Source Water Assessment in the Mud Creek Watershed

ANGELINA & NECHES RIVER AUTHORITY

Prepared by the
Angelina & Neches River Authority

Submitted to the

Texas Water Development Board

August 31, 2010

TWDB Research and Planning Fund Research Grant
Contract No. 0904830919

2010 AUG 30 AM 11:21
EXECUTIVE ADMINISTRATION

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1.0 Introduction

In late 2008, The Texas Water Development Board ("TWDB") Research and Planning Fund awarded a Research Grant to the Angelina & Neches River Authority ("ANRA"). TWDB Contract No. 0904830919 was initiated October 28, 2008, to complete a reservoir source water assessment in Cherokee and Smith counties. The final report deadline is August 31, 2010.

A source water assessment is recommended prior to reservoir construction to identify and locate point and non-point pollution sources, delineate protection areas, and determine the potential threats to the drinking water source. The source water assessment would aid in the development of a Watershed Management Plan and a Source Water Protection Plan. The primary purpose of this study was to define baseline conditions and identify potential water quality contamination issues in the proposed Lake Columbia watershed. This assessment also provided an opportunity to identify potential treatment needs and processes.

2.0 Background

The proposed Lake Columbia Regional Water Supply Reservoir has a watershed containing 384 square miles. While point source outfall locations generally are known, non-contribution sources are largely unknown. The watershed contains a large area within the West Mud Creek drainage which is in a rapidly urbanizing area of the City of Tyler. Additionally, a former Environmental Protection Agency ("EPA") superfund site, which was a battery recycling facility, lies within a portion of the western watershed. The water in Mud Creek is proposed to be impounded to form Lake Columbia. Southern Smith County, in particular the City of Tyler, and northern Cherokee County are developing residential and commercial areas at a rapid pace. Urban areas are known to have point source pollution discharges. Examples include: permitted discharges from sewage treatment plants, potential sanitary sewer overflows, and storm water runoff. Urban areas are also known for non-point source pollution to surface water through runoff of fertilizers and pesticides applied to lawns, golf courses, and other areas. Urban runoff also contains oil, grease, and toxic chemicals from parking lots and roadways, and sediment from improperly managed construction sites. The watershed area also contains agriculture production in the form of cropland, cattle grazing, and poultry production. These operations are also known sources of non-point source runoff in the form of fertilizers, pesticides, and animal waste. In addition, these areas are seeing an increase in the amount of natural gas drilling and development activity. Each of these types of development pose a potential threat to water quality, either through urban storm water runoff or other types of point or non-point discharges of pollutants.

A review of the state's surface water quality database revealed that there is very little to no available water quality data within the proposed project watershed area. Several

locations within the watershed wre sampled for limited parameters in the mid to late 1980's and have not been sampled since. Two locations on Mud Creek and one on West Mud Creek were sampled for only two years from 2001 to 2002. Only two creeks within the watershed have ever been sampled for metals. One was sampled in 1995 and the other in 2002. One site within the project area is currently being sampled under the Texas Clean Rivers Program. However, the data being collected is limited to the field and conventional parameters and does not include the additional parameters included in this study.

3.0 Sampling Methods

The field sampling procedures followed those outlined in the 2003 Surface Water Quality Monitoring Procedures, Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment, and Tissue produced by the Texas Commission on Environmental Quality ("TCEQ"). All testing for this project, including testing done both In-House and by subcontracted laboratories, was performed in accordance with 40 CFR Part 136.

Stream flow measurements were taken monthly when possible. In the event that stream flow measurements were not available, a stream flow estimate was done in accordance with the Surface Water Quality Monitoring Procedures.

All of the field and laboratory data generated were entered into a Microsoft Excel spreadsheet. The data were reviewed for completeness and reasonableness prior to being entered into the spreadsheet. The TCEQ Surface Water Quality Monitoring Team has established a minimum and maximum value for each water quality parameter above or below which is considered an "outlier". All of the data produced was compared against these values and such "outliers" were confirmed and validated prior to being entered into the spreadsheet. The Data Validation and Verification procedures followed those outlined in the TCEQ's FY08-09 Clean Rivers Program Guidance.

The field measurements listed in Table 3.1 were collected on a monthly basis.

Grab samples, flow measurements, and field measurements were collected at seven monitoring locations shown in Figure 3.1 and described in Table 3.2. The sampling period was from January 2009 to December 2009.

Table 3.1 Field Parameters

In-stream Flow	pH	Transparency
Water Temperature	Dissolved Oxygen	Present Weather
Air Temperature	Conductivity	Days Since Last Rainfall
Flow Severity		

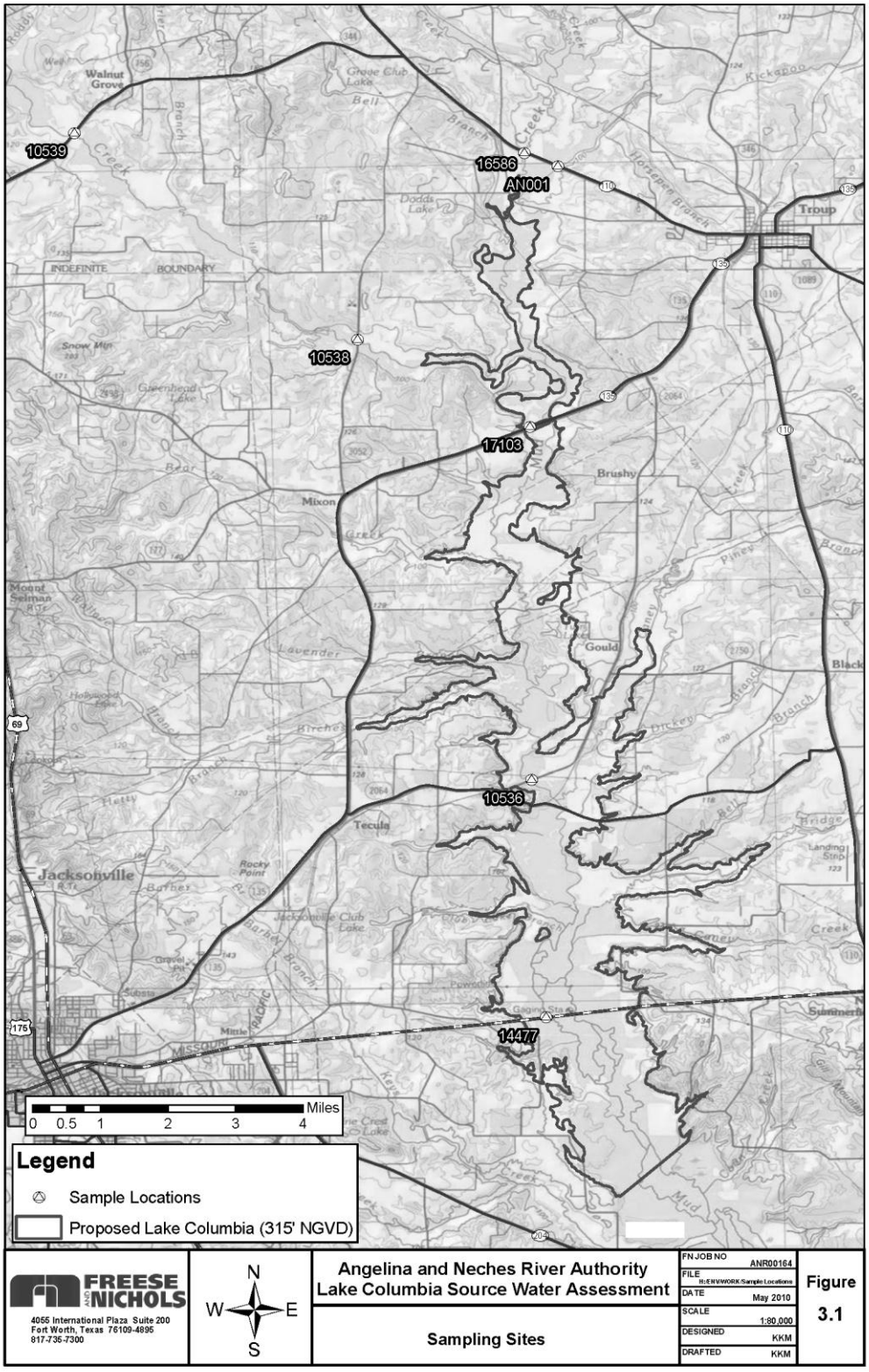

Figure 3.1 Sampling Sites

Table 3.2 Sampling Locations

Station #	Station ID#	Location	Comments	Sampled in (2001)
1	16586	Mud Creek at SH 110	Located at the SH 110 crossing, approximately 6.0 km NW of the City of Troup	Yes
2	10538	West Mud Creek at FM 3052	Located at the FM 3052 crossing, SW of the City of Troup. West Mud Creek is a direct tributary of Mud Creek	Yes
3	17103	Mud Creek at SH 135	Located at the SH 135 crossing, SW of the City of Troup	Yes
4	10536	Mud Creek at FM 2064	This site is located at the FM 2064 crossing, NW of the City of Jacksonville.	Yes
5	14477	Mud Creek at US Hwy 79	Located on the N side of the US Hwy 79 crossing, between the Cities of Jacksonville and New Summerfield	Yes
6	AN001	Kickapoo Creek at SH 110	Located at the SH 110 crossing, NW of the City of Troup. Kickapoo Creek is a direct tributary of Mud Creek	No
7	10539	West Mud Creek at FM 344	This site is located at the FM 344 crossing, East of the City of Bullard and South of the City of Tyler	No

Since the water in these creeks will eventually form Lake Columbia and ultimately be used as a source of drinking water, the parameters being assessed are from the EPA's lists of Primary and Secondary Drinking Water Contaminants (Attachment B). These parameters include heavy metals, organics, herbicides, pesticides, and other chemical constituents.

Monitoring stations 1-5 were sampled in a previous study in 2001. A sixth station on Kickapoo Creek (AN001) was added in order to make a more detailed assessment of the Mud Creek watershed. A seventh station on West Mud Creek (10539) was added to address increased urbanization along the US 69 corridor between the cities of Jacksonville and Tyler.

The samples collected were transported to the ANRA Laboratory for analyses. Routine nutrient parameters and bacteriological samples were analyzed in-house, with the remainder of the testing (such as metals, organics, etc.) that could not be performed in-house being subcontracted to a NELAC-accredited laboratory.

A list of the selected parameters and frequency of analysis is shown in Table 3.3.

Table 3.3 Laboratory Analyses

Monthly Analyses		Quarterly Analyses	Semi-Annual Analyses
Routine Nutrient Parameters		**Metals**	**Organics**
Ammonia-Nitrogen	Chloride	Arsenic	Volatile Organics
Nitrate-Nitrogen	Total Suspended Solids	Barium	Semi-Volatile Organics
Nitrite-Nitrogen	Total Dissolved Solids	Cadmium	Polychlorinated Biphenyls (PCBs)
Total Phosphorus	Chlorophyll-a	Chromium	
Ortho-Phosphorus	Pheophytin	Lead	
Sulfate		Mercury	
Bacteriology		Selenium	
Total Coliform		Silver	
E. coli		Antimony	
Additional Parameters		Beryllium	
Carbonate	Total Solids	Thallium	
Bicarbonate	Biochemical Oxygen Demand	Aluminum	
Sodium	Chemical Oxygen Demand	Copper	
Fluoride	Total Kjeldhal Nitrogen	Iron	
Alkalinity as CaCO3	Turbidity	Manganese	
Hardness, Total	Color	Zinc	
Hardness, Calcium	Total Petroleum Hydrocarbons	**Additional Parameters**	
Hardness, Magnesium		Total Organic Carbon	
Calcium		Cyanide	
Magnesium		Phenols	
		Bromide	
		Organics	
		Herbicides	
		Pesticides	

4.0 Sample Results

4.1 Primary Standards

National Primary Drinking Water Regulations are legally-enforceable standards that apply to public water systems. Primary standards protect drinking water quality by limiting the levels of specific contaminants that can adversely affect human health and

are known or anticipated to occur in water. The EPA adopts rules under the Safe Drinking Water Act. The State of Texas must adopt regulations at least as stringent. The TCEQ is responsible for enforcing the drinking water rules in Texas.

