



DRAFT 2010 Upper Neches Basin Summary Report

Overview & Discussion



ANGELINA & NECHES RIVER AUTHORITY



Available for download at <http://www.anra.org>

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EXECUTIVE SUMMARY

This section is a non-technical summary of the report.

Includes the following sections:

- *Activities and Accomplishments*
- *Significant Findings*
- *Recommendations*

EXECUTIVE SUMMARY

Activities and Accomplishments

The Clean Rivers Program (CRP) utilizes a watershed management approach to identify and evaluate water quality issues, establish priorities for corrective action, and outline strategies to implement those actions. CRP funds are shared equally among the TMDA and ANRA to monitor water bodies in the Neches River Basin. Currently, there are thirty monitoring stations that ANRA submits data for within ANRA's jurisdiction. Those stations are monitored once every quarter (three month period intervals). Four of these stations are collected by City of Tyler. The remaining twenty-six stations are monitored by ANRA personnel.

Significant Findings

Bacteria, used as indicator of support for contact recreation, can be considered problematic on some water bodies including, but not limited to, unfiltered waters of segment 0004, 0015A, 0620, 0610A, parts of 0611, 0612, and parts of 0615. The majority of the water segments placed on the 303(d) list of impaired water bodies within ANRA's jurisdiction are due to elevated fecal bacterial levels.

Dissolved oxygen criterion levels are established to support and maintain aquatic life. Several water bodies have been and are currently impaired for non-support of dissolved oxygen levels within the basin. On the 303(d) list, several segments including 0504, 0504B, 0625A, 0606, and sites within 0615 have been listed for depressed dissolved oxygen levels.

Many water bodies within the basin have pH issues. Some reservoirs have more alkaline waters exceeding the criteria, while other streams and segments fall under the criteria with more acidic waters. Several water bodies within the basin are listed on the 303(d) of im-

paired water bodies. The exceedance of criteria and the consequent lowering of a nutrient level listed from segment to segment as to the issue.

Toxic substances in water including lead, mercury, and zinc have also been found in East Texas waters including the East Fork Angelina River and the Neches River below and above Lake Palestine.

Mercury in edible fish issue is a major concern in East Texas reservoirs. The Angelina River, Lake Barkham, Lewis, and Lake Barkham are just a few examples within the Neches River basin that have mercury in edible fish issues. There is currently a fish advisory in place for mercury in edible fish issues above the Wetland Bay and all contiguous waters from State 6, Hwy 70 bridge area of Lufkin down stream to the U.S. Highway 66 bridge near 16420. Mercury levels are high to impair people can become exposed to fish consumed here. The highest concentrations of mercury can be found in larger fish due to mercury being a substance which bioaccumulates.

Recommendations

TO BE COMPLETED AFTER INPUT FROM THE BASIN STEERING COMMITTEE

Executive Summary, 2011-2012. The 2011-2012 report is the first annual report of the Clean Rivers Program. The report provides a summary of the program's activities and accomplishments. The report also provides a summary of the program's findings and recommendations. The report is intended for use by the public and other interested parties. The report is available in both print and electronic formats. For more information, contact the program manager at (936) 293-1100.

1.0 INTRODUCTION

This section describes the purpose of the report and provides a discussion of the Clean Rivers Program.

Includes the following sections:

- *About the Angelina & Neches River Authority*
- *CRP and Basin Goals & Objectives*
- *Coordination and Cooperation with Other Entities in the Basin*
- *Descriptive Overview of the Neches Basin*
- *Summary of the Neches Basin Water Quality Characteristics*

1.0 INTRODUCTION

The Basin Summary Report, assembled every two years, provides a comprehensive review of water quality data and water quality related issues for the Upper Neches River Basin. The report serves to develop a greater understanding of water quality within the basin, which can be used to aid regulatory agencies in decision making. The report consists of a comprehensive review including descriptions of water quality conditions and issues, trend analysis of water quality by station and parameter, discussion of watershed characteristics, and potential influences on water quality. Furthermore, recommendations of management strategies for correcting identified water quality impairments are also included in the report. The report details activities performed by the Angelina & Neches River Authority (ANRA) under the Texas Clean Rivers Program (CRP).

The 2010 Basin Summary Report was prepared by the Angelina & Neches River Authority in cooperation with the Texas Commission on Environmental Quality (TCEQ) under the authorization of the Texas Clean Rivers Act.



2.0 PUBLIC INVOLVEMENT

This section describes efforts to promote public involvement in water quality issues.

Includes the following sections:

- *ANRA Operations*
- *Public Information*
- *Environmental Laboratory*
- *Basin Steering Committee*
- *Texas Stream Team*

2.0 PUBLIC INVOLVEMENT

ANRA Operations

The Angeline & Naches River Authority promotes public involvement in the Upper Naches River Basin through numerous operations and departments. In addition to monitoring water quality through the Clean Rivers Program, ANRA operates and maintains numerous public drinking water and municipal wastewater facilities, maintains the onsite septic permit program for Sierri Fajourn Reservoir, operates an Environmental Laboratory offering services to the public, and produces and sells biosolid compost through our Naches Compost Facility.

Public Information

ANRA provides the public with information concerning water quality issues on our website (www.ankra.org), which is updated frequently. The ANRA website provides public access to information on the Clean Rivers Program, current and historical Basin Summary and Basin Highlights reports, meeting agendas and minutes, and water quality data. In addition, numerous pamphlets, brochures, and other educational and informational literature on such topics as water quality, conservation, and on-site septic facilities are available to the public at ANRA's offices.

Environmental Laboratory

ANRA has an in-house water quality laboratory that provides services to numerous municipalities, water supply corporations, industries, and the general public, as well as conducting analyses of ambient surface waters to support Clean Rivers Program monitoring activities. The ANRA Environmental Laboratory is certified by the National Environmental Laboratory Accreditation Program to perform chemical and microbiological analyses of both potable and non-potable waters.

