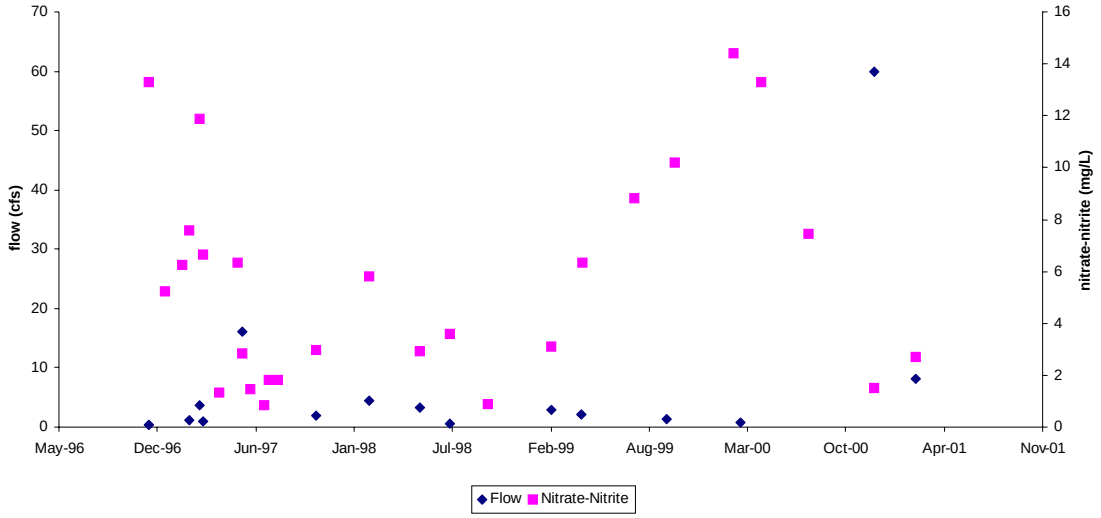

Figure 2. Flow versus Nitrate-nitrogen Concentration

an implicit component established through the use of conservative analytical assumptions (EPA Guidance Doc. 841-D-99-001).

This TMDL has an implicit MOS embodied in the endpoint identification. There is a margin of safety inherent in the drinking water criterion of 10mg/L nitrate-nitrogen. The nitrate-nitrogen standard has a MOS that was built into it during the development of the standard.

This TMDL has an implicit MOS in the allocation, due to the fact that total nitrogen (tot-N), not nitrate-nitrogen, was used in calculating the load allocation. Nitrate-nitrogen is a fraction of the components that make up the tot-N value. This conservative calculation further contributes to the MOS.

Furthermore, the calculated load allocation in the TMDL equation for the Sabinal WWTF utilizes the full permitted flow for the future facility under baseflow conditions. The probability of the WWTF achieving the full permitted flow is very low, based upon historical wastewater loadings from the facility.

Pollutant Load Allocation

TMDLs establish the allowable pollutant loading for each water body, and distribute it among the source categories that contribute the pollutant. The TMDL described in this section will result in compliance with water quality standards. Implementation plans to achieve the recommended loadings may select an adaptive management approach that achieves initial loading allocations from a subset of the source categories. An adaptive management approach would allow for development or refinement of technologies that enhance the effectiveness of certain management measures. Periodic and repeated evaluations of the effectiveness of implementation measures will assure that progress is

occurring, and may show that the original distribution of loading among sources can be modified to increase efficiency, while maintaining the objective of compliance with water quality standards.

The equation for calculating this TMDL is expressed as:

WLA + LA + AFG = TMDL

where WLA (Waste Load Allocation) is the loading assigned to point sources, LA (Load Allocation) is the loading assigned to nonpoint sources, and AFG (Anticipated Future Growth) is to allow for growth of the area, and subsequent pollutant loadings. The remainder of this section will provide the background information and calculations necessary for producing the TMDL equation.

Table 1. Flow Values

Critical flow values:
A 7Q2 of 0.55 cubic feet/second (cfs) = 0.355465 million gallons/day (MGD) [1]
Median annual flow of 1.6 cfs = 1.03 MGD [2]
Sabinal WWTF permitted flow of 0.25 MGD [3]

1. 7Q2 is defined as "the lowest average stream flow for seven consecutive days with a recurrence interval of two years, as statistically determined from historical data." The period of record used to calculate the 7Q2 was 1969 to 1999, using the values reported at the USGS station. This information and values were obtained from an internal TCEQ memo regarding the City of Sabinal WWTF permit renewal in 2002.
2. derived from United States Geological Service gage (#08198000) located near the sampling station.
3. The permitted value for the future Sabinal WWTF (current permitted flow is 0.142 MGD).