The analytical results of the samples are presented in Attachment A. The sampling results are compared to Texas Public Drinking Water Standards and are tabulated by sampling site. The following sections include discussions of the parameters which exceeded the primary standards.

4.1.1 Coliforms

Each of the seven sample locations had positive samples for coliforms. A positive total coliform (including fecal coliforms and *E. Coli*) sample is not a health threat in itself; it is used to indicate whether potentially harmful bacteria may be present. The standard for coliforms is no more than 5% of the total samples test coliform-positive in a month. However, the standard goal is set at zero because ingesting even one bacterium may cause adverse health effects. Coliforms are naturally present in the environment as well as feces. Fecal coliforms and *E. Coli* only come from human and animal fecal waste and are removed during treatment by disinfection.

4.1.2 Nitrogen

Each of the seven sample locations had at least one exceedance for nitrogen. Common sources of nitrogen contamination include runoff from fertilizer use (either commercial or residential), leaching from on-site sewage facilities (septic systems), sewage, or simple erosion of natural deposits locally. Nitrogen is an essential plant nutrient that occurs in several different forms in the environment. Although nitrogen is crucial for plant growth, elevated levels of nitrate-N can contribute to eutrophication of reservoirs if other essential plant nutrients are not limiting to algal populations.

4.1.3 Turbidity

All seven sample locations registered exceedances for all twelve months for Turbidity. Turbidity is a measure of the transparency of water. It is used to indicate water quality and filtration effectiveness. Higher turbidity levels may be associated with higher levels of disease-causing microorganisms such as viruses, parasites and some bacteria. Turbidity can be attributed to many factors, including human activities such as land clearing and natural conditions such as erodible stream beds and banks.

4.2 Secondary Standards

National Secondary Drinking Water Regulations are non-enforceable guidelines regarding contaminants that may cause cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor, or color) in drinking water. EPA recommends secondary standards to water systems, but does not require systems to comply. The state of Texas has chosen to adopt the secondary requirements as enforceable standards. The following sections describe the secondary standards that were exceeded.

4.2.1 Aluminum

Six of the seven sample locations exceeded the standard for aluminum in each of the four quarters. The remaining location (Station 16586) was in attainment of the aluminum standard for one quarter. Aluminum is the most abundant metal in the earth's crust. It is always found combined with other elements such as oxygen, silicon, and fluorine. Small amounts of aluminum can be found dissolved in water. Aluminum is often mixed with small amounts of other metals to form stronger alloys. These compounds have commercial uses such as alums in water-treatment and alumina in abrasives. Consumer products such as buffered aspirin and antiperspirants also contain aluminum compounds.

4.2.2 Color

Each of the seven sample locations had at least one exceedance for color units. Color is a measure of the amount of light absorbed by dissolved material in water. An arbitrary standard scale has been developed for measuring color intensity in water samples. When a water sample is rated as having a color of 5 units, it means the color of this water is equal in intensity to the color of distilled water containing 5 milligrams of platinum as potassium chloroplatinate per liter. U.S. EPA Secondary Drinking Water Regulations recommend that a potable water source possess color of less than 15 units.

4.2.3 Iron

All sample locations exceeded the secondary standard for iron for all four quarters. Making up at least 5% of the earth's crust, iron is one of the earth's most plentiful resources. Iron is mainly present in water in two forms: either the soluble ferrous iron or the insoluble ferric iron. Water containing ferrous iron is clear and colorless because the iron is completely dissolved.

4.2.4 Manganese

All sample locations exceeded the secondary standard for manganese at least two of the four quarters tested. Manganese is a naturally occurring metal found in many types of rocks. Pure manganese does not occur naturally, as it combines with oxygen, sulfur, or chlorine. Manganese occurs naturally in most foods.

5.0 Conclusions

The water quality sampling data collected during this study was screened by comparison to applicable drinking water and surface water quality criteria. The National Primary and Secondary Drinking Water Regulations (40 CFR §§ 141-143) and Texas Drinking Water Standards (30 TAC § 290) establish maximum permissible and recommended maximum contaminant levels. Maximum contaminant levels (mcl) are the maximum allowable limits of specific chemical constituents in a public water

supply system. Secondary maximum contaminant levels (smcl) are recommended goals for certain constituents in public water supplies. As previously stated, TCEQ has chosen to adopt the secondary standards as enforceable regulations.

It should be noted that the drinking water standards contain criteria that have been established for treated water. Samples collected during this study from Kickapoo Creek, Mud Creek, and West Mud Creek were not treated prior to laboratory analysis. If raw, untreated water meets the drinking water standards, it can be assumed the treated water will be well within the standard limits. Even though some of the raw water samples from the streams exceeded some of the drinking water standards, in most cases the treated water from the proposed reservoir will meet the criteria. Coliforms can be removed via disinfection, nitrogen can be removed via ion exchange or reverse osmosis, and turbidity can be improved through filtration. The occurrences of iron and manganese may require an additional step to be added to the treatment process, but the water is still treatable.

Lake Columbia does not appear to have a significant existing pollution problem. Elevated iron and manganese concentrations, both secondary contaminants, were observed consistently. The source of iron is mostly likely from natural geologic formations as well as aging and corroding distribution systems and household pipes. Ingesting iron from drinking water is not directly associated with adverse health effects. Manganese is naturally occurring and a normal constituent of the human diet. Iron and manganese may affect the color, odor, or taste of drinking water, however they are not expected to present significant problems in the reservoir or in the treated drinking water.

Attachment A
Analytical Results

Lake Columbia Sourcewater Assessment Data Analysis
Station ID 16586
Mud Creek at SH 110

Parameter	Texas Public Drinking Water Standards 30 TAC § 290	Units	Jan-09	Feb-09	Mar-09	Apr-09	May-09	Jun-09	Jul-09	Aug-09	Sep-09	Oct-09	Nov-09	Dec-09
Bacteria														
Total Coliform	--	MPN/100ml	1100	1100	2400	920	2400	2400	2400	2400	2400	2400	2400	2400
E. coli	--	MPN/100ml	320	150	210	280	190	190	56	73	210	2400	210	2000
Demand														
BOD - Biochemical Oxygen Demand	--	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.93	ND	ND
COD - Chemical Oxygen Demand	--	mg/L	27.5	36.2	38.9	30.7	29.9	34.8	ND	39	42.3	40.8	ND	43
Total Organic Carbon														
TOC - Total Organic Carbon	2.0 - 8.0	mg/L	6.63	--	--	5.87	--	--	6.26	--	--	9.9	--	--
Nutrients														
Ammonia-N	--	mg/L	0.23	0.17	ND	0.11	0.12	0.15	ND	0.12	ND	ND	ND	0.25
Nitrate (as N)	10	mg/L	0.912	0.373	0.661	0.43	0.853	1.4	1.8	3.61	6.11	0.481	0.481	1.07
Nitrite (as N)	1	mg/L	ND	0.898	**1.35***	ND	ND	ND	ND	ND	0.284	ND	0.222	ND
TKN - Total Kjeldhal Nitrogen	10	mg/L	1.54	2.1	1.12	1.26	2.1	3.64	3.1	1.1	ND	2.9	1.1	1.9
Chloride	300	mg/L	27	15	12	16	36	37	36	43	41	4.6	14	18
Sulfate	300	mg/L	20	15	16	14	18	16	19	17	21	16	13	19
Total Phosphorus	--	mg/L	ND	ND	ND	ND	ND	0.476	0.937	1.11	1.55	0.111	ND	ND
Orthophosphorus	--	mg/L	ND	ND	ND	ND	ND	ND	ND	1.18	1.4	ND	ND	ND
Bromide	--	mg/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Fluoride	2	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlorophyll														
Chlorophyll A	--	ug/L	2.39	2.63	4.34	2.53	3.18	ND	4.93	ND	3.9	1.9	ND	2.1
Pheophytin A	--	ug/L	ND	1.8	3.37	2.44	ND	ND	4.81	ND	3.8	2.3	2.2	1.4
Solids														
Total Dissolved Solids	1000	mg/L	143	92	93.3	103	221	237	224	280	291	108	100	92
Total Suspended Solids	--	mg/L	7	5.3	13	21	4.5	13	13	17	35	40	6	21
Total Solids (calculated)	--	mg/L	150	97	106	124	226	250	237	297	326	148	106	113
Alkalinity														
Alkalinity, Total (as CaCO3)	<10 to >120	mg/L	58.6	34.3	26.3	30.3	97	103	101	109	119	ND	ND	34.3
Bicarbonate	--	mg/L	71.5	41.9	32	37	118	126	123	133	145	ND	ND	41.9
Carbonate	--	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hardness														
Total Hardness	--	mg/L	42	30.6	197	31	42	33	30	36	31	30	32	30
Ca Hardness	--	mg/L	--	20.8	132	--	28.2	22.1	--	23.7	21.2	19.7	20.5	20
Mg Hardness	--	mg/L	--	9.75	65	--	13.6	11.3	--	11.9	9.7	10.7	11.1	10
Organics														
Herbicides	--	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Pesticides	--	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Volatile Organics	--	ug/L	ND	--	--	--	--	--	ND	--	--	--	--	--
Semi-Volatile Organics	--	ug/L	ND	--	--	--	--	--	ND	--	--	--	--	--
Polychlorinated Biphenyls (PCBs)	--	ug/L	ND	--	--	--	--	--	ND	--	--	--	--	--

Lake Columbia Sourcewater Assessment Data Analysis
Station ID 16586
Mud Creek at SH 110

Parameter	Texas Public Drinking Water Standards 30 TAC § 290	Units	Jan-09	Feb-09	Mar-09	Apr-09	May-09	Jun-09	Jul-09	Aug-09	Sep-09	Oct-09	Nov-09	Dec-09
Cyanide & Phenols														
Cyanide, Total	0.2	mg/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Phenolics	--	mg/L	ND	--	--	ND	--	--	0.011	--	--	ND	--	--
Color & Turbidity														
Color	15	CLL	3.5	4.5	4.5	3	4.5	5	5	**18***	14	**36***	6	7
Turbidity	0.3	NTU	**13.4***	**10.2***	**16.9***	**22.6***	**37***	**27.2***	**19***	**27.2***	**39.5***	**92.9***	**10.4***	**33.1***
Metals														
Calcium	--	mg/L	11	8.32	8.01	7.91	11.3	8.85	7.87	9.45	8.44	7.86	8.21	8
Magnesium	--	mg/L	3.58	2.38	2.7	2.77	3.3	2.74	2.52	2.86	2.36	2.62	2.7	2.46
Sodium	--	mg/L	37.6	11.7	14	14.9	60	63.1	62.4	67.7	77.6	4.85	11.8	17.1
Aluminum	50	ug/L	**208***	--	--	39.3	--	--	**112***	--	--	**433***	--	--
Antimony	6	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Arsenic	10	ug/L	1.13	--	--	1.42	--	--	2.86	--	--	ND	--	--
Barium	200	ug/L	64.1	--	--	75.4	--	--	61.8	--	--	58.2	--	--
Beryllium	4	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Cadmium	5	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Chromium	100	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Copper	1300	ug/L	1.06	--	--	1.06	--	--	1.24	--	--	ND	--	--
Iron	300	ug/L	**2270***	--	--	**2380***	--	--	**1980***	--	--	**1250***	--	--
Lead	15	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Manganese	50	ug/L	**240***	--	--	**300***	--	--	**220***	--	--	**37.1**	--	--
Mercury	2	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Selenium	50	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Silver	100	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Thallium	2	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Zinc	5000	ug/L	5.34	--	--	14.8	--	--	14.8	--	--	28.5	--	--
TPH														
TPH (C6 - C35) Total	--	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TPH (C6 - C12) Gas	--	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TPH (C12 - C35) Diesel	--	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Field Parameters														
pH	>7.0	S.U.	7.8	7.7	8.3	7.5	7.67	7.7	7.3	7.57	7.84	**6.87***	7.84	7.67
Water Temperature	--	C (degrees)	7.5	14.6	17.4	20.7	22.22	27.8	26.7	26.11	21.44	20.04	14.06	10.91
Dissolved Oxygen	--	mg/L	9.6	9.3	7.7	6.9	4.46	3.7	3.6	3.64	5.61	5.17	8.67	9.8
Specific Conductance	--	uS/cm	249	142	122	144	357	405	359	422	441	97	134	147
Secchi Depth	--	Meters	0.6	0.9	0.8	0.54	1	0.65	0.5	0.75	0.5	0.2	0.75	0.6
Instantaneous Stream Flow	--	Cfs	--	--	--	--	--	--	--	--	--	--	--	--
Flow Severity	--		3	5	3	4	1	--	3	1	1	4	3	4
Stream Flow Estimate	--	Cfs	41.87	**	**	Flooded	No Flow	Pooled	**	**	No Flow	Flooded	129.6	Flooded