Basin Steering Committee

The steering committee's role is advisory in nature and provides assistance with the review of basin issues and creation of priorities for the Upper Naches River Basin. Committee members assist with the review and development of work plans, reports, basin monitoring guides, selection of reservoirs, and basin action plans. CDF steering committee meetings are held annually each Spring. The committee is made up from a cross-section of stakeholders, including:

- Private citizens
- Fee payers (identified in Texas Water Code Title 26.003570)
- Political subdivisions (including local, regional, and state officials)
- Texas State Soil and Water Conservation Board
- Other agencies (state, federal, and tribal) (e.g., Parks and Wildlife Department, Texas Wildlife Conservation Board, Texas General Land Office, Texas Department of Agriculture, Texas Railroad Commission, and Texas Department of Transportation)
- Other entities (e.g., the local water quality monitoring and the local government on Environmental Quality regional staff, business and industry, agriculture, environmental and other public interest groups)

One of the objectives of the CDF Long Term Positioning and Uniform Reporting System. The Steering Committee process gives stakeholders the opportunity to contribute their ideas and concerns through steering committee meetings, public meetings, and other forums. The process also allows for the communication of issues related to water quality so that agencies may be able to address local, regional, state, and federal needs. The Steering Committee aids in making recommendations to identify pressing issues and concerns, coordinate the CDF process, and identify ways to expand the public's role in water quality management issues.

Texas Stream Team

ANRA works with the Texas Stream Team (TST) as a volunteer monitoring organization for the Upper Naches Basin and provides training opportunities, water quality reports to the public, stream monitoring in the Basin. ANRA supports a number of water quality monitoring stations. The organization will also assist in the monitoring of the Sierri Fajourn Reservoir. CDF maintains a group of representatives from various County and State Agencies including the Texas Department of Agriculture, Texas Department of Transportation, the TST, concerned about protecting water quality in Lake by evaluating and making other statements in the basin.



Stream Team volunteers participating in a water quality monitoring activity.

3.0 WATER QUALITY REVIEW

3.0 WATER QUALITY REVIEW

3.1 Water Quality Terminology

This review of water quality terminology is designed to provide a description of technical terms used in the report. While this review can be used as a glossary, it is intended to provide more than just definitions, as it includes background information about why technical terms, such as high water, water quality standards, monitoring, and the evaluation of water bodies.

The Federal Clean Water Act (CWA)

The forefront of the first law to address water pollution in the United States was the Federal Water Pollution Control Act of 1948. After heightened concerns over water pollution, this act was reorganized, revised, and expanded in 1972. After amendments were added, the law became known as the Federal Clean Water Act (CWA) in 1977. The CWA encompasses the origin of permitted discharges, water quality standards, and holding liable parties responsible. The goal of the CWA is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters (33 U.S.C. § 1251(a)).

According to the Environmental Protection Agency (EPA), the 1977 amendments to the Clean Water Act:

- Established the basic structure for regulating pollutant discharges into the waters of the United States.
- Gave EPA the authority to implement pollution control programs such as setting wastewater standards for industry.
- Made the existing requirements to set water quality standards for all contaminants in surface waters.
- Made it unlawful for any person to discharge any pollutant from a point source into navigable waters, unless a permit was obtained under its provisions.

- Funded the construction of sewage treatment plants under the construction grant program.
- Recognized the need for planning to address the critical problems posed by nonpoint source pollution.

The primary goal of the CWA was to make all waters swimmable and fishable. The CWA established the basic structure for regulations of discharges, pollution abatement in waters, and regulating water quality conditions for surface waters.

Technical Water Quality Standards (TWQS)

Water quality standards were the new, governing regulation of a water body. A water quality standard is a level of water quality that is to be achieved in surface waters. The law, known as the Water Quality Management Act (WQMA), was passed by the Texas Commission on Environmental Quality (TCEQ) that also signed to establish numerical and narrative goals for water quality throughout the state. TCEQ also provides a list of which the TCEQ will carry programs or activities made into methods to implement and attain the water quality for water.

Outlets

Section 104(d)(1) of the CWA requires development of criteria for water quality that is suitable to protect the health and safety of humans and wildlife, and to protect the health of humans and wildlife. Section 104(d) also provides guidance to states and tribes to develop water quality standards. Criteria are developed for the physical quality of water bodies as well as for the chemical (EPA 1974).

Criteria are developed in a number representing a specific use for the water body. For example, for water to be suitable for fishing, the dissolved oxygen criteria may be 5.0 mg/L. Criteria are defined in the Texas Water Quality Standards (TWQS).

Assessment

Impaired water quality assessment is a systematic evaluation of water quality conditions in a water body.

Water Quality Assessment (WQA) and WQA

Water quality standards and criteria are applied to watersheds to assess water quality. Early reports on water quality were done at the local level. The quality of the water and other factors, such as the TWQS, were used to assess water quality. The assessment was done by the TWQS. The TWQS also provided a list of which the TWQS will carry programs or activities made into methods to implement and attain the water quality for water.

The Water Quality Assessment (WQA) is a condition of the water quality that is suitable to protect the health and safety of humans and wildlife.

This section provides an overview of technical terms (including water quality parameters), data review methodology, and summaries of the water quality data for each Sub-Basin.

Includes the following sections:

- *Water Quality Terminology*
- *Data Review Methodology*
- *Sub-Basin Summaries*

3.1 WATER QUALITY TERMINOLOGY

Water Quality Parameters

For each Field and Conventional Parameter evaluated for the report, a narrative summary is provided that discusses:

- Potential Impacts
- Possible Sources/Causes



3.2 DATA REVIEW METHODOLOGY

Trend Analysis

This section details the methods used to compile and evaluate the data for the Basin Summary Report.