Allocating tot-N so as to keep instream concentration at or below 10 mg/L during critical low flow conditions will assure that the nitrate-nitrogen criterion is met. Use of tot-N contributes to the MOS in conjunction with the drinking water criterion of 10 mg/L.

The following calculations assume that background and typical WWTF nitrogen concentrations from QUAL-TX WLE methodology can be used to estimate those sources. For background nitrogen concentrations:

Table 2. Background Total Nitrogen Equation*

Nitrate-Nitrogen = 0.2 mg/L Ammonia Nitrogen = 0.05 mg/L + organic-N = 0.5 mg/L
tot-N = **0.75 mg/L**

*This information and values were obtained from an internal TCEQ memo regarding the City of Sabinal WWTF permit renewal in 2002.

And the concentration for the Sabinal WWTF discharge:

tot-N = **20 mg/L**

Calculations for critical condition low flow:

baseflow + Sabinal WWTF = **0.605465 MGD**

Acceptable load for critical condition low flow is:

(0.605465 MGD) x (8.34 conversion factor) x (10 mg/L tot-N) = **50.5 lb/d tot-N**

Base flow background load at critical condition low flow is:

(0.355465 MGD) x (8.34 conversion factor) x (0.75 mg/L) = **2.2 lb/day tot-N**

Point source loading available beyond background loading during low flow:

50.5 lb/day - 2.2 lb/day = **48.3 lb/day tot-N**

Total Maximum Daily Load for median flow is:

(1.28 MGD[2]) x (8.34 conversion factor) x (10 mg/L) = **106.8 lb/day tot-N**

Waste Load Allocation (WLA) from the Sabinal WWTF tot-N loading will be:

(0.25 MGD) x (8.34 conversion factor) x (20.0 mg/L) = **41.7 lb/day tot-N**

AFG is the difference between the low flow LA and the WLA:

48.3 - 41.7 = **6.6 lb/day tot-N**

Load Allocation (LA) total from nonpoint sources:

Total TMDL	-	WLA	-	AFG	=	LA
106.8 lb/day		41.7 lb/day		6.6 lb/day		**58.5 lb/day**

The final TMDL allocation equation is:

WLA	+	**LA_3**	+	**AFG**	=	**TMDL**
41.7 lb/day		58.5 lb/day		6.6 lb/day		106.8 lb/day tot-Nitrogen

[2] total WWTF permitted flow (0.25MGD) plus median annual flow derived from USGS gage (1.03MGD).

[3] LA = LA base flow background (2.2 lb/day) + LA runoff (56.3 lb/day)

Implementation and Reasonable Assurance

It is the policy of the TCEQ to develop plans that describe the regulatory and voluntary activities necessary to achieve the pollutant reductions identified in all TMDLs adopted by the TCEQ (TNRCC 1999, TCEQ 2002) and to assure the plans are implemented.

All TMDL projects undertaken by the TCEQ include two components (phases). These phases are: (a) TMDL Development; and (b) TMDL Implementation. During TMDL development, the TCEQ determines the acceptable pollutant load for impaired water bodies and the acceptable load is apportioned among broad categories of pollutant sources in the watershed. This information is summarized in a TMDL report such as this document.

During TMDL implementation, the TCEQ develops the management strategies needed to restore water quality to an impaired water body. This information is summarized in a TMDL Implementation Report (TMDL IP) which references, but is separate from the TMDL document. The TMDL IP Report details load reduction and other mitigation measures planned to restore water quality in an impaired water body. The TCEQ will recommend to EPA Region 6, to continue monitoring the nitrate-nitrogen levels in the Lower Sabinal River throughout the Sabinal WWTF relocation process. This additional data would be collected to determine attainment of water quality standards.

This approach provides reasonable assurances that the regulatory and voluntary activities necessary to achieve the pollutant reductions identified will be implemented.

Public Participation

The public and stakeholder participation process in TMDL development is described in detail in the TCEQ general information document titled *Developing Total Maximum Daily Load Projects in Texas: A Guide for Lead Organizations* (GI-250, June, 1999.)

Public notice was published in the *Texas Register* and Sabinal area newspapers stating the dates of the public comment period and the public meeting date, time, and place. The public meeting was held in Sabinal, May 19, 2005 at the Sabinal City Hall. Attendees did not make comment, but after the meeting, time was given to an informal question and answer period. No public comment was submitted during the public comment period.

More information about the public and stakeholder participation process in TMDL development and implementation can be found on the TCEQ's Web site at **www.tnrcc.state.tx.us/water/quality/tmdl/tmdl_guidance.html.**