ND = Not Detected at method reporting limit

*** Exceeds Texas Public Drinking Water Standard**

** insufficient data to calculate flow estimate

Lake Columbia Sourcewater Assessment Data Analysis
Station ID 10538
W. Mud Creek at FM 3052

Parameter	Texas Public Drinking Water Standards 30 TAC § 290	Units	Jan-09	Feb-09	Mar-09	Apr-09	May-09	Jun-09	Jul-09	Aug-09	Sep-09	Oct-09	Nov-09	Dec-09
Bacteria														
Total Coliform	--	MPN/100ml	1700	920	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400
E. coli	--	MPN/100ml	230	99	140	190	64	74	120	48	550	770	520	1600
Demand														
BOD - Biochemical Oxygen Demand	--	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
COD - Chemical Oxygen Demand	--	mg/L	ND	45.1	36.6	37.3	29.9	28.3	29.2	23.7	48.8	29.2	ND	29.3
Total Organic Carbon														
TOC - Total Organic Carbon	2.0 - 8.0	mg/L	5.22	--	--	6.91	--	--	10.2	--	--	12.1	--	--
Nutrients														
Ammonia-N	--	mg/L	0.14	ND	ND	0.1	ND	ND	ND	ND	ND	ND	ND	ND
Nitrate (as N)	10	mg/L	1.66	1.47	1.43	1.21	0.687	4.07	1.98	1.96	0.722	0.383	1.29	0.947
Nitrite (as N)	1	mg/L	ND	0.947	1.08	ND	ND	ND	ND	ND	ND	ND	0.263	ND
TKN - Total Kjeldhal Nitrogen	10	mg/L	2.1	1.54	1.96	1.82	3.08	1.68	4.3	1.4	ND	5.9	**17.4***	5.8
Chloride	300	mg/L	30.5	30	27	18	26	49	32	55	16	7.2	20	18
Sulfate	300	mg/L	29	30	28	23	23	43	32	46	24	30	24	22
Total Phosphorus	--	mg/L	ND	ND	ND	ND	ND	0.062	0.0837	ND	ND	0.0822	ND	ND
Orthophosphorus	--	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	0.394	ND	ND	ND
Bromide	--	mg/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Fluoride	2	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlorophyll														
Chlorophyll A	--	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.8	ND	ND
Pheophytin A	--	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	1	ND	2.3
Solids														
Total Dissolved Solids	1000	mg/L	160	173	175	161	164	275	197	305	148	109	148	132
Total Suspended Solids	--	mg/L	5	8.5	9.7	18	9.5	9.1	18	2.3	55	17	24	25
Total Solids (calculated)	--	mg/L	165	182	185	179	174	284	215	307.3	203	126	172	157
Alkalinity														
Alkalinity, Total (as CaCO3)	<10 to >120	mg/L	62.6	68.7	58.6	60.6	64.6	90.9	70.7	123	42.4	ND	42.4	40.4
Bicarbonate	--	mg/L	76.4	83.8	71.5	73.9	78.9	111	86.3	150	51.8	ND	51.8	49.3
Carbonate	--	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hardness														
Total Hardness	--	mg/L	88	79.7	156	77	77	150	99	151	57	30	65	52
Ca Hardness	--	mg/L	--	43.2	101	--	41.2	62.4	--	61.2	35	19	37.5	30.2
Mg Hardness	--	mg/L	--	36.4	55	--	36.2	87.7	--	90.2	21.8	11.1	27.6	21.4
Organics														
Herbicides	--	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Pesticides	--	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Volatile Organics	--	ug/L	ND	--	--	--	--	--	ND	--	--	--	--	--
Semi-Volatile Organics	--	ug/L	ND	--	--	--	--	--	ND	--	--	--	--	--
Polychlorinated Biphenyls (PCBs)	--	ug/L	ND	--	--	--	--	--	ND	--	--	--	--	--

Lake Columbia Sourcewater Assessment Data Analysis
Station ID 10538
W. Mud Creek at FM 3052

Parameter	Texas Public Drinking Water Standards 30 TAC § 290	Units	Jan-09	Feb-09	Mar-09	Apr-09	May-09	Jun-09	Jul-09	Aug-09	Sep-09	Oct-09	Nov-09	Dec-09
Cyanide & Phenols														
Cyanide, Total	0.2	mg/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Phenolics	--	mg/L	ND	--	--	ND	--	--	0.027	--	--	ND	--	--
Color & Turbidity														
Color	15	CLL	3	5	6	5	4	3	4.5	4	**16***	**20***	10	5
Turbidity	0.3	NTU	**7.45***	**18.1***	**18.1***	**28.2***	**18.8***	**15.4***	**24.6***	**5.13***	**59***	**35.2***	**34.8***	**35.5***
Metals														
Calcium	--	mg/L	18	17.3	16.7	15.4	16.5	25	20.7	24.5	14	7.64	15	12.1
Magnesium	--	mg/L	10.5	8.89	9.11	9.24	8.81	21.3	11.5	21.9	5.3	2.74	6.7	5.22
Sodium	--	mg/L	23.8	20.7	20.9	18.3	19.7	37.6	21.9	41	11.8	7.93	14.1	12
Aluminum	50	ug/L	**198***	--	--	**95.2***	--	--	**116***	--	--	**230***	--	--
Antimony	6	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Arsenic	10	ug/L	0.744	--	--	2.07	--	--	1.43	--	--	ND	--	--
Barium	200	ug/L	54.1	--	--	70.7	--	--	72.1	--	--	50.4	--	--
Beryllium	4	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Cadmium	5	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Chromium	100	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Copper	1300	ug/L	1.1	--	--	1	--	--	1.77	--	--	ND	--	--
Iron	300	ug/L	**1930***	--	--	**4050***	--	--	**1640***	--	--	**1000***	--	--
Lead	15	ug/L	1.06	--	--	1.11	--	--	1.2	--	--	ND	--	--
Manganese	50	ug/L	**186***	--	--	**274***	--	--	**108***	--	--	48.9	--	--
Mercury	2	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Selenium	50	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Silver	100	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Thallium	2	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Zinc	5000	ug/L	10.2	--	--	19.3	--	--	12.7	--	--	75.2	--	--
TPH														
TPH (C6 - C35) Total	--	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TPH (C6 - C12) Gas	--	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TPH (C12 - C35) Diesel	--	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Field Parameters														
pH	>7.0	S.U.	7.8	7.5	7.8	7.4	7.68	7.8	7.2	7.9	7.62	7.29	7.73	7.95
Water Temperature	--	C (degrees)	7.6	14.2	18.4	19.9	21.83	26.8	26.2	25.89	21.62	19.53	11.91	10.77
Dissolved Oxygen	--	mg/L	11.7	9	7.6	7.2	6.76	6.5	6.1	7.01	7.33	6.73	10.28	10.12
Specific Conductance	--	uS/cm	289	280	229	249	260	522	332	532	190	112	208	192
Secchi Depth	--	Meters	0.65	0.5	0	0.51	1	0.5	0.6	1.5	0.5	0.5	0.25	0.35
Instantaneous Stream Flow	--	Cfs	--	--	--	--	--	--	--	--	--	--	--	--
Flow Severity	--		3	3	3	5	3	3	3	2	3	4	3	3
Stream Flow Estimate	--	Cfs	77.92	**	**	**	20.47	**	41.54	No Flow	227.04	Flooded	91.08	186.74

ND = Not Detected at method reporting limit

*** Exceeds Texas Public Drinking Water Standard**

** insufficient data to calculate flow estimate

Lake Columbia Sourcewater Assessment Data Analysis
Station ID 17103
Mud Creek at SH 135

Parameter	Texas Public Drinking Water Standards 30 TAC § 290	Units	Jan-09	Feb-09	Mar-09	Apr-09	May-09	Jun-09	Jul-09	Aug-09	Sep-09	Oct-09	Nov-09	Dec-09
Bacteria														
Total Coliform	--	MPN/100ml	770	1200	2400	1000	2400	2400	2400	2400	2400	2400	2400	2400
E. coli	--	MPN/100ml	160	160	20	190	250	44	120	66	320	770	1400	1300
Demand														
BOD - Biochemical Oxygen Demand	--	mg/L	ND	ND	2.16	ND	ND	ND	ND	ND	ND	ND	ND	ND
COD - Chemical Oxygen Demand	--	mg/L	ND	34	45.8	ND	40.5	28.3	33.6	25.9	42.3	26.8	ND	29.3
Total Organic Carbon														
TOC - Total Organic Carbon	2.0 - 8.0	mg/L	5.53	--	--	8.23	--	--	8.97	--	--	7.1	--	--
Nutrients														
Ammonia-N	--	mg/L	0.15	ND	ND	0.13	ND	ND	ND	ND	ND	ND	ND	0.22
Nitrate (as N)	10	mg/L	0.773	0.764	0.724	1.19	0.815	2.2	3.07	1.69	1.88	0.409	0.424	0.586
Nitrite (as N)	1	mg/L	ND	0.76	**1.24***	ND	0.682	ND	ND	ND	0.274	ND	0.222	ND
TKN - Total Kjeldhal Nitrogen	10	mg/L	**13.2***	1.26	2.8	1.4	1.96	1.4	3.4	ND	ND	**20.4***	4.5	2
Chloride	300	mg/L	32	22	20	23	34	44	46	54	32	9.3	18	19
Sulfate	300	mg/L	31	26	26	25	31	34	38	43	33	19	23	22
Total Phosphorus	--	mg/L	ND	ND	ND	ND	ND	ND	0.166	ND	ND	0.171	ND	ND
Orthophosphorus	--	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromide	--	mg/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Fluoride	2	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlorophyll														
Chlorophyll A	--	ug/L	ND	ND	3.95	1.78	ND	ND	ND	ND	ND	0.8	ND	1.7
Pheophytin A	--	ug/L	ND	ND	2.98	ND	ND	ND	ND	ND	ND	0.9	2.2	1.1
Solids														
Total Dissolved Solids	1000	mg/L	168	151	135	165	200	248	247	255	212	125	120	112
Total Suspended Solids	--	mg/L	2.7	9.7	21	25	13	3.7	8.2	4.7	26	16	8.6	23
Total Solids (calculated)	--	mg/L	171	161	156	190	213	252	255.2	259.7	238	141	128.6	135
Alkalinity														
Alkalinity, Total (as CaCO3)	<10 to >120	mg/L	60.6	42.4	40.4	56.6	72.7	103	86.9	123	72.7	26.3	38.4	34.3
Bicarbonate	--	mg/L	73.9	51.8	49.3	69	88.7	126	106	150	88.7	32	46.8	41.9
Carbonate	--	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hardness														
Total Hardness	--	mg/L	81	56.3	197	64	81	123	114	134	92.9	33.7	51.8	43.6
Ca Hardness	--	mg/L	--	33.5	125	--	41.5	55.7	--	56.2	49.7	21	31.2	26.7
Mg Hardness	--	mg/L	--	22.8	72	--	39.5	67.1	--	77.4	43.2	12.8	20.6	16.9
Organics														
Herbicides	--	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Pesticides	--	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Volatile Organics	--	ug/L	ND	--	--	--	--	--	ND	--	--	--	--	--
Semi-Volatile Organics	--	ug/L	ND	--	--	--	--	--	ND	--	--	--	--	--
Polychlorinated Biphenyls (PCBs)	--	ug/L	ND	--	--	--	--	--	ND	--	--	--	--	--