Topics discussed include:

- Evaluation Period (9/1/99 – 8/31/09)
- Data Management
- Parameters evaluated
- Statistical Analysis

3.2 Data Review Methodology

Trend Analysis

In order to review and evaluate water quality trends for this report, data from the period of September 1999 to August 2009 was queried and exported from TCEQ's Surface Water Quality Monitoring Information System (SWQMS). The public interface for SWQMS can be found at the following web address:

<http://www.tceq.state.tx.us/water/affairs/swqms/index.cfm>

Once the data from the selected range was exported from SWQMS, the raw data files (in the form of pipe-delimited text files), were used to create a relational database in Microsoft Access. Over 748,000 individual records are contained within this database. Queries were written that allowed for records to be selected by Station ID and Parameter. As this data was queried, it was moved to Microsoft Excel spreadsheets for statistical analysis and graphing.

In Excel, workbooks were created for each monitoring station, with separate, specific sheets for each parameter of interest. The following parameters were graphed, with results plotted against time:

- pH
- Dissolved Oxygen (DO)
- Conductance
- Flow
- Zinc
- Total Suspended Solids (TSS)
- Total Dissolved Solids (TDS)
- Ammonia Nitrogen
- Nitrate-Nitrite-Nitrogen
- Orthophosphorus
- Total Phosphorus
- Chloride
- Sulfate
- Chlorophyll-*a*

The count, minimum, maximum, median (50th percentile), mean, and standard deviation were also determined. In the case of Flow, the geometric mean was calculated. The number of values exceeding criteria were marked, and the percentage of values exceeding criteria was determined.

If enough data was present for each parameter (≥ 10 samples in the evaluation period with continuous monitoring), a linear regression against time was performed. Trends were considered to be significant when the slope was > 0.2 and a p -value < 0.1 . In the case of residuals (value reported is less than the method recovery limit), those values were left as-is, ignoring the fact that they were. If a trend was evident due to changes in reporting methods was commonly observed with Chlorophyll-*a*, non-detect measurements were changed to zero for the best possible measurement to make the data consistent, and the trends were again evaluated.

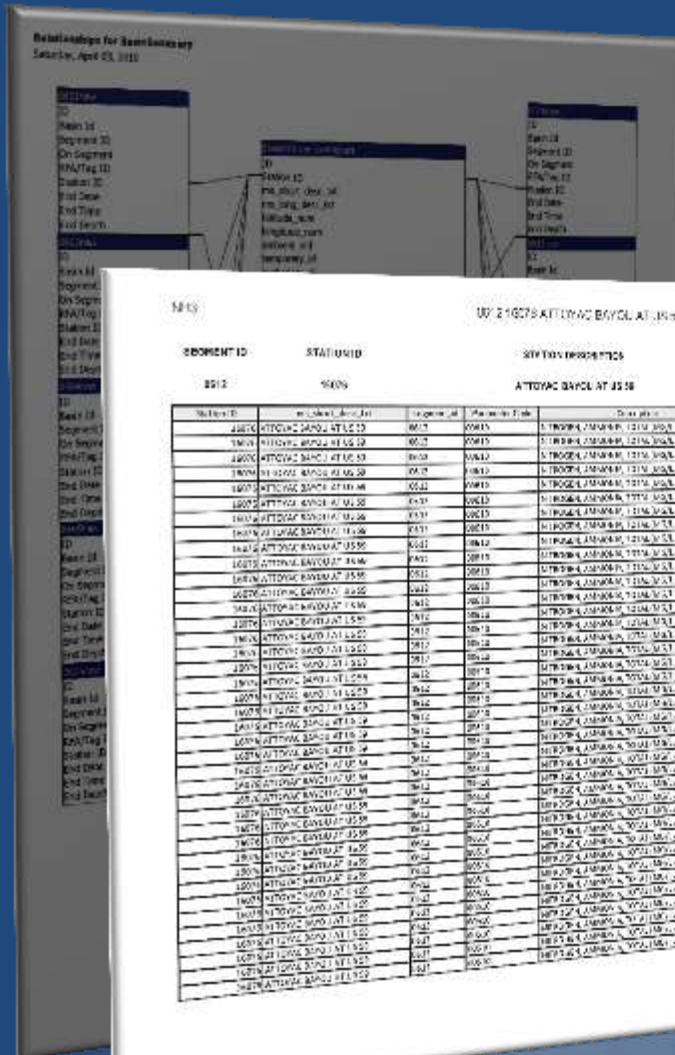
Due to the large volume of data used in the trend analysis, we are unable to include all of the data with regression in appendices. A copy of the Access database and trend analysis spreadsheets will be provided to any interested party.

ANRA's Data Review Methodology (cont.)

Monitoring Station Summaries

Data was queried in the Access database and exported to MS Excel for data evaluation and graphing.

For each monitoring station, tables were created for the individual water quality parameter.