Lake Columbia Sourcewater Assessment Data Analysis
Station ID 17103
Mud Creek at SH 135

Parameter	Texas Public Drinking Water Standards 30 TAC § 290	Units	Jan-09	Feb-09	Mar-09	Apr-09	May-09	Jun-09	Jul-09	Aug-09	Sep-09	Oct-09	Nov-09	Dec-09
Cyanide & Phenols														
Cyanide, Total	0.2	mg/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Phenolics	--	mg/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Color & Turbidity														
Color	15	CLL	3	4	6	4.5	4.5	3.5	3.5	5	12	**18***	12	6
Turbidity	0.3	NTU	**7.03***	**16.3***	**24.6***	**27.2***	**37.4***	**11.9***	**13.4***	**7.9***	**28.6***	**31.4***	**16.8***	**24.1***
Metals														
Calcium	--	mg/L	17.5	13.4	12.7	14.1	16.6	22.3	21.8	22.5	19.8	8.43	12.4	10.7
Magnesium	--	mg/L	9.1	5.55	5.9	7.12	9.63	16.3	14.5	18.8	10.5	3.09	4.99	4.12
Sodium	--	mg/L	22.3	16.5	16.6	18.8	27.5	37.4	36.1	43.1	25	7.61	13.2	12.4
Aluminum	50	ug/L	**261***	--	--	**186***	--	--	**89.1***	--	--	**196***	--	--
Antimony	6	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Arsenic	10	ug/L	0.785	--	--	1.86	--	--	1.61	--	--	ND	--	--
Barium	200	ug/L	57.7	--	--	79.8	--	--	78.4	--	--	50.2	--	--
Beryllium	4	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Cadmium	5	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Chromium	100	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Copper	1300	ug/L	0.986	--	--	1.66	--	--	1.53	--	--	ND	--	--
Iron	300	ug/L	**1800***	--	--	**3590***	--	--	**1110***	--	--	**1090***	--	--
Lead	15	ug/L	3.08	--	--	3.04	--	--	ND	--	--	ND	--	--
Manganese	50	ug/L	**150***	--	--	**336***	--	--	**120***	--	--	36.3	--	--
Mercury	2	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Selenium	50	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Silver	100	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Thallium	2	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Zinc	5000	ug/L	23	--	--	40.4	--	--	10.9	--	--	11.6	--	--
TPH														
TPH (C6 - C35) Total	--	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TPH (C6 - C12) Gas	--	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TPH (C12 - C35) Diesel	--	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Field Parameters														
pH	>7.0	S.U.	--	7.4	7.8	7.4	7.83	7.8	7.2	7.82	7.65	7.11	7.53	7.94
Water Temperature	--	C (degrees)	--	14.1	18.4	20.5	21.49	27.4	26.1	25.69	22.17	19.43	11.79	10.69
Dissolved Oxygen	--	mg/L	--	9.6	7.3	6.9	6.59	5.9	5.9	6.4	7.36	6.18	9.28	10.39
Specific Conductance	--	uS/cm	--	213	180	230	317	434	420	513	329	107	183	191
Secchi Depth	--	Meters	--	0.8	0.6	0.54	1	0.6	0.5	0.75	0.3	1	0.45	0.45
Instantaneous Stream Flow	--	Cfs	--	--	--	--	--	--	12.6	--	--	--	--	--
Flow Severity	--		2	3	3		3	3	3	2	3	4	3	3
Stream Flow Estimate	--	Cfs	65.38	**	**	**	202.5	**	--	104.66	178.82	Flooded	246.75	243.09

ND = Not Detected at method reporting limit

*** Exceeds Texas Public Drinking Water Standard**

** insufficient data to calculate flow estimate

Lake Columbia Sourcewater Assessment Data Analysis
Station ID 10536
Mud Creek at FM 2064

Parameter	Texas Public Drinking Water Standards 30 TAC § 290	Units	Jan-09	Feb-09	Mar-09	Apr-09	May-09	Jun-09	Jul-09	Aug-09	Sep-09	Oct-09	Nov-09	Dec-09
Bacteria														
Total Coliform	--	MPN/100ml	690	690	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400
E. coli	--	MPN/100ml	96	76	140	260	140	60	180	62	110	1000	820	2000
Demand														
BOD - Biochemical Oxygen Demand	--	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
COD - Chemical Oxygen Demand	--	mg/L	ND	36.4	45.8	21.8	32	32.6	38.1	30.3	44.4	31.5	57.7	31.6
Total Organic Carbon														
TOC - Total Organic Carbon	2.0 - 8.0	mg/L	3.83	--	--	7.45	--	--	8.16	--	--	9.47	--	--
Nutrients														
Ammonia-N	--	mg/L	ND	ND	ND	0.12	ND	ND	ND	ND	ND	ND	ND	ND
Nitrate (as N)	10	mg/L	1.03	0.661	0.625	0.799	1.95	1.66	2.29	1.38	1.18	0.379	0.5	0.885
Nitrite (as N)	1	mg/L	ND	0.756	**1.19***	ND	0.779	ND	ND	ND	ND	ND	0.232	ND
TKN - Total Kjeldhal Nitrogen	10	mg/L	7.42	1.54	2.66	1.68	2.1	2.38	1.1	1.1	ND	3.9	3.8	1
Chloride	300	mg/L	28	23.5	20	21	34	40	38	51	24	8.4	19	19
Sulfate	300	mg/L	30	24	27	25	21	31	43	39	28	23	24	22
Total Phosphorus	--	mg/L	ND	ND	ND	ND	ND	ND	0.0871	ND	ND	0.0505	ND	ND
Orthophosphorus	--	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromide	--	mg/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Fluoride	2	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlorophyll														
Chlorophyll A	--	ug/L	ND	ND	2.49	ND	ND	ND	ND	2.78	ND	1.2	ND	ND
Pheophytin A	--	ug/L	ND	ND	2.89	ND	ND	ND	ND	ND	ND	1.2	ND	ND
Solids														
Total Dissolved Solids	1000	mg/L	147	128	143	147	207	231	228	284	195	113	137	115
Total Suspended Solids	--	mg/L	2.7	9.8	20	21	18	6.4	34	9.3	37	28	22	42
Total Solids (calculated)	--	mg/L	150	138	163	168	225	237	262	293.3	232	141	159	157
Alkalinity														
Alkalinity, Total (as CaCO3)	<10 to >120	mg/L	52.5	32.3	36.4	40.4	72.7	97	64.6	119	62.6	20.2	38.4	40.4
Bicarbonate	--	mg/L	64.1	39.4	44.4	49.3	88.7	118	78.9	146	76.4	24.6	46.8	49.3
Carbonate	--	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hardness														
Total Hardness	--	mg/L	75	50.9	455	57	97	113	100	130	73	28	55	45
Ca Hardness	--	mg/L	--	30.5	168	--	44.4	54.2	--	57.5	41.5	17	32	26.7
Mg Hardness	--	mg/L	--	20.4	287	--	52.3	58.9	--	72.1	32	11.1	22.6	18.1
Organics														
Herbicides	--	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Pesticides	--	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Volatile Organics	--	ug/L	ND	--	--	--	--	--	ND	--	--	--	--	--
Semi-Volatile Organics	--	ug/L	ND	--	--	--	--	--	ND	--	--	--	--	--
Polychlorinated Biphenyls (PCBs)	--	ug/L	ND	--	--	--	--	--	ND	--	--	--	--	--

Lake Columbia Sourcewater Assessment Data Analysis
Station ID 10536
Mud Creek at FM 2064

Parameter	Texas Public Drinking Water Standards 30 TAC § 290	Units	Jan-09	Feb-09	Mar-09	Apr-09	May-09	Jun-09	Jul-09	Aug-09	Sep-09	Oct-09	Nov-09	Dec-09
Cyanide & Phenols														
Cyanide, Total	0.2	mg/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Phenolics	--	mg/L	ND	--	--	0.007	--	--	0.011	--	--	ND	--	--
Color & Turbidity														
Color	15	CLL	3.5	4.5	6	6	4	4.5	9	6	14	**27***	12	7
Turbidity	0.3	NTU	**7.33***	**18.9***	**21.2***	**30.8***	**38.1***	**16.2***	**32.8***	**11.6***	**42.3***	**50.6***	**28***	**44.3***
Metals														
Calcium	--	mg/L	15.9	12.2	12.3	13.2	17.8	21.7	20	23	16.6	6.75	12.8	10.7
Magnesium	--	mg/L	8.44	4.98	5.53	5.85	12.7	14.3	12.1	17.5	7.77	2.66	5.5	4.44
Sodium	--	mg/L	18.8	14.9	16.1	22.8	29.5	34.9	30.5	43	20.9	7.85	14.1	12.4
Aluminum	50	ug/L	**198***	--	--	**59.4***	--	--	**216***	--	--	**267***	--	--
Antimony	6	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Arsenic	10	ug/L	0.736	--	--	1.73	--	--	1.9	--	--	0	--	--
Barium	200	ug/L	59.4	--	--	79.8	--	--	87.7	--	--	59.2	--	--
Beryllium	4	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Cadmium	5	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Chromium	100	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Copper	1300	ug/L	ND	--	--	ND	--	--	1.42	--	--	ND	--	--
Iron	300	ug/L	**2240***	--	--	**3990***	--	--	**2110***	--	--	**1650***	--	--
Lead	15	ug/L	1.51	--	--	1.22	--	--	1.2	--	--	ND	--	--
Manganese	50	ug/L	**94.3***	--	--	**212***	--	--	**267***	--	--	**73***	--	--
Mercury	2	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Selenium	50	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Silver	100	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Thallium	2	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Zinc	5000	ug/L	7.17	--	--	34.8	--	--	15.4	--	--	25.2	--	--
TPH														
TPH (C6 - C35) Total	--	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TPH (C6 - C12) Gas	--	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TPH (C12 - C35) Diesel	--	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Field Parameters														
pH	>7.0	S.U.	--	7.4	7.8	7.5	7.77	7.8	7.2	7.94	7.62	6.82	7.57	7.8
Water Temperature	--	C (degrees)	--	13.8	18.8	20.6	21.89	27.3	26.6	25.86	22.38	19.86	12.85	11.05
Dissolved Oxygen	--	mg/L	--	9.9	7.6	7.2	6.62	6.3	6	6.72	7.62	6.54	9.57	10.26
Specific Conductance	--	uS/cm	--	193	174	205	338	397	380	487	270	101	190	182
Secchi Depth	--	Meters	--	0.95	0.5	0.5	1	0.58	0.6	0	1	0.5	0.25	0.2
Instantaneous Stream Flow	--	Cfs	--	--	--	--	--	--	--	--	--	--	--	--
Flow Severity	--		2	3	5	5	3	3	3	2	3	4	3	4
Stream Flow Estimate	--	Cfs	77.64	**	**	**	193.43	**	**	44.28	80.23	Flooded	289.11	Flooded

ND = Not Detected at method reporting limit

*** Exceeds Texas Public Drinking Water Standard**

** insufficient data to calculate flow estimate

Lake Columbia Sourcewater Assessment Data Analysis
Station ID 14477
Mud Creek at US 79

Parameter	Texas Public Drinking Water Standards 30 TAC § 290	Units	Jan-09	Feb-09	Mar-09	Apr-09	May-09	Jun-09	Jul-09	Aug-09	Sep-09	Oct-09	Nov-09	Dec-09
Bacteria														
Total Coliform	--	MPN/100ml	1000	690	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400
E. coli	--	MPN/100ml	86	150	160	180	250	130	61	42	77	2400	520	1700
Demand														
BOD - Biochemical Oxygen Demand	--	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.38	ND	ND
COD - Chemical Oxygen Demand	--	mg/L	0	54	34.3	0	38.4	28.3	47	23.7	48.8	45.4	ND	27
Total Organic Carbon														
TOC - Total Organic Carbon	2.0 - 8.0	mg/L	5.57	--	--	8.29	--	--	8.96	--	--	8.81	--	--
Nutrients														
Ammonia-N	--	mg/L	0.14	ND	ND	0.13	ND	ND	ND	ND	ND	ND	0.13	0.11
Nitrate (as N)	10	mg/L	0.506	0.606	0.652	0.652	1.05	1.42	1.03	1.34	1.12	0.473	0.636	1.07
Nitrite (as N)	1	mg/L	ND	0.885	**1.22***	ND	ND	ND	ND	ND	ND	ND	0.234	ND
TKN - Total Kjeldhal Nitrogen	10	mg/L	1.54	3.08	2.66	1.96	1.82	1.96	9.9	ND	ND	8.2	**11.3***	1.8
Chloride	300	mg/L	28	22.5	22	22	34	41	26	50	22	5.8	20	14
Sulfate	300	mg/L	37	29	37	41	38	37	44	48	30	28	34	48
Total Phosphorus	--	mg/L	ND	ND	ND	ND	ND	ND	0.121	ND	ND	0.134	ND	ND
Orthophosphorus	--	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	0.416	ND	ND	ND
Bromide	--	mg/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Fluoride	2	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlorophyll														
Chlorophyll A	--	ug/L	ND	ND	2.76	ND	ND	ND	ND	ND	ND	3.5	1.1	1.5
Pheophytin A	--	ug/L	ND	ND	2.8	ND	ND	ND	ND	ND	ND	3.9	0.8	0.9
Solids														
Total Dissolved Solids	1000	mg/L	161	144	145	169	216	232	199	287	183	111	164	163
Total Suspended Solids	--	mg/L	4.3	16	34	22	6	6.6	30	5	16	40	19	18
Total Solids (calculated)	--	mg/L	165	160	179	191	222	239	229	292	199	151	183	181
Alkalinity														
Alkalinity, Total (as CaCO3)	<10 to >120	mg/L	62.6	40.4	34.3	36.4	68.7	70.7	50.5	117	58.6	ND	40.4	28.3
Bicarbonate	--	mg/L	76.4	49.3	41.9	44.4	83.8	86.3	61.6	143	71.5	ND	49.3	34.5
Carbonate	--	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hardness														
Total Hardness	--	mg/L	75	55.6	376	67	94	111	76	120	68	25	57	62
Ca Hardness	--	mg/L	--	32.8	135	--	45.9	58.2	--	57.4	39.7	14.7	32.5	34.7
Mg Hardness	--	mg/L	--	22.8	242	--	48.2	52.7	--	63	28.3	10.3	24.3	27.2
Organics														
Herbicides	--	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Pesticides	--	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Volatile Organics	--	ug/L	ND	--	--	--	--	--	ND	--	--	--	--	--
Semi-Volatile Organics	--	ug/L	ND	--	--	--	--	--	ND	--	--	--	--	--
Polychlorinated Biphenyls (PCBs)	--	ug/L	ND	--	--	--	--	--	ND	--	--	--	--	--

Lake Columbia Sourcewater Assessment Data Analysis
Station ID 14477
Mud Creek at US 79

Parameter	Texas Public Drinking Water Standards 30 TAC § 290	Units	Jan-09	Feb-09	Mar-09	Apr-09	May-09	Jun-09	Jul-09	Aug-09	Sep-09	Oct-09	Nov-09	Dec-09
Cyanide & Phenols														
Cyanide, Total	0.2	mg/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Phenolics	--	mg/L	ND	--	--	ND	--	--	0.017	--	--	ND	--	--
Color & Turbidity														
Color	15	CLL	3.5	4.5	6	5	5	4	8	6	14	**36***	12	6
Turbidity	0.3	NTU	**9.32***	**25.8***	**34.5***	**40.4***	**53.6***	**18.3***	**48.7***	**8.56***	**24.5***	**77.2***	**22.1***	**28.2***
Metals														
Calcium	--	mg/L	16.7	13.1	13.5	15	18.4	23.3	16.5	23	15.9	5.89	13	13.9
Magnesium	--	mg/L	8.14	5.57	6.1	7.22	11.7	12.8	8.54	15.3	6.89	2.53	5.93	6.55
Sodium	--	mg/L	25.3	17.2	17.4	19.1	29.6	33.1	23.5	44.9	20.6	6.76	16.3	17.8
Aluminum	50	ug/L	**255***	--	--	**78.3***	--	--	**177***	--	--	**352***	--	--
Antimony	6	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Arsenic	10	ug/L	0.996	--	--	1.97	--	--	1.6	--	--	ND	--	--
Barium	200	ug/L	57.5	--	--	78.5	--	--	77.7	--	--	44.2	--	--
Beryllium	4	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Cadmium	5	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Chromium	100	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Copper	1300	ug/L	ND	--	--	1.34	--	--	1.41	--	--	ND	--	--
Iron	300	ug/L	**2200***	--	--	**4080***	--	--	**2230***	--	--	**1480***	--	--
Lead	15	ug/L	ND	--	--	1.82	--	--	1.78	--	--	ND	--	--
Manganese	50	ug/L	**106***	--	--	**278***	--	--	**215***	--	--	44.8	--	--
Mercury	2	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Selenium	50	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Silver	100	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Thallium	2	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Zinc	5000	ug/L	4.97	--	--	33.5	--	--	42.7	--	--	35.5	--	--
TPH														
TPH (C6 - C35) Total	--	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TPH (C6 - C12) Gas	--	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TPH (C12 - C35) Diesel	--	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Field Parameters														
pH	>7.0	S.U.	8	7.5	7.5	7.4	7.36	7.6	7.2	7.86	7.73	**6.93***	7.58	7.78
Water Temperature	--	C (degrees)	8.2	14.2	18.5	20.8	22.27	26.8	27.1	25.76	22.54	20.4	12.89	11.11
Dissolved Oxygen	--	mg/L	10.3	9.9	7.6	7.1	6.21	5.9	5.7	6.48	7.35	6.22	9.83	11.63
Specific Conductance	--	uS/cm	291	210	193	244	337	394	293	494	260	93	211	252
Secchi Depth	--	Meters	0.8	0.65	0.5	0.51	0.5	0.4	0.5	1	1.25	0.5	0.35	0.5
Instantaneous Stream Flow***	--	Cfs	77	148	237	173	58	20	49	23	47	715	269	290
Flow Severity	--		3	3	3	5	3	3	3	2	3	4	3	3
Stream Flow Estimate	--	Cfs	--	--	--	--	--	--	--	--	--	--	--	--

ND = Not Detected at method reporting limit

*** Exceeds Texas Public Drinking Water Standard**

*** Instantaneous Stream Flow taken from USGS Gage Station flow data

Lake Columbia Sourcewater Assessment Data Analysis
Station ID AN001
Kickapoo Creek at SH 110

Parameter	Texas Public Drinking Water Standards 30 TAC § 290	Units	Jan-09	Feb-09	Mar-09	Apr-09	May-09	Jun-09	Jul-09	Aug-09	Sep-09	Oct-09	Nov-09	Dec-09
Bacteria														
Total Coliform	--	MPN/100ml	1300	2000	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400
E. coli	--	MPN/100ml	190	360	190	440	320	650	140	220	280	2400	260	2400
Demand														
BOD - Biochemical Oxygen Demand	--	mg/L	ND	ND	ND	ND	ND	ND	ND	2.08	ND	2.73	ND	5.1
COD - Chemical Oxygen Demand	--	mg/L	ND	31.8	34.3	ND	34.2	52	43.8	30.7	42.3	47.8	ND	59.1
Total Organic Carbon														
TOC - Total Organic Carbon	2.0 - 8.0	mg/L	3.81	--	--	8.35	--	--	7.5	--	--	8.57	--	--
Nutrients														
Ammonia-N	--	mg/L	0.14	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.12	5
Nitrate (as N)	10	mg/L	0.282	0.558	0.497	0.46	0.399	1.2	0.567	ND	0.302	0.367	0.6	1.87
Nitrite (as N)	1	mg/L	ND	**1.05***	**1.2***	ND	0.684	ND	ND	ND	ND	ND	0.299	ND
TKN - Total Kjeldhal Nitrogen	10	mg/L	1.82	1.54	1.82	1.12	1.96	1.96	7.8	ND	ND	4.4	3.4	7.2
Chloride	300	mg/L	30	35	30	29	31	37	14	37	13	4.6	36	25
Sulfate	300	mg/L	61	77	92	61	54	24	18	33	24	23	54	97
Total Phosphorus	--	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.065	ND	0.339
Orthophosphorus	--	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	0.394	ND	ND	ND
Bromide	--	mg/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Fluoride	2	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlorophyll														
Chlorophyll A	--	ug/L	2.28	1.96	ND	ND	ND	5.72	3.6	20.5	4.7	2.4	1.2	3.4
Pheophytin A	--	ug/L	ND	ND	ND	ND	ND	ND	ND	4.42	1.5	2.9	0.5	5.2
Solids														
Total Dissolved Solids	1000	mg/L	204	252	244	229	229	221	189	205	151	120	247	232
Total Suspended Solids	--	mg/L	13	12	19	24	18	88	15	17	26	69	14	210
Total Solids (calculated)	--	mg/L	217	264	263	253	247	309	204	222	177	189	261	442
Alkalinity														
Alkalinity, Total (as CaCO3)	<10 to >120	mg/L	48.5	36.4	30.3	34.3	46.5	76.8	46.5	44.4	46.5	22.2	72.7	40.4
Bicarbonate	--	mg/L	59.1	44.4	37	41.9	56.7	93.6	56.7	54.2	56.7	27.1	88.7	49.3
Carbonate	--	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hardness														
Total Hardness	--	mg/L	86	105	563	89	82	71	301	84	38	30	71	97
Ca Hardness	--	mg/L	--	65.8	160	--	48.7	45.7	--	43.4	25.7	20.2	44.2	62.9
Mg Hardness	--	mg/L	--	38.9	404	--	32.9	25.1	--	40.4	11.9	9.9	26.4	33.8
Organics														
Herbicides	--	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Pesticides	--	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Volatile Organics	--	ug/L	ND	--	--	--	--	--	ND	--	--	--	--	--
Semi-Volatile Organics	--	ug/L	ND	--	--	--	--	--	ND	--	--	--	--	--
Polychlorinated Biphenyls (PCBs)	--	ug/L	ND	--	--	--	--	--	ND	--	--	--	--	--

Lake Columbia Sourcewater Assessment Data Analysis
Station ID AN001
Kickapoo Creek at SH 110

Parameter	Texas Public Drinking Water Standards 30 TAC § 290	Units	Jan-09	Feb-09	Mar-09	Apr-09	May-09	Jun-09	Jul-09	Aug-09	Sep-09	Oct-09	Nov-09	Dec-09
Cyanide & Phenols														
Cyanide, Total	0.2	mg/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Phenolics	--	mg/L	0.014	--	--	ND	--	--	0.009	--	--	ND	--	--
Color & Turbidity														
Color	15	CLL	4	4	5	4.5	6	4.5	**18***	7	**18***	**31.5***	10	4.5
Turbidity	0.3	NTU	**19.3***	**22.2***	**31.2***	**29.7***	**48.5***	**87.5***	**102***	**31.6***	**39.2***	**137***	**22***	**175***
Metals														
Calcium	--	mg/L	22	26.3	24.9	21	19.5	18.3	9.28	17.4	10.3	8.1	17.7	25.1
Magnesium	--	mg/L	7.51	9.48	9.75	8.96	8.04	6.05	2.69	9.81	2.91	2.37	6.39	8.23
Sodium	--	mg/L	27.3	27.4	26	25.5	32.8	32.1	22.1	35.7	19.2	4.72	47.9	21.8
Aluminum	50	ug/L	**176***	--	--	**96.5***	--	--	**381***	--	--	**456***	--	--
Antimony	6	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Arsenic	10	ug/L	ND	--	--	1.3	--	--	ND	--	--	ND	--	--
Barium	200	ug/L	66.8	--	--	85.5	--	--	60.7	--	--	69.2	--	--
Beryllium	4	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Cadmium	5	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Chromium	100	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Copper	1300	ug/L	ND	--	--	1.27	--	--	ND	--	--	ND	--	--
Iron	300	ug/L	**2330***	--	--	**4800***	--	--	**2800***	--	--	**1430***	--	--
Lead	15	ug/L	0	--	--	2.21	--	--	ND	--	--	ND	--	--
Manganese	50	ug/L	**89.5***	--	--	**162***	--	--	41	--	--	49	--	--
Mercury	2	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Selenium	50	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Silver	100	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Thallium	2	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Zinc	5000	ug/L	9.29	--	--	25.6	--	--	33.9	--	--	17.6	--	--
TPH														
TPH (C6 - C35) Total	--	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TPH (C6 - C12) Gas	--	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TPH (C12 - C35) Diesel	--	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Field Parameters														
pH	>7.0	S.U.	7.5	7.5	7.8	7.1	7.8	7.9	7.2	7.38	7.88	**6.98***	7.67	7.55
Water Temperature	--	C (degrees)	7.1	13.8	17.8	19.6	20.85	25.9	25.6	24.43	20.58	19.41	10.85	9.97
Dissolved Oxygen	--	mg/L	11.5	10.1	7.7	7.9	7.5	7.6	6.9	3.04	7.93	1.2	10.16	10.84
Specific Conductance	--	uS/cm	325	375	308	322	308	341	183	362	184	123	386	395
Secchi Depth	--	Meters	0.3	0.3	0.4	0.7	0	0.2	0.3	0.5	0.25	0.2	0.3	0.15
Instantaneous Stream Flow	--	Cfs	4	--	--	6.7	--	0.82	1.8	--	--	--	--	--
Flow Severity	--		3	3	3	5	3	3	5	1	1	4	3	5
Stream Flow Estimate	--	Cfs	--	**	**	--	28.24	--	--	No Flow	No Flow	Flooded	76.24	138.9