MS EXCEL 2007: ATT002 ATT002 ATT002

COMMENT ID	STATION ID	SITE ENVIRONMENT	PARAMETER
0012	ATT002	ATT002 ATT002 ATT002	ATT002 ATT002 ATT002
0013	ATT002	ATT002 ATT002 ATT002	ATT002 ATT002 ATT002
0014	ATT002	ATT002 ATT002 ATT002	ATT002 ATT002 ATT002
0015	ATT002	ATT002 ATT002 ATT002	ATT002 ATT002 ATT002
0016	ATT002	ATT002 ATT002 ATT002	ATT002 ATT002 ATT002
0017	ATT002	ATT002 ATT002 ATT002	ATT002 ATT002 ATT002
0018	ATT002	ATT002 ATT002 ATT002	ATT002 ATT002 ATT002
0019	ATT002	ATT002 ATT002 ATT002	ATT002 ATT002 ATT002
0020	ATT002	ATT002 ATT002 ATT002	ATT002 ATT002 ATT002
0021	ATT002	ATT002 ATT002 ATT002	ATT002 ATT002 ATT002
0022	ATT002	ATT002 ATT002 ATT002	ATT002 ATT002 ATT002
0023	ATT002	ATT002 ATT002 ATT002	ATT002 ATT002 ATT002
0024	ATT002	ATT002 ATT002 ATT002	ATT002 ATT002 ATT002
0025	ATT002	ATT002 ATT002 ATT002	ATT002 ATT002 ATT002
0026	ATT002	ATT002 ATT002 ATT002	ATT002 ATT002 ATT002
0027	ATT002	ATT002 ATT002 ATT002	ATT002 ATT002 ATT002
0028	ATT002	ATT002 ATT002 ATT002	ATT002 ATT002 ATT002
0029	ATT002	ATT002 ATT002 ATT002	ATT002 ATT002 ATT002
0030	ATT002	ATT002 ATT002 ATT002	ATT002 ATT002 ATT002
0031	ATT002	ATT002 ATT002 ATT002	ATT002 ATT002 ATT002
0032	ATT002	ATT002 ATT002 ATT002	ATT002 ATT002 ATT002
0033	ATT002	ATT002 ATT002 ATT002	ATT002 ATT002 ATT002
0034	ATT002	ATT002 ATT002 ATT002	ATT002 ATT002 ATT002
0035	ATT002	ATT002 ATT002 ATT002	ATT002 ATT002 ATT002
0036	ATT002	ATT002 ATT002 ATT002	ATT002 ATT002 ATT002
0037	ATT002	ATT002 ATT002 ATT002	ATT002 ATT002 ATT002
0038	ATT002	ATT002 ATT002 ATT002	ATT002 ATT002 ATT002
0039	ATT002	ATT002 ATT002 ATT002	ATT002 ATT002 ATT002
0040	ATT002	ATT002 ATT002 ATT002	ATT002 ATT002 ATT002
0041	ATT002	ATT002 ATT002 ATT002	ATT002 ATT002 ATT002
0042	ATT002	ATT002 ATT002 ATT002	ATT002 ATT002 ATT002
0043	ATT002	ATT002 ATT002 ATT002	ATT002 ATT002 ATT002
0044	ATT002	ATT002 ATT002 ATT002	ATT002 ATT002 ATT002
0045	ATT002	ATT002 ATT002 ATT002	ATT002 ATT002 ATT002
0046	ATT002	ATT002 ATT002 ATT002	ATT002 ATT002 ATT002
0047	ATT002	ATT002 ATT002 ATT002	ATT002 ATT002 ATT002
0048	ATT002	ATT002 ATT002 ATT002	ATT002 ATT002 ATT002
0049	ATT002	ATT002 ATT002 ATT002	ATT002 ATT002 ATT002
0050	ATT002	ATT002 ATT002 ATT002	ATT002 ATT002 ATT002
0051	ATT002	ATT002 ATT002 ATT002	ATT002 ATT002 ATT002
0052	ATT002	ATT002 ATT002 ATT002	ATT002 ATT002 ATT002
0053	ATT002	ATT002 ATT002 ATT002	ATT002 ATT002 ATT002
0054	ATT002	ATT002 ATT002 ATT002	ATT002 ATT002 ATT002
0055	ATT002	ATT002 ATT002 ATT002	ATT002 ATT002 ATT002
0056	ATT002	ATT002 ATT002 ATT002	ATT002 ATT002 ATT002
0057	ATT002	ATT002 ATT002 ATT002	ATT002 ATT002 ATT002
0058	ATT002	ATT002 ATT002 ATT002	ATT002 ATT002 ATT002
0059	ATT002	ATT002 ATT002 ATT002	ATT002 ATT002 ATT002
0060	ATT002	ATT002 ATT002 ATT002	ATT002 ATT002 ATT002

ANRA's Data Review Methodology (cont.)

Statistical Analysis

For each parameter meeting criteria (minimum of 20 data points, with continuous monitoring), linear regression against time was performed.

Trends were considered significant with a $t\text{-stat} \geq |2|$ and a $p\text{-value} < 0.1$

LINE 3070 10226 A TONAC BAMPOLAT UR 89

REGRESSION OUTPUT

DEPENDENT VARIABLE

NUMBER 12
 OBSERV 12
 MISSING 0
 MISSING 0
 MISSING 0
 MISSING 0
 MISSING 0

ADJUSTED R-SQ 0.824

REGRESSION	R	ST	SE	P	STATISTICS
Regression	1	0.2046330	0.0491903	0.0000000	0.0000000
Residual	2	0.0000000	0.0000000	0.0000000	0.0000000
Total	3	0.0000000	0.0000000	0.0000000	0.0000000

Parameter	Sum of Squares	Total	Number	Lower 95%	Upper 95%	Lower 90%	Upper 90%
Intercept	0.2277902	0.2277902	0.1111111	1.3411111	4.2144444	1.1555556	5.2222222
Time (hr)	0.1126255	0.1126255	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000