ND = Not Detected at method reporting limit

*** Exceeds Texas Public Drinking Water Standard**

** insufficient data to calculate flow estimate

Lake Columbia Sourcewater Assessment Data Analysis
Station ID 10539
W. Mud Creek at FM 344

Parameter	Texas Public Drinking Water Standards 30 TAC § 290	Units	Jan-09	Feb-09	Mar-09	Apr-09	May-09	Jun-09	Jul-09	Aug-09	Sep-09	Oct-09	Nov-09	Dec-09
Bacteria														
Total Coliform	--	MPN/100ml	1400	610	2400	1200	2400	2400	2400	2400	2400	2400	2400	2400
E. coli	--	MPN/100ml	130	110	180	250	2400	130	120	410	520	2400	200	2400
Demand														
BOD - Biochemical Oxygen Demand	--	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.26	ND	2.45
COD - Chemical Oxygen Demand	--	mg/L	ND	36.2	36.6	ND	36.3	30.5	38.1	25.9	44.4	38.5	ND	29.3
Total Organic Carbon														
TOC - Total Organic Carbon	2.0 - 8.0	mg/L	4.83	--	--	14.4	--	--	8.64	--	--	7.09	--	--
Nutrients														
Ammonia-N	--	mg/L	0.3	ND	0.11	0.14	ND	ND	ND	0.11	ND	ND	0.24	0.24
Nitrate (as N)	10	mg/L	1.4	2.17	1.63	2.17	2.62	4.27	3.81	2.4	0.741	0.448	1.77	1.13
Nitrite (as N)	1	mg/L	ND	**1.47***	0.757	ND	0.74	ND	ND	ND	ND	ND	0.23	ND
TKN - Total Kjeldhal Nitrogen	10	mg/L	1.68	3.92	1.4	1.82	2.38	1.4	2.4	ND	ND	5.6	3.7	1.1
Chloride	300	mg/L	33.5	37	31	29	32	52	38	59	16	6.4	26	18
Sulfate	300	mg/L	33	35	32	27	29	42	33	48	25	15	29	24
Phosphorus	--	mg/L	ND	ND	ND	ND	ND	0.129	0.168	0.0177	ND	3.64	ND	ND
Orthophosphorus	--	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	0.408	2.94	ND	ND
Bromide	--	mg/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Fluoride	2	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlorophyll														
Chlorophyll A	--	ug/L	2.18	ND	4.04	ND	ND	ND	ND	ND	ND	1.3	0.7	1.1
Pheophytin A	--	ug/L	ND	1.71	2.9	ND	ND	ND	ND	ND	ND	1.4	0.5	1
Solids														
Total Dissolved Solids	1000	mg/L	189	207	203	201	193	305	225	312	149	117	168	128
Total Suspended Solids	--	mg/L	6.5	15	15	27	14	8.1	15	40	25	35	10	26
Total Solids (calculated)	--	mg/L	196	222	218	228	207	313	240	352	174	152	178	154
Alkalinity														
Alkalinity, Total (as CaCO3)	<10 to >120	mg/L	80.8	72.7	64.6	76.8	72.7	115	80.8	127	46.5	26.3	38.4	41.4
Bicarbonate	--	mg/L	98.6	88.7	78.9	93.6	88.7	140	98.6	155	56.7	32	46.8	50.5
Carbonate	--	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hardness														
Total Hardness	--	mg/L	107	95.6	398	97	102	151	114	150	61	34	83	53
Ca Hardness	--	mg/L	--	49.3	157	--	51.4	60.2	--	60.7	38.5	22.7	43.7	30.5
Mg Hardness	--	mg/L	--	46.3	242	--	50.7	90.6	--	89.4	22.2	11.5	39.5	22.2
Organics														
Herbicides	--	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Pesticides	--	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Volatile Organics	--	ug/L	ND	--	--	--	--	--	ND	--	--	--	--	--
Semi-Volatile Organics	--	ug/L	ND	--	--	--	--	--	ND	--	--	--	--	--
Polychlorinated Biphenyls (PCBs)	--	ug/L	ND	--	--	--	--	--	ND	--	--	--	--	--

Lake Columbia Sourcewater Assessment Data Analysis
Station ID 10539
W. Mud Creek at FM 344

Parameter	Texas Public Drinking Water Standards 30 TAC § 290	Units	Jan-09	Feb-09	Mar-09	Apr-09	May-09	Jun-09	Jul-09	Aug-09	Sep-09	Oct-09	Nov-09	Dec-09
Cyanide & Phenols														
Cyanide, Total	0.2	mg/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Phenolics	--	mg/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Color & Turbidity														
Color	15	CLL	2.5	4	4.5	4	3.5	3	3.5	5	14	**18***	9	6
Turbidity	0.3	NTU	**6.49***	**23.8***	**16.6***	**30.8***	**33***	**11.1***	**21.6***	**33.1***	**35.8***	**73.6***	**15.7***	**37.6***
Metals														
Calcium	--	mg/L	21.5	19.7	19.1	19.7	20.6	24.1	24.3	24.3	15.4	9.09	17.5	12.2
Magnesium	--	mg/L	12.9	11.3	11	11.7	12.3	21.9	12.9	21.7	5.41	2.77	9.57	5.43
Sodium	--	mg/L	22.9	23.8	22.8	23.2	25.3	38.5	27.4	42.1	12.9	6.26	17.9	12.3
Aluminum	50	ug/L	**242***	--	--	**51.1***	--	--	**124***	--	--	**305***	--	--
Antimony	6	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Arsenic	10	ug/L	0.812	--	--	1.97	--	--	1.52	--	--	ND	--	--
Barium	200	ug/L	52.7	--	--	63	--	--	71.6	--	--	50	--	--
Beryllium	4	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Cadmium	5	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Chromium	100	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Copper	1300	ug/L	1.43	--	--	1.38	--	--	2.4	--	--	ND	--	--
Iron	300	ug/L	**1340***	--	--	**2720***	--	--	**1390***	--	--	**891***	--	--
Lead	15	ug/L	ND	--	--	1.24	--	--	1.2	--	--	ND	--	--
Manganese	50	ug/L	**146***	--	--	**190***	--	--	**98.3***	--	--	28.9	--	--
Mercury	2	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Selenium	50	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Silver	100	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Thallium	2	ug/L	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Zinc	5000	ug/L	9.32	--	--	17.9	--	--	17.3	--	--	38	--	--
TPH														
TPH (C6 - C35) Total	--	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TPH (C6 - C12) Gas	--	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TPH (C12 - C35) Diesel	--	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Field Parameters														
pH	>7.0	S.U.	8.1	7.8	8.2	7.6	7.9	7.8	--	7.63	8.32	7.67	8.01	7.37
Water Temperature	--	C (degrees)	7.7	14.4	18.3	19.9	21.6	25.5	--	25.25	21.26	20.19	11.51	10.79
Dissolved Oxygen	--	mg/L	10.6	9.1	7.6	7.1	7.29	6.7	--	6.31	6.77	5.37	9.31	9.58
Specific Conductance	--	uS/cm	336	332	268	310	336	550	--	543	203	99	267	198
Secchi Depth	--	Meters	0.85	0.62	0.7	0.45	0	0.5	0.5	0.5	0.5	0	0.2	0.2
Instantaneous Stream Flow	--	Cfs	--	--	--	--	--	--	--	--	--	--	--	--
Flow Severity	--		3	3	5	5	5	--	3	3	3	4	3	5
Stream Flow Estimate	--	Cfs	173.14	**	**	**	517.05	**	**	575.64	202.5	Flooded	336	571.2

ND = Not Detected at method reporting limit

*** Exceeds Texas Public Drinking Water Standard**

** insufficient data to calculate flow estimate

Attachment B
EPA Primary and Secondary Drinking Water Contaminants

National Primary Drinking Water Regulations

Contaminant	MCL or TT[1] (mg/L)[2]	Potential health effects from long-term[3] exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal (mg/L)[2]
OC Acrylamide	TT[4]	Nervous system or blood problems; increased risk of cancer	Added to water during sewage/ wastewater treatment	zero
OC Alachlor	0.002	Eye, liver, kidney or spleen problems; anemia; increased risk of cancer	Runoff from herbicide used on row crops	zero
R Alpha/photon emitters	15 picocuries per Liter (pCi/L)	Increased risk of cancer	Erosion of natural deposits of certain minerals that are radioactive and may emit a form of radiation known as alpha radiation	zero
IOC Antimony	0.006	Increase in blood cholesterol; decrease in blood sugar	Discharge from petroleum refineries; fire retardants; ceramics; electronics; solder	0.006
IOC Arsenic	0.010	Skin damage or problems with circulatory systems, and may have increased risk of getting cancer	Erosion of natural deposits; runoff from orchards; runoff from glass & electronics production wastes	0
IOC Asbestos (fibers >10 micrometers)	7 million fibers per Liter (MFL)	Increased risk of developing benign intestinal polyps	Decay of asbestos cement in water mains; erosion of natural deposits	7 MFL
OC Atrazine	0.003	Cardiovascular system or reproductive problems	Runoff from herbicide used on row crops	0.003
IOC Barium	2	Increase in blood pressure	Discharge of drilling wastes; discharge from metal refineries; erosion of natural deposits	2
OC Benzene	0.005	Anemia; decrease in blood platelets; increased risk of cancer	Discharge from factories; leaching from gas storage tanks and landfills	zero
OC Benzo(a)pyrene (PAHs)	0.0002	Reproductive difficulties; increased risk of cancer	Leaching from linings of water storage tanks and distribution lines	zero
IOC Beryllium	0.004	Intestinal lesions	Discharge from metal refineries and coal-burning factories; discharge from electrical, aerospace, and defense industries	0.004
R Beta photon emitters	4 millirems per year	Increased risk of cancer	Decay of natural and man-made deposits of certain minerals that are radioactive and may emit forms of radiation known as photons and beta radiation	zero
DBP Bromate	0.010	Increased risk of cancer	Byproduct of drinking water disinfection	zero
IOC Cadmium	0.005	Kidney damage	Corrosion of galvanized pipes; erosion of natural deposits; discharge from metal refineries; runoff from waste batteries and paints	0.005
OC Carbofuran	0.04	Problems with blood, nervous system, or reproductive system	Leaching of soil fumigant used on rice and alfalfa	0.04
OC Carbon tetrachloride	0.005	Liver problems; increased risk of cancer	Discharge from chemical plants and other industrial activities	zero
D Chloramines (as Cl_2)	MRDL=4.0[1]	Eye/nose irritation; stomach discomfort; anemia	Water additive used to control microbes	MRDLG=4[1]
OC Chlordane	0.002	Liver or nervous system problems; increased risk of cancer	Residue of banned termiticide	zero
D Chlorine (as Cl_2)	MRDL=4.0[1]	Eye/nose irritation; stomach discomfort	Water additive used to control microbes	MRDLG=4[1]
D Chlorine dioxide (as ClO_2)	MRDL=0.8[1]	Anemia; infants, young children, and fetuses of pregnant women: nervous system effects	Water additive used to control microbes	MRDLG=0.8[1]
DBP Chlorite	1.0	Anemia; infants, young children, and fetuses of pregnant women: nervous system effects	Byproduct of drinking water disinfection	0.8
OC Chlorobenzene	0.1	Liver or kidney problems	Discharge from chemical and agricultural chemical factories	0.1
IOC Chromium (total)	0.1	Allergic dermatitis	Discharge from steel and pulp mills; erosion of natural deposits	0.1
IOC Copper	TT[5]; Action Level = 1.3	Short-term exposure: Gastrointestinal distress. Long-term exposure: Liver or kidney damage. People with Wilson's Disease should consult their personal doctor if the amount of copper in their water exceeds the action level	Corrosion of household plumbing systems; erosion of natural deposits	1.3
M *Cryptosporidium*	TT[7]	Short-term exposure: Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste	zero

LEGEND

D Disinfectant | IOC Inorganic Chemical | OC Organic Chemical

DBP Disinfection Byproduct | M Microorganism | R Radionuclides

Contaminant	MCL or TT[1] (mg/L)[2]	Potential health effects from long-term[3] exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal (mg/L)[2]
IOC Cyanide (as free cyanide)	0.2	Nerve damage or thyroid problems	Discharge from steel/metal factories; discharge from plastic and fertilizer factories	0.2
OC 2,4-D	0.07	Kidney, liver, or adrenal gland problems	Runoff from herbicide used on row crops	0.07
OC Dalapon	0.2	Minor kidney changes	Runoff from herbicide used on rights of way	0.2
OC 1,2-Dibromo-3-chloropropane (DBCP)	0.0002	Reproductive difficulties; increased risk of cancer	Runoff/leaching from soil fumigant used on soybeans, cotton, pineapples, and orchards	zero
OC o-Dichlorobenzene	0.6	Liver, kidney, or circulatory system problems	Discharge from industrial chemical factories	0.6
OC p-Dichlorobenzene	0.075	Anemia; liver, kidney or spleen damage; changes in blood	Discharge from industrial chemical factories	0.075
OC 1,2-Dichloroethane	0.005	Increased risk of cancer	Discharge from industrial chemical factories	zero
OC 1,1-Dichloroethylene	0.007	Liver problems	Discharge from industrial chemical factories	0.007
OC cis-1,2-Dichloroethylene	0.07	Liver problems	Discharge from industrial chemical factories	0.07
OC trans-1,2-Dichloroethylene	0.1	Liver problems	Discharge from industrial chemical factories	0.1
OC Dichloromethane	0.005	Liver problems; increased risk of cancer	Discharge from drug and chemical factories	zero
OC 1,2-Dichloropropane	0.005	Increased risk of cancer	Discharge from industrial chemical factories	zero
OC Di(2-ethylhexyl) adipate	0.4	Weight loss, liver problems, or possible reproductive difficulties	Discharge from chemical factories	0.4
OC Di(2-ethylhexyl) phthalate	0.006	Reproductive difficulties; liver problems; increased risk of cancer	Discharge from rubber and chemical factories	zero
OC Dinoseb	0.007	Reproductive difficulties	Runoff from herbicide used on soybeans and vegetables	0.007
OC Dioxin (2,3,7,8-TCDD)	0.00000003	Reproductive difficulties; increased risk of cancer	Emissions from waste incineration and other combustion; discharge from chemical factories	zero
OC Diquat	0.02	Cataracts	Runoff from herbicide use	0.02
OC Endothall	0.1	Stomach and intestinal problems	Runoff from herbicide use	0.1
OC Endrin	0.002	Liver problems	Residue of banned insecticide	0.002
OC Epichlorohydrin	TT[4]	Increased cancer risk; stomach problems	Discharge from industrial chemical factories; an impurity of some water treatment chemicals	zero
OC Ethylbenzene	0.7	Liver or kidney problems	Discharge from petroleum refineries	0.7
OC Ethylene dibromide	0.00005	Problems with liver, stomach, reproductive system, or kidneys; increased risk of cancer	Discharge from petroleum refineries	zero
M Fecal coliform and *E. coli*	MCL[6]	Fecal coliforms and *E. coli* are bacteria whose presence indicates that the water may be contaminated with human or animal wastes. Microbes in these wastes may cause short term effects, such as diarrhea, cramps, nausea, headaches, or other symptoms. They may pose a special health risk for infants, young children, and people with severely compromised immune systems.	Human and animal fecal waste	zero[6]
IOC Fluoride	4.0	Bone disease (pain and tenderness of the bones); children may get mottled teeth	Water additive which promotes strong teeth; erosion of natural deposits; discharge from fertilizer and aluminum factories	4.0
M *Giardia lamblia*	TT[7]	Short-term exposure: Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste	zero
OC Glyphosate	0.7	Kidney problems; reproductive difficulties	Runoff from herbicide use	0.7
DBP Haloacetic acids (HAA5)	0.060	Increased risk of cancer	Byproduct of drinking water disinfection	n/a[9]
OC Heptachlor	0.0004	Liver damage; increased risk of cancer	Residue of banned termiticide	zero
OC Heptachlor epoxide	0.0002	Liver damage; increased risk of cancer	Breakdown of heptachlor	zero
M Heterotrophic plate count (HPC)	TT[7]	HPC has no health effects; it is an analytic method used to measure the variety of bacteria that are common in water. The lower the concentration of bacteria in drinking water, the better maintained the water system is.	HPC measures a range of bacteria that are naturally present in the environment	n/a

LEGEND

D Disinfectant
IOC Inorganic Chemical
OC Organic Chemical
DBP Disinfection Byproduct
M Microorganism
R Radionuclides

Contaminant		MCL or TT[1] (mg/L)[2]	Potential health effects from long-term[3] exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal (mg/L)[2]
OC	Hexachlorobenzene	0.001	Liver or kidney problems; reproductive difficulties; increased risk of cancer	Discharge from metal refineries and agricultural chemical factories	zero
OC	Hexachlorocyclopentadiene	0.05	Kidney or stomach problems	Discharge from chemical factories	0.05
IOC	Lead	TT5; Action Level=0.015	Infants and children: Delays in physical or or mental development; children could show slight deficits in attention span and learning abilities; Adults: Kidney problems; high blood pressure	Corrosion of household plumbing systems; erosion of natural deposits	zero
M	*Legionella*	TT7	Legionnaire's Disease, a type of pneumonia	Found naturally in water; multiplies in heating systems	zero
OC	Lindane	0.0002	Liver or kidney problems	Runoff/leaching from insecticide used on cattle, lumber, gardens	0.0002
IOC	Mercury (inorganic)	0.002	Kidney damage	Erosion of natural deposits; discharge from refineries and factories; runoff from landfills and croplands	0.002
OC	Methoxychlor	0.04	Reproductive difficulties	Runoff/leaching from insecticide used on fruits, vegetables, alfalfa, livestock	0.04
IOC	Nitrate (measured as Nitrogen)	10	Infants below the age of six months who drink water containing nitrate in excess of the MCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue-baby syndrome.	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits	10
IOC	Nitrite (measured as Nitrogen)	1	Infants below the age of six months who drink water containing nitrite in excess of the MCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue-baby syndrome.	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits	1
OC	Oxamyl (Vydate)	0.2	Slight nervous system effects	Runoff/leaching from insecticide used on apples, potatoes, and tomatoes	0.2
OC	Pentachlorophenol	0.001	Liver or kidney problems; increased cancer risk	Discharge from wood-preserving factories	zero
OC	Picloram	0.5	Liver problems	Herbicide runoff	0.5
OC	Polychlorinated biphenyls (PCBs)	0.0005	Skin changes; thymus gland problems; immune deficiencies; reproductive or nervous system difficulties; increased risk of cancer	Runoff from landfills; discharge of waste chemicals	zero
R	Radium 226 and Radium 228 (combined)	5 pCi/L	Increased risk of cancer	Erosion of natural deposits	zero
IOC	Selenium	0.05	Hair or fingernail loss; numbness in fingers or toes; circulatory problems	Discharge from petroleum and metal refineries; erosion of natural deposits; discharge from mines	0.05
OC	Simazine	0.004	Problems with blood	Herbicide runoff	0.004
OC	Styrene	0.1	Liver, kidney, or circulatory system problems	Discharge from rubber and plastic factories; leaching from landfills	0.1
OC	Tetrachloroethylene	0.005	Liver problems; increased risk of cancer	Discharge from factories and dry cleaners	zero
IOC	Thallium	0.002	Hair loss; changes in blood; kidney, intestine, or liver problems	Leaching from ore-processing sites; discharge from electronics, glass, and drug factories	0.0005
OC	Toluene	1	Nervous system, kidney, or liver problems	Discharge from petroleum factories	1
M	Total Coliforms	5.0 percent[8]	Coliforms are bacteria that indicate that other, potentially harmful bacteria may be present. See fecal coliforms and *E. coli*	Naturally present in the environment	zero
DBP	Total Trihalomethanes (TTHMs)	0.080	Liver, kidney or central nervous system problems; increased risk of cancer	Byproduct of drinking water disinfection	n/a[9]
OC	Toxaphene	0.003	Kidney, liver, or thyroid problems; increased risk of cancer	Runoff/leaching from insecticide used on cotton and cattle	zero
OC	2,4,5-TP (Silvex)	0.05	Liver problems	Residue of banned herbicide	0.05
OC	1,2,4-Trichlorobenzene	0.07	Changes in adrenal glands	Discharge from textile finishing factories	0.07
OC	1,1,1-Trichloroethane	0.2	Liver, nervous system, or circulatory problems	Discharge from metal degreasing sites and other factories	0.2
OC	1,1,2-Trichloroethane	0.005	Liver, kidney, or immune system problems	Discharge from industrial chemical factories	0.003
OC	Trichloroethylene	0.005	Liver problems; increased risk of cancer	Discharge from metal degreasing sites and other factories	zero

LEGEND

D Disinfectant
DBP Disinfection Byproduct
IOC Inorganic Chemical
M Microorganism
OC Organic Chemical
R Radionuclides

Contaminant	MCL or TT[1] (mg/L)[2]	Potential health effects from long-term[3] exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal (mg/L)[2]
M Turbidity	TT[7]	Turbidity is a measure of the cloudiness of water. It is used to indicate water quality and filtration effectiveness (e.g., whether disease-causing organisms are present). Higher turbidity levels are often associated with higher levels of disease-causing microorganisms such as viruses, parasites and some bacteria. These organisms can cause short term symptoms such as nausea, cramps, diarrhea, and associated headaches.	Soil runoff	n/a
R Uranium	30µg/L	Increased risk of cancer, kidney toxicity	Erosion of natural deposits	zero
OC Vinyl chloride	0.002	Increased risk of cancer	Leaching from PVC pipes; discharge from plastic factories	zero
M Viruses (enteric)	TT[7]	Short-term exposure: Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste	zero
OC Xylenes (total)	10	Nervous system damage	Discharge from petroleum factories; discharge from chemical factories	10

LEGEND

D Disinfectant
DBP Disinfection Byproduct
IOC Inorganic Chemical
M Microorganism
OC Organic Chemical
R Radionuclides

NOTES

1 Definitions

- Maximum Contaminant Level Goal (MCLG)—The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety and are non-enforceable public health goals.
- Maximum Contaminant Level (MCL)—The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to MCLGs as feasible using the best available treatment technology and taking cost into consideration. MCLs are enforceable standards.
- Maximum Residual Disinfectant Level Goal (MRDLG)—The level of a drinking water disinfectant below which there is no known or expected risk to health. MRDLGs do not reflect the benefits of the use of disinfectants to control microbial contaminants.
- Maximum Residual Disinfectant Level (MRDL)—The highest level of a disinfectant allowed in drinking water. There is convincing evidence that addition of a disinfectant is necessary for control of microbial contaminants.
- Treatment Technique (TT)—A required process intended to reduce the level of a contaminant in drinking water.