RESIDUAL OUTPUT

Observation	Observed Value	Number	Adjusted Regression	Residual	ST
1	1.1953265	1	0.9903265	0.2050000	0.01
2	1.1511802	2	0.9511802	0.2000000	0.01
3	1.1751150	3	0.9711500	0.2040000	0.01
4	1.1493243	4	0.9502443	0.1990000	0.01
5	1.1712254	5	0.9712254	0.2000000	0.01
6	1.1580404	6	0.9580404	0.2000000	0.01
7	1.1424241	7	0.9424241	0.2000000	0.01
8	1.1630245	8	0.9630245	0.2000000	0.01
9	1.1530245	9	0.9530245	0.2000000	0.01
10	1.1630245	10	0.9630245	0.2000000	0.01
11	1.1630245	11	0.9630245	0.2000000	0.01
12	1.1630245	12	0.9630245	0.2000000	0.01
13	1.1630245	13	0.9630245	0.2000000	0.01
14	1.1630245	14	0.9630245	0.2000000	0.01
15	1.1630245	15	0.9630245	0.2000000	0.01
16	1.1630245	16	0.9630245	0.2000000	0.01
17	1.1630245	17	0.9630245	0.2000000	0.01
18	1.1630245	18	0.9630245	0.2000000	0.01
19	1.1630245	19	0.9630245	0.2000000	0.01
20	1.1630245	20	0.9630245	0.2000000	0.01
21	1.1630245	21	0.9630245	0.2000000	0.01
22	1.1630245	22	0.9630245	0.2000000	0.01
23	1.1630245	23	0.9630245	0.2000000	0.01
24	1.1630245	24	0.9630245	0.2000000	0.01
25	1.1630245	25	0.9630245	0.2000000	0.01
26	1.1630245	26	0.9630245	0.2000000	0.01
27	1.1630245	27	0.9630245	0.2000000	0.01
28	1.1630245	28	0.9630245	0.2000000	0.01
29	1.1630245	29	0.9630245	0.2000000	0.01
30	1.1630245	30	0.9630245	0.2000000	0.01

REGRESSION OUTPUT

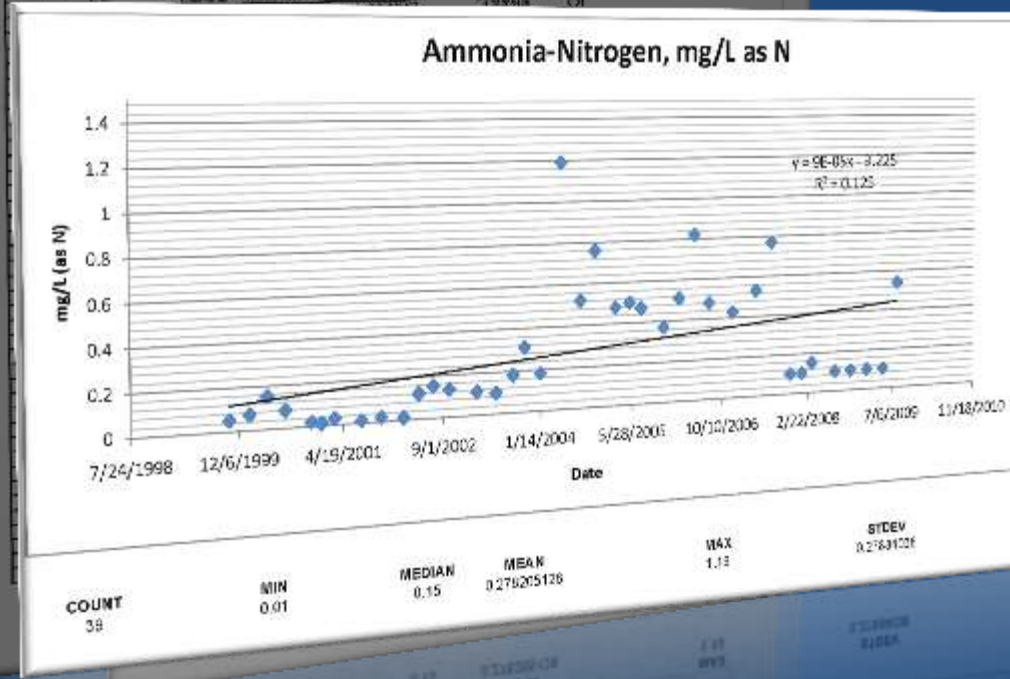
Parameter	Sum of Squares	Total	Number	Lower 95%	Upper 95%	Lower 90%	Upper 90%
Intercept	0.2277902	0.2277902	0.1111111	1.3411111	4.2144444	1.1555556	5.2222222
Time (hr)	0.1126255	0.1126255	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000

ANRA's Data Review Methodology (cont.)

Trend Graphs

Data was plotted against time.

Each graph includes a trendline and equation of the line. For statistically significant trends, the *t-stat* and *p-value* are included on the graph.



3.3 SUB-BASIN SUMMARIES

3.3 Sub-Basin Summaries

For the purpose of this report, data will be divided and presented based upon sub-basins (as defined by their 8-digit hydrologic unit code).

The Sub-Basin Summaries provide detailed information about the water quality in each watershed in the basin. The sub-basins in the Upper Neches Basin include:

- Upper Angelina
- Lower Angelina
- Upper Neches
- Middle Neches
- Lower Neches

Each Sub-Basin Summary includes a narrative and description of the sub-basin's geographic area, population centers, stream segments, and water quality discharge permits. A map of each sub-basin is included with each summary. In each Sub-Basin Summary is a discussion of individual segments within the sub-basin, including information from TCEQ's 2009 Water Quality Inventory and a trend analysis of water quality parameters. Maps are also included with each segment to show monitoring stations monitored by ANRA and other agencies in the Basin. In the review of water quality parameters which show significant trends or exceedences of standards are provided.

As ANRA has only one monitoring station in the Lower Neches Sub-Basin, this station has been combined with the Middle Neches Sub-basin for discussion purposes.

For more information on the other sub-basins comprising the Neches Basin, such as Lower Neches, Village and Pine Island Bayou sub-basins, please refer to the Basin Summary Report developed by the Lower Neches Water Authority.



Data is divided and presented based upon Sub-Basins as defined by their 8-digit hydrologic unit code.

The Sub-Basins in the Upper Neches Basin are:

- Upper Angelina
- Lower Angelina
- Upper Neches
- Middle Neches
- Lower Neches

Sub-Basins Included in the Basin Summary Report



Layout of the Sub-Basin Summaries

Each Sub-Basin Summary begins with a map of the Sub-Basin. Each map identifies:

- *ANRA Monitoring Stations*
- *TCEQ Monitoring Stations*
- *LNVA Monitoring Stations (where applicable)*
- *City of Tyler Monitoring Stations (where applicable)*
- *Segments*
- *Segment Boundaries*
- *Cities*
- *Major Highways*



Layout of the Sub-Basin Summaries (cont.)