2 Units are in milligrams per liter (mg/L) unless otherwise noted. Milligrams per liter are equivalent to parts per million (ppm).

3 Health effects are from long-term exposure unless specified as short-term exposure.

4 Each water system must certify annually, in writing, to the state (using third-party or manufacturers certification) that when it uses acrylamide and/or epichlorohydrin to treat water, the combination (or product) of dose and monomer level does not exceed the levels specified, as follows: Acrylamide = 0.05 percent dosed at 1 mg/L (or equivalent); Epichlorohydrin = 0.01 percent dosed at 20 mg/L (or equivalent).

5 Lead and copper are regulated by a Treatment Technique that requires systems to control the corrosiveness of their water. If more than 10 percent of tap water samples exceed the action level, water systems must take additional steps. For copper, the action level is 1.3 mg/L, and for lead is 0.015 mg/L.

6 A routine sample that is fecal coliform-positive or *E. coli*-positive triggers repeat samples--if any repeat sample is total coliform-positive, the system has an acute MCL violation. A routine sample that is total coliform-positive and fecal coliform-negative or *E. coli*-negative triggers repeat samples--if any repeat sample is fecal coliform-positive or *E. coli*-positive, the system has an acute MCL violation. See also Total Coliforms.

7 EPA's surface water treatment rules require systems using surface water or ground water under the direct influence of surface water to (1) disinfect their water, and (2) filter their water or meet criteria for avoiding filtration so that the following contaminants are controlled at the following levels:

- *Cryptosporidium*: 99 percent removal for systems that filter. Unfiltered systems are required to include Cryptosporidium in their existing watershed control provisions.
- Giardia lamblia: 99.9 percent removal/inactivation
- Viruses: 99.99 percent removal/inactivation
- *Legionella*: No limit, but EPA believes that if *Giardia* and viruses are removed/inactivated according to the treatment techniques in the surface water treatment rule, *Legionella* will also be controlled.
- Turbidity: For systems that use conventional or direct filtration, at no time can turbidity (cloudiness of water) go higher than 1 nephelolometric turbidity unit (NTU), and samples for turbidity must be less than or equal to 0.3 NTU in at least 95 percent of the samples in any month. Systems that use filtration other than conventional or direct filtration must follow state limits, which must include turbidity at no time exceeding 5 NTU.
- HPC: No more than 500 bacterial colonies per milliliter
- Long Term 1 Enhanced Surface Water Treatment; Surface water systems or ground water systems under the direct influence of surface water serving fewer than 10,000 people must comply with the applicable Long Term 1 Enhanced Surface Water Treatment Rule provisions (e.g. turbidity standards, individual filter monitoring, *Cryptosporidium* removal requirements, updated watershed control requirements for unfiltered systems).
- Long Term 2 Enhanced Surface Water Treatment; This rule applies to all surface water systems or ground water systems under the direct influence of surface water. The rule targets additional *Cryptosporidium* treatment requirements for higher risk systems and includes provisions to reduce risks from uncovered finished water storages facilities and to ensure that the systems maintain microbial protection as they take steps to reduce the formation of disinfection byproducts. (Monitoring start dates are staggered by system size. The largest systems (serving at least 100,000 people) will begin monitoring in October 2006 and the smallest systems (serving fewer than 10,000 people) will not begin monitoring until October 2008. After completing monitoring and determining their treatment bin, systems generally have three years to comply with any additional treatment requirements.)
- Filter Backwash Recycling: The Filter Backwash Recycling Rule requires systems that recycle to return specific recycle flows through all processes of the system's existing conventional or direct filtration system or at an alternate location approved by the state.

8 No more than 5.0 percent samples total coliform-positive in a month. (For water systems that collect fewer than 40 routine samples per month, no more than one sample can be total coliform-positive per month.) Every sample that has total coliform must be analyzed for either fecal coliforms or *E. coli*. If two consecutive TC-positive samples, and one is also positive for *E. coli* or fecal coliforms, system has an acute MCL violation.

9 Although there is no collective MCLG for this contaminant group, there are individual MCLGs for some of the individual contaminants:

- Haloacetic acids: dichloroacetic acid (zero); trichloroacetic acid (0.3 mg/L)
- Trihalomethanes: bromodichloromethane (zero); bromoform (zero); dibromochloromethane (0.06 mg/L)

National Secondary Drinking Water Regulation

National Secondary Drinking Water Regulations are non-enforceable guidelines regarding contaminants that may cause cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor, or color) in drinking water. EPA recommends secondary standards to water systems but does not require systems to comply. However, some states may choose to adopt them as enforceable standards.

Contaminant	Secondary Maximum Contaminant Level
Aluminum	0.05 to 0.2 mg/L
Chloride	250 mg/L
Color	15 (color units)
Copper	1.0 mg/L
Corrosivity	noncorrosive
Fluoride	2.0 mg/L
Foaming Agents	0.5 mg/L
Iron	0.3 mg/L
Manganese	0.05 mg/L
Odor	3 threshold odor number
pH	6.5-8.5
Silver	0.10 mg/L
Sulfate	250 mg/L
Total Dissolved Solids	500 mg/L
Zinc	5 mg/L

For More Information

EPA's Safe Drinking Water Web site:
http://www.epa.gov/safewater/

EPA's Safe Drinking Water Hotline:
(800) 426-4791

To order additional posters or other ground water and drinking water publications, please contact the National Service Center for Environmental Publications at :
(800) 490-9198, or
email: nscep@bps-lmit.com.

United States Environmental Protection Agency

EPA 816-F-09-004
May 2009

Appendix I
TWDB Draft Final Report Comments

TEXAS WATER DEVELOPMENT BOARD

James E. Herring, *Chairman*
Lewis H. McMahan, *Member*
Edward G. Vaughan, *Member*

J. Kevin Ward
Executive Administrator

Jack Hunt, *Vice Chairman*
Thomas Weir Labatt III, *Member*
Joe M. Crutcher, *Member*

July 8, 2010

Kelley Holcomb
General Manager
Angelina & Neches River Authority
210 Lufkin Avenue
Lufkin, TX 75901

RE: Contract between the Texas Water Development Board (TWDB) and the Angelina & Neches River Authority (ANRA), TWDB Contract No. 0904830919, Draft Final Report Comments

Dear Mr. ~~Holcomb~~ Kelley:

Staff members of TWDB have completed a review of the Draft Final Study Report under TWDB Contract No. 0904830919. As stated in the above-referenced contract, ANRA will consider incorporating Draft Final Study Report comments, shown in Attachment 1, as well as other comments received, into the Final Study Report. In accordance with paragraph 4, Article III, Section II of the contract, a copy of these TWDB Executive Administrator comments as well as a written summary of how the Draft Final Study Report was revised in response must be included in all the Final Study Report documents, for example, as an appendix.

TWDB looks forward to receiving one (1) electronic copy of all files, one electronic copy of each Final Study Report in Portable Document Format (PDF), and nine (9) bound double-sided copies of each Final Study Report to the TWDB Executive Administrator no later than the contract Final Study Report Deadline. Please also transfer copies of all data and reports generated by the planning process and used in developing the Final Study Report to the TWDB Executive Administrator no later than the contract Final Study Report Deadline.

If you have any questions concerning this contract, please contact Temple McKinnon, TWDB's designated Contract Manager for this study at (512) 475-2057

Sincerely,

Carolyn L. Brittin
Deputy Executive Administrator
Water Resources Planning and Information

Enclosures

c: Temple McKinnon, TWDB

Attachment I
Lake Columbia Source Water Assessment Study
(Contract No. 0904830919) Draft Report Review Comments

Section 3.0:

1. Scope of Work Task 2.1 states that station AN001 (Kickapoo Creek at SH 110) will be submitted to the TCEQ for a permanent station ID prior to any data submittal. Please state the permanent station ID in the final report.

Attachment A:

2. Scope of Work Task 2.2 states there should be 84 instream flow measurements or estimates determined if measurements were not possible in accordance with the 2003 Surface Water Quality Monitoring Procedures, Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment, and Tissue by TCEQ. The draft report contains 19 flow measurements with no discussion of why monthly samples were not possible. Please provide a discussion of why stream measurements were not possible on the applicable sampling dates. If estimates are necessary, please provide flow severity values in accordance with the above-referenced guidance document.

3. The Scope of Work Task 3 outlines the selected parameters and frequency of analysis for water quality constituents. The following constituents were not reported:

   * Total Phosphorus (monthly)
   * Herbicides (quarterly)
   * Pesticides (quarterly)
   * Volatile Organics (semi annually)
   * Semi-Volatile Organics (semi annually)
   * Polychlorinated Biphenyls (semi annually)

   Please report the results for the missing constituents.

4. The August flow measurement at Station ID 14477 (Mud Creek at US 79) is recorded as 2,777.14 cfs while the following month is 73.21 cfs. Please review and confirm that these measurements are correct in the final report.

Appendix II
Response to Draft Final Report Comments

APPENDIX 1

Response to TWDB Comments

Comment: *Scope of Work Task 2.1 states that station AN001 (Kickapoo Creek at SH 110) will be submitted to the TCEQ for a permanent station ID prior to any data submittal. Please state the permanent station ID in the final report.*

Response: During the development of a Quality Assurance Project Plan to allow for data to be included in the TCEQ's Surface Water Quality Monitoring Information Management System (SWQMIS), it was determined that in order to meet the reporting limits at the Ambient Water Reporting Limit (AWRL) as required by TCEQ, the project would be unfeasible due to costs. Specifically, reporting to the AWRL would have required that samples be sent to a different subcontracted laboratory, resulting in substantial cost increases (just the subcontracted portion of the analyses would have exceeded the total cost of the grant). Since the purpose of the project was to assess the source water for drinking water purposes instead of support for other designated uses, it was determined that the analyses would be conducted using the higher reporting limits and that the data would not be submitted to TCEQ for inclusion in their database. This decision was supported and approved by the TWDB Contract Manager for this study.

Comment: *Scope of Work 2.2 states that there should be 84 instream flow measurements or estimates determined if measurements were not possible in accordance with the 2003 Surface Water Quality Monitoring Procedures, Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment, and Tissue by TCEQ. The draft report contains 19 flow measurements with no discussion of why monthly samples were not possible. Please provide a discussion of why stream measurements were not possible on the applicable sampling dates. If estimates are necessary, please provide flow severity values in accordance with the above-referenced guidance document.*

Response: During this project, Texas experienced drought conditions which many times resulted in little to no flow at sites. On several occasions, creeks were dry during routine sampling events, and additional monitoring had to be performed to collect samples for those stations.

On several occasions, we were not able to calculate instantaneous stream flow estimates due to incomplete field data. For example, the field collector may have recorded stream width, distance object travelled, and time for object to travel distance, but neglected to record the stream depth. Without all of this information, it is impossible to calculate a stream flow estimate. Employee turnover and insufficient training of new personnel resulted in this error.

Comment: *The Scope of Work Task 3 outlines the selected parameters and frequency of analysis for water quality constituents. The following constituents were not reported:*

** Total Phosphorus (monthly)*
** Herbicides (quarterly)*
** Pesticides (quarterly)*
** Volatile Organics (semi annually)*
** Semi-Volatile Organics (semi annually)*
** Polychlorinated Biphenyls (semi annually)*

Please report the results for the missing constituents.

Response: Total Phosphorus was analyzed monthly. Because it was analyzed by Inductively Coupled Plasma (ICP), it was reported with the metals. The Total Phosphorus results have been moved and are now grouped with Routine Nutrient Parameters.

The organic parameters (Herbicides, Pesticides, Volatiles, Semi-Volatiles, and Polychlorinated Biphenyls) have been added to the results tables.

Comment: *The August flow measurement at Station ID 14477 (Mud Creek at US 79) is recorded as 2,777.14 cfs while the following month is 73.21 cfs. Please review and confirm that these measurements are correct in the final report.*

Response: The result of 2,777.14 cfs was miscalculated by field staff. Flow measurements for Station ID 14477 in the data table included in the final report are from the USGS Gage Station data at this monitoring station. All other flow estimate values were recalculated to verify accuracy.