Profiles of each Sub-Basin include narrative discussions of:

- *Population*
- *Land Characteristics and Use*
- *Permitted Discharges*

Each profile includes a table listing the segments included in each Sub-Basin.

Profile of the Lower Angelina Sub-Basin

Population

The Lower Angelina Sub-Basin includes, partially or wholly, Angelina, Jasper, Neacledochas, Keweenaw, Fuls, Sabine, Shelby and San Augustine counties. The sub-basin includes the following cities: Chrens, Garson, Neacledochas, Lufkin, Huntington, Broadbuck, Pineleaf, Brownfield, San Augustine, and Appsey. Approximately 282,000 persons reside within the counties included in the sub-basin.

Land Characteristics and Use

In the Lower Angelina Sub-Basin, evergreen forest, shrub-wetland, and young forest, grassland, and pine forest are emergent. Land coverage in the northern part of the sub-basin includes: forest, pasture, shrub, developed open space, and developed low intensity regions located around Lufkin and Neacledochas. Within the southern portion of the sub-basin, land use includes emergent herbaceous and mixed forest. There are areas of water oak, water oak, and blackgum located at the upper reaches of San Fyburn reservoir. Camero-Alexand, Sparta, Texas Jackson, and Gulf Coast are the major cities in the region. Average annual precipitation is 72 inches. The South-Central Plains ecoregion includes floodplains, low terraces, southern hairy woodpecker, and tertiary uplands. Some counties have experienced an increase in total number of farms, while others have not from 2002 to 2007. Within all the counties in the sub-basin, there are approximately 50,807,436 broilers and other meat-type chickens, not including Sabine county which could not disclose data for the USDA Agricultural Census. A total of 176,297 heads of cattle are also included within the sub-basin.

Permitted Discharges

There are thirty-two permitted discharges within the Lower Angelina Sub-Basin.

Segments included in the Lower Angelina Sub-Basin

Segment ID	Segment Name	Length or Average
0609	Angelina River Below San Fyburn Reservoir	12 miles
0610	San Fyburn Reservoir	100 miles
0610A	Upper San Fyburn Reservoir	20 miles
0611	Shelby River and Tributaries	20 miles
0612	Neacledochas River	20 miles
0612A	Tributaries to Neacledochas River	20 miles
0613	Wichita River and Tributaries	100 miles
0614	Neacledochas River and Tributaries	100 miles
0615	Angelina River and Tributaries	100 miles
0616	Neacledochas River and Tributaries	100 miles



San Fyburn Reservoir near Sparta

Layout of the Sub-Basin Summaries (cont.)

Each Sub-Basin Summary includes the 2008 Texas Surface Water Quality Standards for segments in that Sub-Basin.

Texas Surface Water Quality Standards (2008) Criteria

Texas Surface Water Quality Standards (2008) Criteria for the Lower Angelina Sub-Basin		
Segment ID	Assigned Use	Screening Levels for Specified Use
0605	General Use	Ammonia 0.3 mg/L, Chlorophyll <i>a</i> 10 mg/L, Nitrate Nitrogen 10 mg/L, Total phosphorus 0.25 mg/L, Total Suspended Solids 50 mg/L
	Public Water Supply Use	Chloride 20 mg/L, Sulfate 25 mg/L, TDS 25 mg/L
	Contact Recreation Use	Zinc 0.05 mg/L, Lead 0.01 mg/L, Cadmium 0.001 mg/L, Copper 0.01 mg/L, Silver 0.001 mg/L, Manganese 0.1 mg/L
	High Aquatic Life Use	Dissolved oxygen 5 mg/L, DO saturation 12 mg/L, DO 24 hr average 50 mg/L, DO 24 hr minimum 2 mg/L
0610	General Use	Ammonia 0.3 mg/L, Chlorophyll <i>a</i> 25 mg/L, Nitrate Nitrogen 10 mg/L, Total phosphorus 0.25 mg/L, Total Suspended Solids 50 mg/L, pH 6-9
	Public Water Supply Use	Chloride 100 mg/L, Sulfate 100 mg/L, TDS 100 mg/L
	Contact Recreation Use	Zinc 0.05 mg/L, Lead 0.01 mg/L, Cadmium 0.001 mg/L, Copper 0.01 mg/L, Silver 0.001 mg/L, Manganese 0.1 mg/L
	High Aquatic Life Use	DO Screening level 5 mg/L, DO saturation 12 mg/L, DO 24 hr average 50 mg/L, DO 24 hr minimum 2 mg/L
0610A	Fish Consumption	Argonite 0.25 mg/L, Chlorophyll <i>a</i> 100 mg/L, Nitrate Nitrogen 10 mg/L, Total phosphorus 0.25 mg/L, Total Suspended Solids 50 mg/L
	General Use	Ammonia 0.25 mg/L, Chlorophyll <i>a</i> 100 mg/L, Nitrate Nitrogen 10 mg/L, Total phosphorus 0.25 mg/L, Total Suspended Solids 50 mg/L
0611B	General Use	Ammonia 0.25 mg/L, Chlorophyll <i>a</i> 100 mg/L, Nitrate Nitrogen 10 mg/L, Total phosphorus 0.25 mg/L, Total Suspended Solids 50 mg/L
	Public Water Supply Use	Chloride 100 mg/L, Sulfate 100 mg/L, TDS 100 mg/L
0612	General Use	Ammonia 0.25 mg/L, Chlorophyll <i>a</i> 100 mg/L, Nitrate Nitrogen 10 mg/L, Total phosphorus 0.25 mg/L, Total Suspended Solids 50 mg/L
	Contact Recreation Use	Zinc 0.05 mg/L, Lead 0.01 mg/L, Cadmium 0.001 mg/L, Copper 0.01 mg/L, Silver 0.001 mg/L, Manganese 0.1 mg/L
	High Aquatic Life Use	Dissolved oxygen 5 mg/L, DO saturation 12 mg/L, DO 24 hr average 50 mg/L, DO 24 hr minimum 2 mg/L
0612C	General Use	Ammonia 0.25 mg/L, Chlorophyll <i>a</i> 100 mg/L, Nitrate Nitrogen 10 mg/L, Total phosphorus 0.25 mg/L, Total Suspended Solids 50 mg/L
	Public Water Supply Use	Chloride 100 mg/L, Sulfate 100 mg/L, TDS 100 mg/L
	Contact Recreation Use	Zinc 0.05 mg/L, Lead 0.01 mg/L, Cadmium 0.001 mg/L, Copper 0.01 mg/L, Silver 0.001 mg/L, Manganese 0.1 mg/L
0615	General Use	Ammonia 0.3 mg/L, Chlorophyll <i>a</i> 10 mg/L, Nitrate Nitrogen 10 mg/L, Total phosphorus 0.25 mg/L, Total Suspended Solids 50 mg/L
	Public Water Supply Use	Chloride 100 mg/L, Sulfate 100 mg/L, TDS 100 mg/L
	Contact Recreation Use	Zinc 0.05 mg/L, Lead 0.01 mg/L, Cadmium 0.001 mg/L, Copper 0.01 mg/L, Silver 0.001 mg/L, Manganese 0.1 mg/L
0615A	General Use	Ammonia 0.3 mg/L, Chlorophyll <i>a</i> 10 mg/L, Nitrate Nitrogen 10 mg/L, Total phosphorus 0.25 mg/L, Total Suspended Solids 50 mg/L
	Contact Recreation Use	Zinc 0.05 mg/L, Lead 0.01 mg/L, Cadmium 0.001 mg/L, Copper 0.01 mg/L, Silver 0.001 mg/L, Manganese 0.1 mg/L
	Aquatic Life Use	Dissolved oxygen 5 mg/L, DO saturation 12 mg/L, DO 24 hr average 50 mg/L, DO 24 hr minimum 2 mg/L

Layout of the Sub-Basin Summaries (cont.)

Segment Profiles

A Segment Profile is available for each segment in the Sub-Basin. Each profile includes a:

- *Narrative Summary*
- *Segment Map*
- *List of Monitoring Stations*

Segment 0610 Sam Rayburn Reservoir

Segment Profile

This segment includes 106,656 acres from Sam Rayburn Dam in Jasper County to a point 5.6 kilometers (3.5 miles) upstream of Marion's Ferry on the Angelina River Arm in Angelina/Polk counties and to a point 3.4 km (2.1 miles) downstream of Curry Creek on the Atoka Rayburn Arm in Hancock County. Construction of the dam began in 1956 for the purpose of hydroelectric power generation, flood control, municipal/industrial/agricultural water conservation, and recreational uses. The designated uses are general use, high aquatic life use, public water supply use, contact recreation, and fish consumption. Located around Sam Rayburn are various contact recreational uses including trails, campgrounds, boating areas, marinas, designated swimming areas, and picnicking areas.

Multiple locations within Sam Rayburn Reservoir are listed on the PCB list due to mercury (Hg) presence in water fish tissue. All areas were first listed on the 2003 list in 1996 and are currently under a 5c classification.

There are multiple monitoring stations located on Sam Rayburn Reservoir, with routine monitoring being performed by TCEQ Region 5, LWMA, and ANKA. Only a portion of the stations are discussed in the Upper Keches Basin Summary Report.



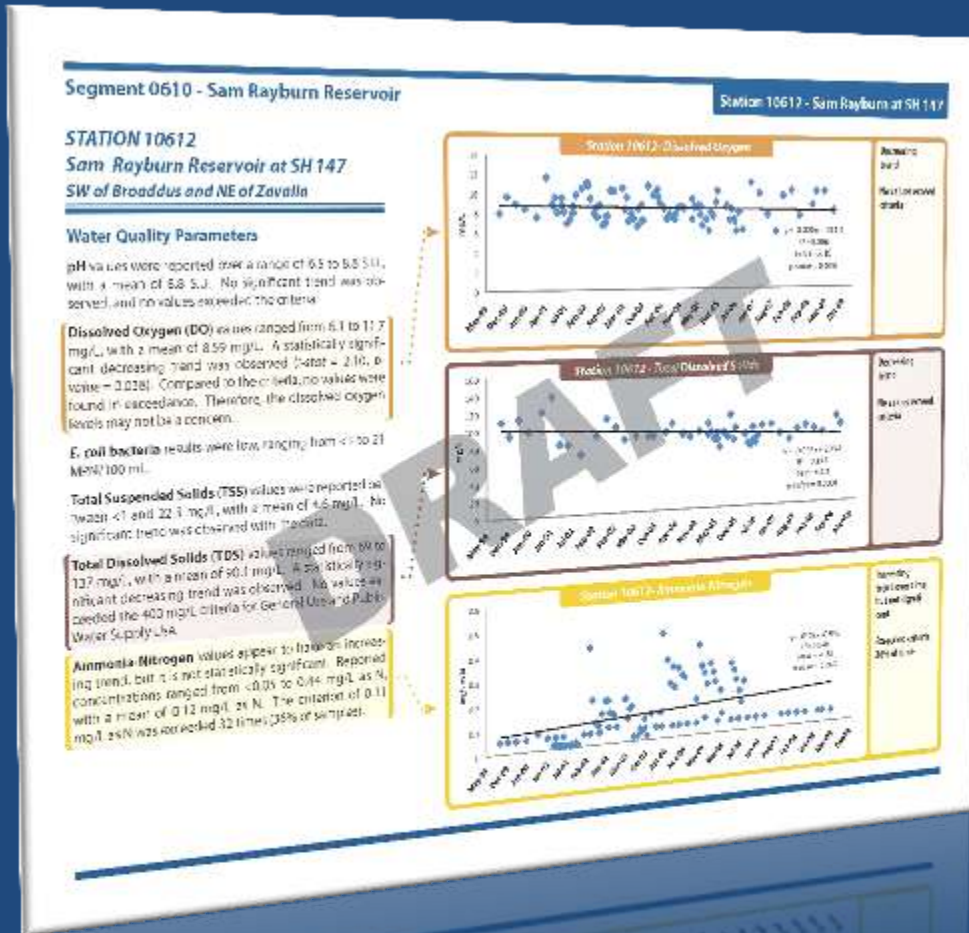
Station ID	Station Name	Collecting Agency	Priority	Purpose(s)
10612	Sam Rayburn Reservoir S-142	TCEQ	2	For a contact recreation use
10613	Sam Rayburn Reservoir S-102 (down of 0610)	TCEQ	2	For a contact recreation use
10614	Sam Rayburn Reservoir S-101 (down of 0610)	TCEQ	2	For a contact recreation use
14366	Sam Rayburn Reservoir S-101	TCEQ	2	For a contact recreation use
14367	Sam Rayburn Reservoir S-101	TCEQ	2	For a contact recreation use
15023	Sam Rayburn Reservoir S-101	TCEQ	2	For a contact recreation use
15024	Sam Rayburn Reservoir S-101	TCEQ	2	For a contact recreation use

Layout of the Sub-Basin Summaries (cont.)

Monitoring Station Data Review

For each monitoring station, results of water quality parameter analyses are discussed.

Graphs are included to show items of interest (statistically significant trends, exceedances, etc.).



Layout of the Sub-Basin Summaries (cont.)

Water Quality Issues Summary

A Summary of Water Quality Issues is included for each Sub-Basin.

Each Summary includes a discussion of each:

- *Water Quality Issue*
- *Affected Area*
- *Possible Influences/Causes*
- *Possible Effects*
- *Possible Solutions/Actions Taken*

Summary for the Lower Angelina Sub-Basin

Water Quality Issues Summary for the Lower Angelina Sub-Basin				
Water Quality Issue	Affected Area	Possible Influences/Causes	Possible Effects	Possible Solutions/Actions Taken
Mercury in edible fish tissue	Since 1956, Sam Rayburn Reservoir has been listed on the 303 (b) list	<ul style="list-style-type: none"> Atmospheric deposition Unknown sources 	<ul style="list-style-type: none"> Causes serious health concerns that affect the public, including children and pregnant women Block accumulation over years of consumption is threatening fishing in primary use of water 	<ul style="list-style-type: none"> Post list in order to avoid need to public health ch. for associated with consumption of fish is also mercury in fish listed Enforce strict limitations on all permits Evaluate effectiveness of remedial control measures for the general public
Elevated bacteria levels: Currently listed on 303 (b) list due to impairments	<ul style="list-style-type: none"> Segment 0610A Ayish Bayou Segment 0611 Angelina River above Sam Rayburn from US 84 to lower boundary Segment 0611B La Nana Bayou (inflow to SHZ) Segment 0612 Artzyac Bayou 	<ul style="list-style-type: none"> Agricultural activities including cattle farming and poultry activities within the area may introduce point source pollution via runoff Point source municipal discharge Unknown 	<ul style="list-style-type: none"> Risk for contact recreation Facilitate loads from agricultural runoff reduced by riparian flow 	<ul style="list-style-type: none"> Track sources for bacterial contamination in possible flow reductions
Significant decreasing trend of dissolved oxygen levels	Observed at two stations at Sam Rayburn Reservoir (511 147; 54 103)	<ul style="list-style-type: none"> Agri waste plants (plant material) 	<ul style="list-style-type: none"> Detrital to aquatic community 	<ul style="list-style-type: none"> Investigate current of faulting activity to control localized flooding plants Solutions to reduce plant flow were found to be most promising to determine if new cost is valid
Significant decreasing trend of nitrate-nitrite, total phosphorus, and chloride levels	Several stations at Sam Rayburn Reservoir	<ul style="list-style-type: none"> Closure of Abil Paper Mill has reduced the nutrient load entering the reservoir Efficient On-site Sewage Treatment (OOST) program around Sam Rayburn 	<ul style="list-style-type: none"> Decreases in water nutrient loading for vegetation community 	<ul style="list-style-type: none"> Continued monitoring

4.0 RECOMMENDATIONS AND CONCLUSIONS

This section includes:

- recommendations and comments made by stakeholders
- an outline of recommendations to protect and improve water quality in the basin
- priorities to address water quality
- the long-term vision of how basin efforts need to be directed

Steering Committee input is needed to develop this section of the report.

Steering Committee Member Comments

Examples of comments received thus far:

- Specify that the report refers to the 2008 303(d) list, as the 2010 list is still a draft
- Verify and correct rainfall data
- Include Fish Consumption Use for all water bodies
- Report sample size for all graphs
- Report *t-stat* and *p-value* for all graphs, not just those showing statistically significant trends (to maintain consistency)
- Query for special studies or intensive surveys to have a more complete sample set

Steering Committee Member Comments

Examples of comments received thus far (continued):

- Remove lines connecting data points from DO graphs (to maintain consistency)
- List the criteria, especially for graphs with exceedances
- Examine and/or add a qualifying statement regarding the effect of laboratory limits of quantification on trends (false trends?)
- Compare different constituents (Chl-*a* vs Flow, DO vs Flow, etc.) to look for correlations or explanatory trends
- Look for more seasonal trends
- Provide more graphs of data that exceed criteria
- Draw conclusions and give reasons why trends are occurring

Steering Committee Member Comments

Comments from the Steering Committee Members are a crucial part of this process, and help to increase our understanding of issues in the basin.

Comments will be incorporated into the Final Basin Summary Report.

Please direct Questions, Comments, and Recommendations to:

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